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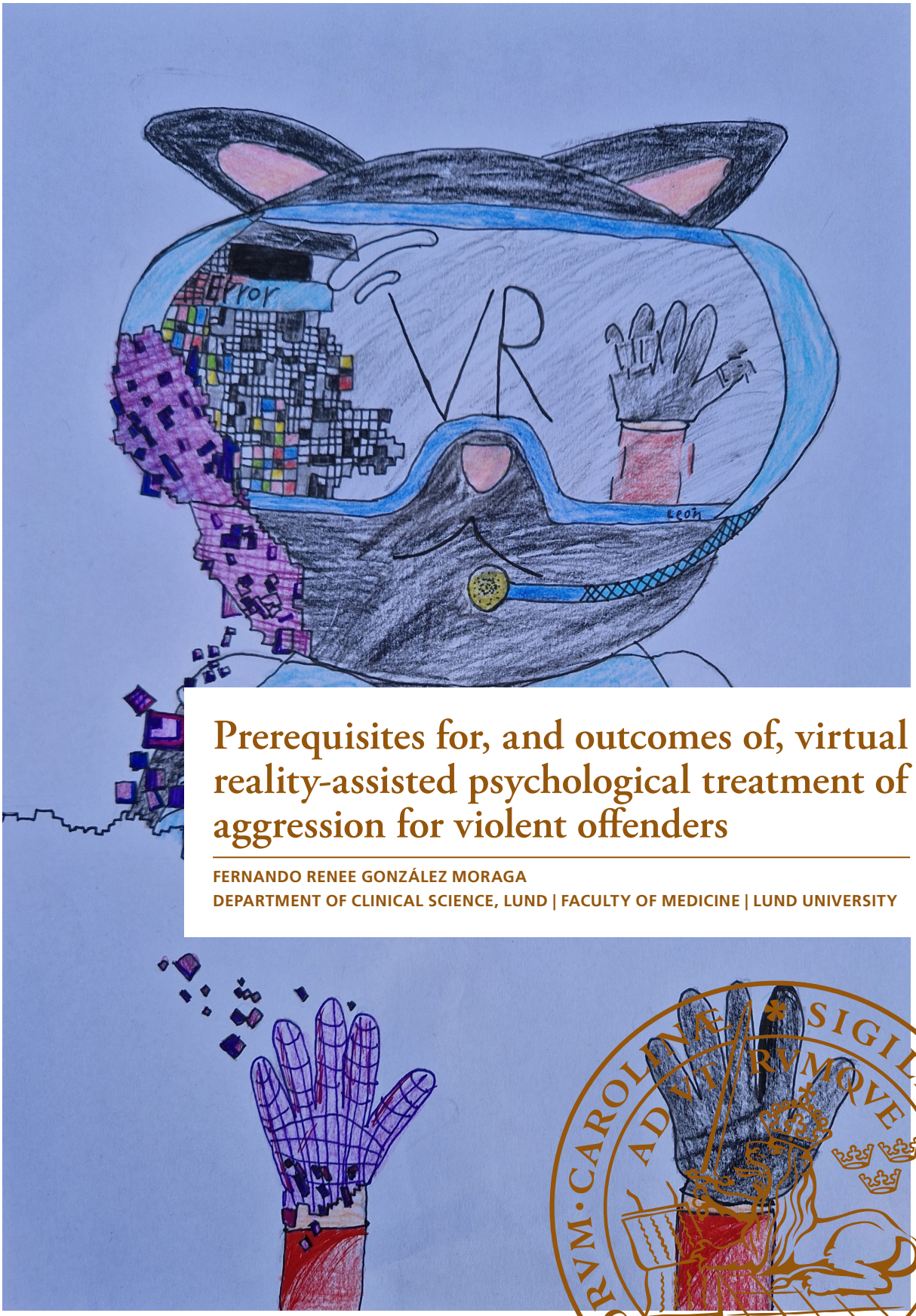

Prerequisites for, and outcomes of, virtual reality-assisted psychological treatment of aggression for violent offenders

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Fernando Renee González Moraga

LUND
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Study II outlines the revision process of a VR-assisted psychological treatment program designed to address aggression in violent offenders within forensic settings. This study highlights the theoretical framework, technological advancements, and clinical considerations that guided the program's development.

Study III explores the treatment content of the VR-assisted psychological intervention through the perspectives of both patients and therapists in a maximum-security forensic psychiatric setting. By incorporating qualitative insights, this study sheds light on the perceived efficacy, challenges, and therapeutic engagement associated with the intervention.

Study IV examines the progression of aggressive behaviors in forensic psychiatric patients, as observed by staff, before, during, and after participation in the VR-assisted treatment program. This study assesses changes in both the frequency and severity of aggressive incidents, offering empirical evidence on the intervention's impact over time.

Study V delves into the firsthand experiences of forensic psychiatric patients who have undergone VR-assisted psychological treatment for aggression. By capturing patients' perspectives, this study provides valuable insights into the acceptability, perceived effectiveness, and psychological impact of VR-assisted interventions in forensic psychiatry.

Together, these studies contribute to the growing body of research on aggression treatment in forensic populations and demonstrate the potential of VR-assisted psychological interventions in addressing violent behavior. The findings offer implications for clinical practice, forensic treatment strategies, and future research on the integration of immersive technologies in mental health interventions.

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To R., L., E., and E.

Table of Contents

Abstract

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Sammanfattning

Aggression bidrar med stora utmaningar inom kriminalvård och rättspsykiatri. Denna avhandling undersöker samband mellan aggression, psykopatiska drag och intelligens hos unga våldsbrottslingar samt utveckling, implementering och utfall av en ny VR-assisterad psykologisk behandling av aggression för våldsbrottslingar.

Studie I undersöker samband mellan aggressivt antisocialt beteende, psykopatiska drag och intelligens hos unga våldsbrottslingar inom svensk kriminalvård. Genom att identifiera psykologiska och kognitiva faktorer bakom aggression bidrar studien till en djupare förståelse av de mekanismer som kan ligga till grund för våldsamt beteende i denna population.

Studie II beskriver revideringsprocessen av en VR-assisterad psykologisk behandlingsmetod för aggression hos våldsbrottslingar. Studien belyser den teoretiska grunden, teknologiska innovationer och kliniska överväganden som format vidareutvecklingen av behandlingsprogrammet.

Studie III utforskar behandlingsinnehåll i den VR-assisterade psykologiska interventionen genom patienters och terapeuters perspektiv i en rättspsykiatrisk högsäkerhetsmiljö. Studien ger insikter i behandlingsupplevelser, terapeutiska utmaningar samt patienters engagemang i interventionen.

Studie IV analyserar utvecklingen av aggressivt beteende hos rättspsykiatriska patienter, såsom det observeras av personal före, under och efter deltagande i den VR-assisterade behandlingen. Studien undersöker både förekomst och svårighetsgrad av aggressiva incidenter och bidrar med empiriska belägg för interventionens utfall över tid.

Studie V fokuserar på rättspsykiatriska patienters egna upplevelser av att genomgå VR-assisterad psykologisk behandling för aggression. Genom att fånga patienternas perspektiv ger studien värdefulla insikter i behandlingens acceptans, upplevda effektivitet och psykologiska inverkan.

Sammantaget bidrar dessa studier till forskningen om aggressionsbehandling i forensiska miljöer samt visar potentialen för VR-assisterade psykologiska interventioner i arbetet med våldsamt beteende. Resultaten har implikationer för klinisk praxis, behandlingsstrategier och framtida forskning kring integrationen av immersiva teknologier inom psykologisk behandling.

Resumen

La agresión presenta desafíos significativos en entornos forenses. Esta disertación explora las interconexiones entre la agresión, la psicopatía y la inteligencia en jóvenes delincuentes violentos, al tiempo que examina el desarrollo, la implementación y el impacto de un novedoso tratamiento psicológico asistido por realidad virtual (RV) para la agresión en poblaciones de psiquiatría forense.

Estudio I investiga las relaciones entre comportamientos antisociales agresivos, rasgos psicopáticos e inteligencia en jóvenes delincuentes violentos dentro del Servicio Penitenciario y de Libertad Condicional de Suecia. Al identificar correlatos psicológicos y cognitivos clave de la agresión, este estudio proporciona una base para comprender los mecanismos subyacentes que contribuyen a los comportamientos violentos en esta población.

Estudio II describe el proceso de revisión de un programa de tratamiento psicológico asistido por RV diseñado para abordar la agresión en delincuentes violentos en entornos forenses. Este estudio destaca el marco teórico, los avances tecnológicos y las consideraciones clínicas que guiaron el desarrollo del programa.

Estudio III explora el contenido del tratamiento psicológico asistido por RV desde las perspectivas tanto de los pacientes como de los terapeutas en un entorno psiquiátrico forense de alta seguridad. Al incorporar información cualitativa, este estudio arroja luz sobre la eficacia percibida, los desafíos y el compromiso terapéutico asociados con la intervención.

Estudio IV examina la progresión de los comportamientos agresivos en pacientes de psiquiatría forense, según lo observado por el personal, antes, durante y después de la participación en el programa de tratamiento asistido por RV. Este estudio evalúa los cambios en la frecuencia y la gravedad de los incidentes agresivos, proporcionando evidencia empírica sobre el impacto de la intervención a lo largo del tiempo.

Estudio V profundiza en las experiencias de primera mano de los pacientes de psiquiatría forense que han recibido tratamiento psicológico asistido por RV para la agresión. Al capturar las perspectivas de los pacientes, este estudio proporciona información valiosa sobre la aceptabilidad, la efectividad percibida y el impacto psicológico de las intervenciones basadas en RV en la psiquiatría forense.

En conjunto, estos estudios contribuyen al creciente cuerpo de investigación sobre el tratamiento de la agresión en poblaciones forenses y demuestran el potencial de las intervenciones psicológicas asistidas por RV para abordar la conducta violenta. Los hallazgos ofrecen implicaciones para la práctica clínica, las estrategias de tratamiento forense y la investigación futura sobre la integración de tecnologías inmersivas en las intervenciones de salud mental.

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Preface

My journey in forensic psychiatry and virtual reality has been shaped by curiosity, perseverance, and a deep fascination with the challenges of working in this field. From the moment I arrived in Sweden, I embraced the opportunity to adapt, grow, and push my own limits, both personally and professionally. I earned my degree in psychology at the Universidad Austral de Chile, in its Puerto Montt campus. Early in my studies, I had the incredible opportunity to be part of a research project on psychopathy and attachment in a high-security prison in Chile. That experience sparked my passion for understanding complex human behavior in secure environments, which ultimately led me to pursue new horizons abroad.

In December 2012, I arrived in Sweden with my pregnant wife, just in time for the Lucia celebrations. From day one, I saw this transition not just as a challenge but as an opportunity to build a new life while expanding my knowledge and expertise. Learning Swedish as my second language and English as my third was a demanding process, but instead of being discouraged, I embraced it. While at home with my newborn son, I started writing academic articles and exploring new ways to contribute to the field. At the same time, my wife was working, and I was studying Swedish and English, and balancing multiple responsibilities. However, breaking into the Swedish job market as a psychologist proved more difficult than expected. I was not accepted for several positions, but rather than seeing rejection as a setback, I took it as motivation to find another way forward. Around this time, my daughter was born, which made the challenge even more meaningful. I started working as a staff in forensic psychiatry, a role that gave me firsthand experience of the reality inside a maximum-security psychiatric clinic. I worked day and night shifts, responding to alarms, cleaning floors, washing dishes, preparing coffee, and slowly gaining a deeper understanding of the patients, staff, and daily operations of the clinic.

I quickly realized that many of the rules shaping life inside these institutions were not always logical but were followed simply because someone higher up had said so (e.g., a chief, a forensic psychiatrist, a psychologist, a writer, or even an unwritten rule). The hierarchical structure, the occasional unpredictability of aggressive incidents, and the constant need to adapt to changing conditions all became part of my daily learning. If an alarm sounded, even if it was false, every patient had to return to their rooms, and we, the staff, had to run to the location immediately. Resources were sometimes limited, meaning we had to balance priorities and make quick decisions on the spot. Sometimes, we were forced to say no to certain activities for the patients because there were too few staff members in the ward. Rather than being frustrated by these challenges, I found them fascinating. Working in this environment gave me a unique perspective on forensic psychiatry, one that textbooks alone could never provide. It allowed me to see the human side of maximum-security psychiatric care, understand the complex interactions between

patients and staff, and develop critical insights into how technology, something I had never dreamed of working with, let alone pursuing a PhD or using virtual reality, could play a role in treatment, rehabilitation, habilitation, and staff training.

Virtual Reality (VR) is an advanced immersive technology that enables users to engage with a simulated, computer-generated environment in a way that closely mimics real-world interactions. By utilizing high-fidelity head-mounted displays (HMDs) and precise motion-tracking systems, VR creates a dynamic, three-dimensional simulation that responds to user movements and actions in real time (Greengard, 2019). This technology has been increasingly adopted across various fields, including professional training, therapeutic interventions, and education, due to its ability to provide controlled, interactive, and repeatable simulated scenarios (Rizzo & Bouchard, 2019; Spiegel, 2020).

In forensic psychiatry, VR serves as a valuable tool for exposure therapy and behavioral training, enabling controlled simulations of high-stress or socially complex situations (Geraets et al, 2022; Sygel & Wallinius, 2021). By systematically exposing individuals to challenging environments within a safe and adaptable virtual setting, VR supports the development of emotional regulation strategies, adaptive behavioral responses, and improved coping mechanisms. Additionally, VR-based simulations can be tailored to the specific therapeutic and habilitation needs of patients while also serving as an effective training platform for forensic psychiatric staff, enhancing their preparedness and response strategies in demanding clinical environments. Beyond forensic psychiatry, VR has proven beneficial in medical training, emergency response, and professional development, allowing users to practice complex skills in a risk-free environment.

Moreover, non-violent VR applications provide engaging experiences that promote problem-solving, coordination, habilitation, and rehabilitation without violent content. When used under professional supervision, VR can also benefit vulnerable populations, including forensic psychiatry patients, older adults, and children, by supporting therapy, cognitive training, habilitation, and social interaction (Bailenson, 2018).

With responsible design and ethical implementation, VR emerges as a powerful tool for learning, habilitation, rehabilitation, and behavioral change across diverse applications. Sweden is now at the forefront of integrating virtual reality into the study and treatment of aggression in forensic psychiatric populations. This pioneering effort has been made possible thanks to the ambition and vision of Märta Wallinius, who saw the potential of VR-assisted aggression treatment and sought to bring and adapt the intervention model that was being developed in Wim Veling's lab in the Netherlands. Thanks to the collaboration and approval of our Dutch colleagues, we were able to implement and adapt the methodology for use in Sweden, ensuring that the intervention was not only scientifically grounded but also culturally and clinically relevant for forensic psychiatric patients within the Swedish

healthcare system. Their groundbreaking work in VR-based social cognition training inspired the Swedish adaptation of virtual reality as a tool to manage and reduce aggression in forensic patients. Because of this initiative, Sweden has become a key player in exploring new methods to understand and modify aggressive behaviors, particularly in secure settings where traditional interventions may be limited.

To fully grasp aggression, we must move beyond simple, linear explanations. The concepts of equifinality and multifinality provide valuable frameworks for understanding how aggression develops and manifests in different individuals (Garcia & González Moraga, 2017). Equifinality refers to the idea that multiple different paths can lead to the same outcome, in this case, aggression. A person may become aggressive due to early childhood trauma, neurobiological vulnerabilities, environmental stressors, or social learning, yet all these different factors may contribute to similar behavioral expressions of aggression. On the other hand, multifinality suggests that the same initial conditions can lead to different outcomes. Two individuals who experience early adversity (such as abuse, neglect, or exposure to violence) may develop in entirely different ways: one may become aggressive and violent, while another may develop resilience and lead a prosocial life. Understanding these principles is crucial for forensic psychiatry, as it highlights the need for individualized interventions rather than one-size-fits-all solutions. Virtual reality provides an innovative tool that can help us explore and test interventions tailored to different pathways leading to aggression.

The rapid evolution of virtual reality feels more like science fiction than traditional technological advancement. Literary works such as Snow Crash by Neal Stephenson (1994), where the term "Metaverse" was first coined, and Ready Player One by Ernest Cline (2011) have heavily influenced the digital world we are building today. These novels envision virtual realms like OASIS, where education, work, and social interactions seamlessly merge into an alternative reality. If we want to imagine the future of the Metaverse, we need only look at how Cline describes OASIS: a vast, interconnected digital universe where the virtual becomes a full extension of human experience. But these stories not only invite us to dream of digital futures, they also challenge us to question the nature of our own reality. Philosopher David Chalmers (2022) argues that even if we are living in a simulation, our reality remains authentic. According to him, virtual worlds can generate genuine consciousness, blurring the line between what is “real" and what is "digital." Unlike Nick Bostrom (2003), who suggests that we are likely simulated beings, Chalmers defends the idea that existence in a virtual world is just as meaningful and legitimate as any other form of reality.

Beyond reshaping how we perceive existence, immersive digital environments also present groundbreaking possibilities for human behavior, particularly in the treatment of aggression. Virtual reality is already being explored as a tool for managing and reducing violent impulses, allowing individuals to confront and

regulate aggression in controlled, simulated scenarios. Through tailored virtual environments, individuals can safely engage with high-stress situations, developing cognitive and emotional strategies that help prevent violent outbursts before they manifest in the real world. But what if we could go further? Minority Report, the dystopian vision created by Philip K. Dick (2002) and later adapted into film, speculates on a future where crimes are prevented before they occur. While the ethical implications of such a system remain controversial, VR-driven psychological interventions could bring us closer to early detection and prevention of violent behavior. By analyzing behavioral patterns in virtual spaces, we might identify risks before they escalate into real-world harm, offering not just treatment, but the potential to reshape crime prevention itself. As virtual worlds become more advanced and artificial intelligence plays a greater role, their applications extend beyond entertainment, merging with philosophy, neuroscience, and even law enforcement. The question is no longer just whether our reality is simulated, but whether simulations themselves could help us build a safer, more conscious society.

During my PhD, I have had the opportunity to travel the world, observe different realities and cultures up close, and almost feel what it is like to work in forensic psychiatry in other places. One of the most striking experiences was attending the Virtual Medicine Conference 2023, where the extreme luxury of producers, movie stars, musicians, entertainers, and sports celebrities collided with the homelessness crisis. This contrast was truly shocking and remains deeply moving to this day. It was a stark reminder of how human beings can adapt and coexist in such vastly different environments. Just days before, I had visited Stanford University, where I explored the Virtual Human Interaction Lab, walked around Palo Alto, and visited The HP Garage, widely recognized as the birthplace of Silicon Valley. Not satisfied with just that, I took the opportunity to explore San Francisco, where I attended an NBA game and saw Steph Curry lead the Golden State Warriors to victory. However, what impacted me the most was walking the streets of San Francisco for hours late into the night, witnessing firsthand the city's drug overdose epidemic, a reality that is both distressing and eye-opening.

Through my travels to Canada, Chile, Mexico, Australia, New Zealand, and across Europe, I can confidently say that access to technologies like virtual reality is still far from being an integrated part of daily practice in forensic settings. This inequity becomes particularly evident when attempting to conduct studies with international colleagues. The economic difficulties are just one side of the challenge, cultural differences have also played a significant role in shaping my day-to-day experiences. For example, in New Zealand, there is a strong emphasis on quality of life and cultural heritage recognition, particularly regarding the Māori culture. There, efforts are being made to use virtual reality as a tool to recreate and experience ancestral traditions, bringing historical and cultural narratives to life in ways that were previously impossible. This approach contrasts with other regions,

where VR is seen primarily as a tool for training and rehabilitation rather than a means of cultural preservation and identity reinforcement.

Through my work, I have developed a strong interest not only in rehabilitation but also in habilitation, ensuring that individuals under forensic psychiatric care receive the necessary tools and opportunities to develop new skills, regain autonomy, and improve their quality of life. This dual focus has shaped both my research and professional endeavors, driving me to explore innovative ways to enhance therapeutic interventions.

In my clinical practice, I work with long-stay patients, and one of the issues I find particularly challenging is how forensic psychiatric care is discussed in Sweden. In my opinion, too little is said about the duration of this care, despite its significant impact. Some patients have been under forensic psychiatric care for more than 20 years, yet they continue receiving standard treatment with only minor adjustments. I believe this group should be recognized and treated as a distinct category with specialized approaches tailored to their prolonged institutionalization. Moreover, I believe it should be more difficult for both forensic institutions and the legal system to deprive individuals of their liberty for such extended periods without reassessing their situation. This also calls for a broader reconsideration of forensic psychiatric care as a whole, rethinking how long-stay patients are managed and how long-stay units should function to balance the needs of these patients with those of society. This issue becomes even more interesting when compared to individuals sentenced to serve time in prison. Unlike forensic psychiatric patients, prisoners are not necessarily provided with any form of treatment; they are simply required to serve a fixed-term sentence. The contrast between these two systems is striking, highlighting enormous differences in how deprivation of liberty is structured and justified. Of course, this is a highly simplified description, but my intention is to introduce the reader to these types of ethical and legal dilemmas present in our society, without delving too deeply into them.

These dilemmas become even more pronounced in the daily practice of forensic psychiatry, where there is a constant need to balance care with surveillance. This creates what is often referred to as the "dual-role dilemma", on one hand, forensic psychiatry is responsible for providing treatment, rehabilitation, and recovery-oriented care, while on the other, it must function as an extension of the legal system, ensuring security, control, and risk management (Pedersen et al., 2025). This tension can lead to conflicting priorities, where the therapeutic role risks being overshadowed by the custodial function. The complexity of navigating this dual responsibility makes forensic psychiatric care a uniquely challenging field, raising critical questions about the ethical and legal boundaries of treatment under involuntary care.

The importance of a multidisciplinary, evidence-based, and person-centered approach in forensic psychiatry cannot be overstated. A striking example of this is

the case of Sture Bergwall, formerly known as Thomas Quick. Born in 1950 in Korsnäs, Sweden, Bergwall struggled with drug addiction and had a history of criminal behavior. After being institutionalized at Säter psychiatric hospital in 1991, he confessed to over 30 unsolved murders between 1994 and 2001 and was convicted of eight, despite the lack of physical evidence. Undergoing intensive psychotherapy and medication, he later admitted that his confessions had been entirely fabricated under the influence of therapy and drugs. By 2014, all his convictions were overturned, and he was released. His case is considered one of Sweden's biggest judicial scandals, exposing flaws in investigative and psychiatric methods at the time. It underscores the vital need for forensic psychiatry to rely on rigorous scientific evidence, interdisciplinary teamwork, and a commitment to avoiding past errors.

This doctoral thesis did not emerge in isolation; rather, it has been influenced by political, socioeconomic, and unforeseen global events. When I was accepted into Lund University, it coincided with the birth of my third child, approximately a year before the pandemic. For instance, the COVID-19 pandemic disrupted the launch of our pilot study, underscoring the vulnerability of research initiatives to external crises. Additionally, forensic psychiatric research depends on competitive grants and institutional support, which vary significantly across clinics. While I am grateful for the support I received from my clinic, given the knowledge gaps in this field (Howner et al., 2018), it is paradoxical that some institutions do not prioritize research.

Sweden has a long history, spanning over 500 years, of recognizing the necessity for specialized care for individuals with mental health conditions. Despite this historical awareness, national guidelines for forensic psychiatric care remain absent. A century ago, head physicians in psychiatric institutions wielded near-totalitarian authority, making decisions not only about patient care but also extending control over staff members' professional and personal lives. Although contemporary systems are more democratic, hierarchical structures continue to dictate practices, and significant disparities persist in defining and prioritizing quality care across forensic psychiatric clinics.

In my opinion, the forensic psychiatric care system in Sweden remains fragmented, with substantial variability in care standards and treatment approaches depending on the clinic. Addressing these challenges requires the establishment of national guidelines, the promotion of research as a fundamental pillar of forensic psychiatric practice, and a commitment to fostering more participatory and adaptive care models.

I find it indispensable to keep the history of forensic psychiatry alive, to learn from it and prevent repeating past mistakes, or at least make every effort to do so. Forensic psychiatry does not exist in isolation; it is deeply intertwined with broader societal structures, democracy, and the role of civil society. The community,

civilians, social organizations, and the press all play a crucial role in holding institutions accountable and ensuring that forensic psychiatric practices align with democratic principles. This is even more critical in uncertain times, such as those in which this text is being written; in the aftermath of a pandemic, amid global warming, increasing tensions between world powers, and a rising global military presence. To put it in numbers, between 2021 and 2024, EU member states' total defense expenditure rose by more than 30%. In 2024 alone, it reached an estimated €326 billion, about 1.9% of the EU's GDP. These figures illustrate the geopolitical shifts and growing investments in security and defense at a time when public healthcare, including mental health services, often remains underfunded and undervalued.

The rapid evolution of digital technology has led to an unprecedented bombardment of information, raising concerns about its impact on human brain development. While access to vast amounts of data can enhance knowledge and connectivity, it also fosters a state of constant distraction, weakening our ability to focus deeply and process information critically. Some researchers argue that the modern brain, shaped by endless notifications and fragmented attention, is becoming less capable of sustained thought and reflection (Gazzaley & Rosen, 2016). This issue is particularly concerning among adolescents, who are highly exposed to social media. Studies suggest that excessive social media use can lead to anxiety, depression, and reduced attention spans, as young minds become increasingly dependent on instant gratification and external validation (Keles et al., 2020).

At its core, this crisis reflects a deeper tension, our ancient brains, shaped for survival in slower, more demanding environments, are now struggling to adapt to a high-tech world designed to exploit their cognitive vulnerabilities. If our mental resources are continually spread thin, are we truly evolving intellectually, or is society merely adapting to a shallower, more distracted mode of thinking, especially in younger generations? VR further complicates this landscape. While VR has the potential to enhance learning, therapeutic interventions, and even social interactions in ways that traditional digital experiences cannot, it also raises questions about cognitive adaptation. Unlike passive screen-based media, VR immerses users in fully interactive digital environments, engaging the brain in ways that mimic real-life experiences. This can be beneficial (e.g. boosting memory retention, empathy, and problem-solving skills) but it also presents new risks. The intensity of virtual immersion could deepen existing tendencies toward distraction, making the real world seem dull by comparison. For younger generations, who are still developing their cognitive control and emotional regulation, prolonged exposure to virtual worlds might further blur the line between reality and simulation, fostering escapism rather than resilience.

If social media has conditioned young minds to seek constant stimulation and external validation, could VR amplify this effect, creating environments where the real world no longer holds the same weight? Or, conversely, could it be harnessed

as a tool for deep focus and engagement, counteracting the fragmented attention of the digital age? The challenge lies in shaping VR experiences that strengthen cognitive depth rather than erode it, guiding the evolution of our minds toward richer, more meaningful interactions rather than an ever-growing detachment from reality. While digital distractions pose challenges, they also offer new ways of learning, problem-solving, and connecting with others. The same social media platforms that contribute to anxiety and reduced attention spans can, in some cases, serve as spaces for creativity, activism, and knowledge-sharing. Additionally, the ability to process large amounts of information quickly could be seen as an evolution rather than a regression. However, this adaptation comes at a cost. The growing difficulty many people face in maintaining focus, especially in open-space offices, where constant noise and interruptions make deep work nearly impossible, raises the question of whether this transformation is truly beneficial (Gazzaley & Rosen, 2016). In a world that demands constant connectivity, the ability to sustain attention and mental well-being seems to be at risk, suggesting that rather than an evolution, we might be experiencing a crisis of adaptation.

Forensic psychiatry exists at the intersection of care, law, ethics, and human vulnerability, navigating some of the most challenging questions in mental health care. Across all clinics nationwide, the field faces growing demands to provide high-quality, evidence-based treatment while grappling with systemic constraints, ethical dilemmas, and the profound complexity of aggression treatment. Virtual reality offers new possibilities, yet it also raises important questions about its role, effectiveness, and ethical implications in such a sensitive field. This thesis is the first doctoral work in Sweden to explore virtual reality in forensic psychiatry. A small step into an evolving landscape that still holds many unanswered questions.

This thesis is the result of years of learning, questioning, and innovating. It represents not only my academic research but also my commitment to pushing boundaries, embracing challenges, and continuously seeking better solutions for forensic psychiatric care and mental health with the assistance of technology. My hope is that this research contributes to a deeper understanding, encourages further exploration, and, in some way, helps improve care for those who need it most.

Fernando Renee González Moraga

Tävelsås, 17 March 2025

Abbreviations

ADHD	Attention-Deficit/Hyperactivity Disorder
AI	Artificial Intelligence
AR	Augmented Reality
CBT	Cognitive Behavioral Therapy
DAABS	Development of Aggressive Antisocial Behavior Study
EX	Extended Reality
FP	Forensic Psychiatry
FPE	Forensic Psychiatric Examination
FOV	Field of View
GAM	General Aggression Model
HMD	Head-Mounted Display
LHA	Life History of Aggression
MX	Mixed Reality
MAALIN	MAOA-associated lncRNA
PCL-R	Psychopathy Checklist-Revised
RCT	Randomized Controlled Trial
SMD	Severe Mental Disorders
SDAS-9	Social Dysfunction and Aggression Scale-9
SDR	Special Discharge Review
VR	Virtual Reality
VRAPT	Virtual Reality Aggression Prevention Training
WAIS-III	Wechsler Adult Intelligence Scales – Third Edition.

List of included papers

I. **González Moraga, F. R.**, Garcia, D., Billstedt, E., & Wallinius, M. (2019). Facets of psychopathy, intelligence, and aggressive antisocial behaviors in young violent offenders. Frontiers in psychology, 10, 449489.

II. **González Moraga, F. R.**, Tuente, S., Perrin, S., Enebrink, P., Sygel, K., Veling, W., & Wallinius, M. (2022). New developments in virtual reality-assisted treatment of aggression in forensic settings: the case of VRAPT. Frontiers in Virtual Reality, 2, 675004.

III. Sivermo, F., **González Moraga, F. R.**, & Wallinius, M. A Pilot Study on Treatment Content in Virtual Reality-Assisted Aggression Therapy at a Maximum-Security Forensic Psychiatric Clinic. *Manuscript under peer review.*

IV. **González Moraga, F. R.**, Enebrink, P., Perrin, S., Sygel, K., Veling, W., & Wallinius, M. Staff-observed Outcomes of Virtual Reality Aggression Prevention Training in Maximum-Security Forensic Psychiatry. *Manuscript in preparation.*

V. **González Moraga, F. R.**, Enebrink, P., Perrin, S., Sygel, K., Veling, W., & Wallinius, M. (2024). VR-assisted aggression treatment in forensic psychiatry: a qualitative study in patients with severe mental disorders. Frontiers in psychiatry, 15, 1307633.

Introduction

Young violent offenders

Young violent offenders commit a significant portion of serious criminal activity, with males disproportionately represented in offenses such as homicide, robbery, and aggravated assault (Luthman, 2024; Wallinius, 2012; Farrington, 2003; Loeber & Farrington, 2001). This demographic pattern aligns with developmental criminology, which highlights that antisocial behavior often escalates in adolescence and, for some individuals, persists into adulthood (Moffitt, 1993; Basto-Pereira & Farrington, 2022). The World Health Organization (2023) reports that young men, particularly those aged 15–29, are responsible for a large share of violent crimes worldwide, underscoring the necessity of targeted interventions.

The emergence of violent offending in youth is influenced by a combination of biological, psychological, and social factors. Hirschi's (1969) social control theory suggests that weak societal bonds and a lack of pro-social attachments contribute to delinquency, making adolescent males particularly vulnerable to criminal pathways. Moreover, economic studies indicate that offenses committed by young men impose a significant burden on society, reinforcing the urgency of preventive strategies (Piquero, Jennings & Farrington, 2013; Parker, 2024).

Beyond social influences, individual risk factors such as neurodevelopmental vulnerabilities, psychiatric disorders, and exposure to adverse childhood experiences play a crucial role in shaping violent tendencies (Loeber & Farrington, 2012; Hofvander et al., 2017; Tärnhäll et al., 2023). Victimization during adolescence further exacerbates the likelihood of criminal involvement, suggesting a cyclical pattern of violence that requires early intervention (Rubio et al., 2023). Addressing these underlying issues through comprehensive rehabilitation programs, incorporating psychological treatment, educational support, and social reintegration, is essential for reducing recidivism and promoting long-term behavioral change.

In terms of psychological and neurodevelopmental factors, young violent offenders frequently present childhood-onset conditions such as attention-deficit/hyperactivity disorder (ADHD), conduct disorder, and oppositional defiant disorder (Billstedt et al., 2017). These disorders are associated with executive dysfunction, poor impulse control, and an increased propensity for risk-taking

behavior (Raine, 2019; Fairchild et al., 2019). Additionally, psychiatric conditions such as antisocial personality disorder, borderline personality disorder, schizophrenia, and substance use disorders are highly prevalent in this population (Fazel et al., 2008; Tärnhäll, 2024). These mental health challenges often co-occur, complicating both assessment and treatment efforts (Heilbrun, 2009; Heilbrun et al., 2012, Siponen et al., 2023).

Trauma and adverse childhood experiences play a central role in the development of violent behavior among young offenders. A significant proportion of individuals in this category have been exposed to domestic violence, neglect, and childhood abuse, contributing to emotional dysregulation and maladaptive coping mechanisms (Anda et al., 2006; Baglivio et al., 2014; Wallinius et al., 2016; Astridge et al., 2023). Experiences such as early-life instability, foster care placement, and juvenile justice involvement further increase vulnerability to criminal behavior (Loeber & Farrington, 2012). Moreover, social and environmental influences, including gang affiliation, delinquent peer associations, and familial dysfunction, serve as additional risk factors for continued engagement in violent crime (Thornberry et al., 1993; Wojciechowski, 2021; Confer, 2024).

The legal response to young violent offenders varies depending on the presence or absence of severe mental disorders (SMD; Svennerlind et al., 2010). In the traditional prison system, offenders who are deemed criminally responsible are incarcerated based on the severity of their crimes (Foucault, 1977). Within correctional institutions, young offenders may be placed in juvenile detention centers or specialized young offender units in adult prisons. However, the prison system faces significant challenges, including high recidivism rates, limited access to mental health care, prevalent substance abuse, and exposure to criminal influences that can reinforce antisocial behavior (Loeber & Farrington, 2012; Fazel et al., 2016; van Ginneken & Palmen, 2023). The correctional environment often fails to provide the rehabilitative support necessary for long-term behavioral change (Logan et al., 2025).

Given the high risk of recidivism among young violent offenders, intervention strategies must be tailored to address their psychological, behavioral, and social needs. In correctional settings, cognitive behavioral therapy has shown promise in improving impulse control, anger management, and decision-making skills (Lipsey et al., 2007; Henwood et al., 2015; Papalia et al., 2019; Giesbrecht, 2023; Saxena & Sahai, 2024). Integrating substance abuse treatment with mental health care is essential for individuals with co-occurring disorders (Yule & Kelly, 2019; Peters, 2017). Educational and vocational training programs play a crucial role in improving post-release employment prospects, which is a key factor in reducing reoffending (Verweij, 2022). Additionally, structured gang desistance programs can support disengagement from criminal networks and promote prosocial alternatives (Roman et al., 2017).

Determining criminal responsibility - the role of forensic psychiatry

Forensic psychiatry is a highly specialized field at the intersection of psychiatry, law, and criminal justice. It involves the evaluation, treatment, and management of individuals with mental disorders who have committed offenses or are involved in legal proceedings. The field encompasses a broad range of clinical, legal, and ethical considerations, focusing on criminal responsibility, competency to stand trial, risk assessment, and long-term psychiatric care for offenders. In common law systems, such as those in the United States, the United Kingdom, Canada, and Australia, the insanity defense is often applied based on legal principles such as the M'Naghten Rule, which assesses whether the defendant was incapable of understanding the nature of their actions at the time of the offense (Loughnan, 2012). If an individual is deemed not criminally responsible due to a psychiatric condition, they may be committed to a forensic psychiatric institution rather than a correctional facility, as seen in the case of forensic mental health legislation in the United States and Canada (Pinals, 2014). In civil law systems, including Germany, France, Chile, Sweden, and Japan, forensic psychiatric evaluations are typically integrated into criminal proceedings, and diminished responsibility is considered a mitigating factor (Zinkler & Priebe, 2002). In these jurisdictions, individuals found to have lacked criminal responsibility due to a psychiatric disorder may be subject to mandatory psychiatric treatment in specialized forensic facilities, as outlined in the German Penal Code and similar legal provisions in other civil law countries (Perlin, 2016). Here, forensic psychiatric treatment serves as a security measure rather than a punishment. Mixed and hybrid legal systems, such as those in South Africa, Russia, China, and Brazil, combine elements of both common law and civil law traditions, leading to variations in how psychiatric conditions impact criminal responsibility. Some jurisdictions emphasize rehabilitation within forensic psychiatric institutions, while others integrate psychiatric care with penal measures, often requiring forensic psychiatric assessments to determine the level of culpability (Bennet, 2024). Despite these differences, the fundamental principle across legal systems is that individuals suffering from SMD at the time of the offense may not be held fully criminally responsible and are instead placed in forensic psychiatric care for treatment and risk management (Völlm et al., 2016). Sweden's approach differs in that individuals are held criminally responsible but are sentenced to care, reflecting the principle of dual responsibility, which acknowledges both criminal liability and the need for treatment (Jehle et al., 2021).

The Swedish system for managing offenders with severe mental disorders

Sweden has developed a distinctive approach to forensic psychiatry. A distinguishing feature of the Swedish legal system is that individuals suffering from SMD at the time of an offense are still considered criminally responsible and are convicted rather than declared not guilty by reason of insanity (Söderberg et al., 2023). However, instead of being sentenced to imprisonment, they are sentenced to forensic psychiatric care, which is determined by the court (Howner et al., 2018).

The Swedish Penal Code and the Compulsory Psychiatric Care Act provide the legal framework for forensic psychiatric care, allowing courts to mandate psychiatric treatment instead of traditional sentencing when mental illness plays a significant role in criminal behavior (Bennet, 2024). A central concept in Swedish forensic psychiatry is the classification of SMD, which includes conditions such as schizophrenia, psychotic disorders, severe affective disorders, and certain personality disorders if they cause significant impairment (Trägårdh, 2023). The process of determining whether a person holds a SMD begins with a forensic psychiatric examination (FPE). If a person is suspected of having a SMD at the time of the crime, the court orders an FPE. FPEs are in Sweden conducted by the National Board of Forensic Medicine and involve multidisciplinary assessments by forensic psychiatrists, psychologists, social workers, and forensic mental health support worker (Sjöström, 2011). These evaluations determine whether the defendant has understood the nature and consequences of their actions and evaluate the risk of future violent behavior (Lindqvist & Skipworth, 2000; Lutz et al., 2022).

If a defendant is diagnosed with SMD, the court may impose compulsory forensic psychiatric care instead of imprisonment, prioritizing treatment over punitive measures (Svennerlind et al., 2010). Unlike fixed prison sentences, forensic psychiatric care is indefinite and subject to ongoing evaluations to assess risk and rehabilitation progress. If the individual is deemed dangerous, compulsory care with special discharge restrictions (SDR) may be applied already at the sentencing, requiring court approval for any release (Degl'Innocenti et al., 2014).

Forensic psychiatric care

Patients in forensic psychiatric care constitute a highly heterogeneous, challenging, and vulnerable population within both healthcare and society. Their clinical profiles often present a complex interplay of SMD, antisocial behavioral patterns, substance use, and heightened impulsivity and/or diminished empathy (Noland & Strandh, 2021). Forensic psychiatric populations include individuals with varying degrees of

psychopathic traits and aggressive antisocial behaviors, both of which present significant therapeutic challenges (Wallinius et al., 2012; Delfin et al., 2018; González Moraga et al., 2019).

Within forensic psychiatric care, individualized treatment with continuous risk assessment and relapse prevention strategies ensure that progress is continuously monitored, providing mental health care while reducing the likelihood of future violent behavior (Bonta & Andrews, 2023). Gradual reintegration programs that facilitate supervised transitions to community-based mental health services improve the chances of successful social adaptation (Heilbrun et al., 2012). Family and community support systems play a crucial role in reducing recidivism, as strong social connections can help prevent reoffending. However, certain forms of support may inadvertently encourage criminal behavior rather than providing protection (Schaefer et al., 2021). Effectively addressing the complex challenges of forensic psychiatry requires a multidisciplinary approach that adapts to evolving evidence-based practices. By focusing on mental health treatment, social reintegration, and educational opportunities, justice systems can promote rehabilitation, enhance social stability, and reduce recidivism. Forensic psychiatric care integrates diverse treatment modalities, including pharmacological, psychological, psychosocial, habilitation, and rehabilitation interventions, to manage psychiatric symptoms while addressing criminogenic factors (Papalia et al., 2020; Bonta and Andrews, 2023).

Pharmacological treatment typically involves the use of antipsychotics, mood stabilizers, and antidepressants to manage symptoms associated with SMD (Fazel et al., 2016). Cognitive Behavioral Therapy (CBT) is widely used to improve emotional regulation, impulse control, and cognitive distortions that contribute to violent behavior (Papalia et al., 2020). Rehabilitation programs emphasize social reintegration, offering vocational training, employment support, and structured release planning to minimize the risk of reoffending (Lin et al., 2023). Despite its rehabilitative focus, forensic psychiatric care presents challenges, including treatment resistance, difficulties in reintegration after prolonged institutionalization, and concerns regarding the indeterminate nature of forensic hospitalization (Heilbrun et al., 2012, Noland et al., 2024; Söderberg, 2024). Former forensic psychiatric patients often encounter significant barriers to social adaptation. Social stigma, difficulties in securing employment and housing, and continued legal restrictions pose challenges to successful reintegration (Lindqvist & Skipworth, 2000, Noland et al., 2023). Addressing these challenges requires community-based forensic psychiatric services, ensuring that former patients receive ongoing mental health support while maintaining public safety (Krona et al., 2017; Noland and Strandh, 2021).

Forensic psychiatric care applies risk assessments, which involves evaluating the likelihood of reoffending and implementing interventions aimed at reducing this risk (Douglas et al., 2013). Historical-Clinical-Risk Management, Version 3 (HCR-V3) is widely used to assess the risk of violent behaviors, incorporating historical,

clinical, and future-oriented risk factors (Douglas et al., 2013). The Psychopathy Checklist-Revised (PCL-R) is employed to evaluate psychopathy, a condition strongly associated with criminal recidivism (Hare, 2003). Additionally, the Level of Service Inventory-Revised (LSI-R) measures general criminogenic risk factors, supporting individualized treatment planning (Bonta & Andrews, 2023). These assessment tools play a crucial role in determining whether individuals require continued forensic psychiatric care or can be safely reintegrated into society (Fazel & Wolf, 2015).

Forensic psychiatric care in Sweden

Forensic psychiatric care in Sweden is provided within psychiatric hospitals with different security levels, where patients undergo structured rehabilitation under supervision. The level of security is determined by the patient's risk profile, with high-security units reserved for those deemed highly dangerous or at risk of absconding (Selvin et al., 2021). Medium-security units house patients undergoing rehabilitation but still requiring substantial security measures, while open forensic psychiatric units facilitate gradual reintegration into society under supervised conditions (Söderberg, 2024).

Release from forensic psychiatric care in Sweden is determined through ongoing psychiatric evaluations and legal oversight by the administrative court, which assesses whether the patient no longer poses a risk to society (Söderberg et al., 2023). Unlike prisoners who serve fixed sentences, forensic psychiatric patients remain institutionalized until they demonstrate sufficient clinical stability for reintegration (Fazel et al., 2016). The median duration of forensic psychiatric care in Sweden has been estimated at 89.7 months, with longer treatment for individuals who committed violent crimes, had psychosis or a history of substance use disorder, and for those whose sentences included SDR (Sivak et al., 2023). In some cases, individuals remain under lifelong psychiatric monitoring due to their risk profile, requiring structured outpatient care and regular assessments (Völlm, 2022).

The indefinite nature of forensic psychiatric care raises ethical concerns regarding human rights and proportionality in sentencing (Söderberg et al., 2023). Critics argue that some individuals may remain institutionalized for periods exceeding what would have been their prison sentence, raising questions about fairness and due process (Tomlin & Völlm, 2022). The definition of SMD has also been a topic of debate, particularly in cases where psychiatric symptoms fluctuate over time (Söderberg, 2024). Balancing public safety with the rights of forensic psychiatric patients remains a key issue in Sweden's legal-psychiatric framework (Fazel & Wolf, 2015).

The Bergwall Commission (2015), led by Professor Emeritus Daniel Tarschys, conducted an extensive investigation into the wrongful convictions of Sture

Bergwall (formerly known as Thomas Quick) for eight murders in Sweden. The Bergwall case exposed critical weaknesses in forensic psychiatry's role within the legal system (Tarschys, 2015).

Bergwall, diagnosed with SMD, was admitted to Säter Forensic Psychiatric Hospital in 1991, where he remained in therapy until 2002. His psychiatric condition and long-term medication use raised concerns about the extent to which forensic psychiatric evaluations influenced legal decisions without sufficient external scrutiny (Råstam, 2013). The Commission found that his confessions, made under the influence of medication and suggestive therapeutic practices, were not independently verified by police or prosecutors (Josefsson, 2015).

A key factor in Bergwall's treatment was the therapeutic framework applied by psychologists and psychotherapists, who largely based their approach on early childhood sexual abuse and repressed memories as an explanatory model. This perspective was in line with contemporary psychological theories at the time and was supported by influential psychiatrists. The use of recovered memory therapy, a controversial practice now widely questioned due to its potential to create false memories, played a central role in shaping Bergwall's confessions (Josefsson, 2015; Råstam, 2013).

Among the Bergwall Commission's proposals (Tarschys, 2015) was that county councils should increase their focus on forensic psychiatry and compulsory psychiatric care, as well as strengthen knowledge development in these areas. Furthermore, it was suggested that the Swedish Research Council should conduct an international review of forensic psychiatric research in Sweden, and that the Swedish Agency for Health Technology Assessment and Assessment of Social Services should identify areas within forensic psychiatry where systematic knowledge reviews are needed. However, many of these problematic methods had already been widely criticized and largely abandoned by the early 2000s.

Policy developments in Sweden have focused on expanding alternative forensic psychiatric interventions, such as specialized community-based forensic services aimed at preventing reoffending while reducing institutionalization (Völlm et al., 2018; De Cuyper et al., 2023). Early intervention programs that address psychiatric disorders and criminogenic risk factors before criminal behavior escalates are gaining attention as a means to reduce the number of individuals entering the forensic psychiatric system (Olsson et al., 2021). As forensic psychiatry continues to evolve, an emphasis on rehabilitation, diverse and meaningful activities, patient involvement, human rights protections, and evidence-based interventions remains central to its future development (Söderberg et al., 2020; Askola et al, 2022).

In 2024, the Swedish National Board of Health and Welfare was tasked with strengthening and developing involuntary and forensic psychiatric care, emphasizing the need for evidence-based interventions and improved risk management strategies (Socialstyrelsen, 2024). This initiative highlights the

importance of refining treatment models for individuals with SMD, ensuring that clinical approaches effectively address both aggression and rehabilitation potential. Research suggests that interventions targeting emotional processing, impulse control, and social integration may offer some promise, though long-term effectiveness remains debated (Olver et al., 2013).

Aggression

Aggression is a complex behavior extensively studied across multiple disciplines, including psychology, sociology, and neuroscience. Theoretical frameworks have been developed to explain the origins, mechanisms, and manifestations of aggression, each contributing to a broader understanding of this phenomenon.

Biological theories suggest that aggression has a hereditary component and is influenced by genetic and neurophysiological factors. The MAOA gene, often referred to as the "warrior gene" has been linked to aggressive behavior, particularly in individuals exposed to adverse environments (Caspi et al., 2002). However, the concept of a "warrior gene" oversimplifies the complex relationship between genetics, environment, and behavior. While studies like Caspi et al. (2002) suggest an interaction between MAOA variants and early-life adversity in predicting aggression, this reductionist label risks reinforcing genetic determinism. Mentis et al. (2021) review highlights the need for an integrated approach, combining psychological, radiological, and genomic methods, to fully understand aggression. Furthermore, the discovery of MAOA-associated lncRNA (MAALIN) and other regulatory mechanisms suggests that MAOA's role is far more nuanced than a single genetic variant dictating behavior. Moving beyond sensationalized narratives, translational solutions should focus on personalized and context-dependent interventions (Labonté et al., 2021).

Evolutionary psychology posits that aggression has developed as an adaptive mechanism for survival and reproduction, with aggression playing a role in resource competition and mate selection (Buss & Shackelford, 1997; Buss, 2021). Neurobiological research underscores the role of brain structures such as the amygdala and prefrontal cortex in regulating aggression (Gillespie et al., 2018). Dysfunctions in these areas, particularly when coupled with low serotonin have been associated with increased aggressive tendencies (da Cunha-Bang & Knudsen, 2021).

Psychological theories provide additional insights into the mechanisms underlying aggression. The frustration-aggression hypothesis originally proposed by Dollard et al. (1939) suggests that aggression arises from frustration when goal-directed behavior is blocked. This hypothesis was later expanded by Berkowitz (1989) to incorporate cognitive and situational factors that mediate aggressive responses.

Social learning theory, introduced by Albert Bandura (1973), emphasizes the role of observational learning in aggressive behavior. The Bobo doll experiment, conducted by Bandura et al. (1961) investigated how children learn aggression through observation. In the study, children watched an adult interact with a Bobo doll, with some observing aggressive behavior (hitting, kicking, and yelling) and others seeing non-aggressive behavior or no model at all. The results showed that children who observed aggressive behavior were significantly more likely to imitate it, especially when the aggressive model was not punished (Bandura, 1977). This experiment provided key evidence for social learning theory, demonstrating that behavior is influenced by observation, reinforcement, and punishment. The findings have had lasting implications for understanding the effects of media violence and social influences on child development (Bandura, 1986).

Extensive research indicates that exposure to violent media can increase aggressive behavior in both children and adults, with effects that are significant and comparable to other recognized public health threats (Huesmann et al., 2003; Ybarra et al., 2022). Anderson and Dill (2000) provided empirical support for the link between violent video games and increased aggressive thoughts, feelings, and behaviors. Meta-analyses further confirm that repeated exposure to violent media can enhance aggressive cognition while diminishing prosocial behavior, highlighting the importance of considering age-related risks in video game rating policies (Anderson et al., 2010; Burkhardt & Lenhard, 2022).

However, other studies suggest that engagement with violent video games is not associated with increased aggression in adolescents (Przybylski & Weinstein, 2019). Additionally, a systematic review by Pante et al. (2022) found that violent video game exposure may be linked to either an increase in testosterone or a decrease in cortisol, both of which are associated with aggression. These studies demonstrate that there is still no consensus on how aggression is conceptualized, how it should be measured, or what the expected outcomes should be. More standardized studies, along with clear and transparent protocols, are needed to better understand the complexities of aggression in the context of violent media exposure.

Sociocultural theories of aggression argue that social structures and environmental factors significantly contribute to aggressive behavior. The culture of honor hypothesis suggests that certain societies promote aggressive responses to perceived threats as a means of maintaining social status and respect (Nisbett, 1996). Deindividuation theory, introduced by Zimbardo (1969), posits that anonymity and reduced self-awareness in group settings can facilitate aggressive behavior. This theory has been supported by research on mob violence and online aggression, where individuals act aggressively due to diminished personal accountability.

The development of aggression has also been examined from a lifespan perspective. Social information processing models emphasize cognitive biases and schemas in shaping aggressive behavior. Dodge and Coie (1987) distinguished between

reactive and proactive aggression, highlighting the role of cognitive distortions in aggressive responses. Crick and Dodge (1994) further refined this model, linking social information processing to social adjustment difficulties. Developmental research (Dishion & Patterson, 2015; Pinquart, 2017) underscored the importance of early family environments and reinforcement mechanisms in shaping aggressive tendencies. Additionally, poor sleep quality is consistently associated with higher levels of aggression (Van Veen, 2021).

A central and integrative framework in aggression research is the General Aggression Model (GAM), proposed by Anderson and Bushman (2002). The GAM synthesizes elements from various theories, illustrating how personal and situational factors interact to influence aggressive behavior. This model emphasizes cognitive, affective, and arousal mechanisms as mediators in aggressive responses. Empirical studies have applied GAM to diverse contexts, including intimate partner violence, intergroup conflict, and the influence of environmental stressors on aggression (DeWall et al., 2011; Warburton & Anderson, 2015; Plante et al., 2020). By providing a comprehensive framework, GAM remains one of the most influential models in contemporary aggression research, with applications in forensic psychology, social policy, and media studies.

Proactive, reactive and psychotic aggression

Aggression may manifest in multiple forms, each requiring tailored interventions and legal considerations (González Moraga et al., 2022), and one way to identify the motives and functions of aggression is by categorizing different typologies. Coccaro and McCloskey (2018) suggested that aggression can be understood both as a continuum (dimensional approach) and as a dichotomy between normative and pathological aggression (e.g., through diagnostic classifications). Previous research has identified three distinct types of aggression: reactive aggression (also referred to as impulsive or affective aggression), proactive aggression (also known as instrumental, cold-blooded, or psychopathic aggression), and psychotic aggression (Blair, 2001; Greenage & Trestman, 2018; Stahl, 2014; Quanbeck et al., 2007). Proactive aggression necessitates cognitive and behavioral strategies, reactive aggression demands emotion regulation interventions, and psychotic aggression requires psychiatric treatment (Quanbeck et al., 2007; Fung et al., 2009; Tapscott et al., 2012).

Proactive aggression, also known as instrumental aggression, is deliberate and goal-oriented. It is often associated with psychopathy and antisocial personality disorder (Blair, 2018). Individuals exhibiting proactive aggression display reduced emotional arousal and increased strategic planning, making their behavior more manipulative and calculated (Cornell et al., 1996). This form of aggression is prevalent among offenders engaged in premeditated crimes, such as fraud, organized violence, and planned homicides. Neurobiologically, proactive

aggression is linked to dysfunctions in the prefrontal cortex and reduced amygdala activation, which contribute to impaired moral reasoning and emotional processing (Glenn & Raine, 2014). In forensic settings, proactive aggression necessitates interventions targeting cognitive distortions, empathy deficits, and impulse control.

Reactive aggression, in contrast, is impulsive and emotionally driven, typically occurring in response to perceived threats or provocations. This type of aggression is common in individuals with borderline personality disorder, intermittent explosive disorder, and post-traumatic stress disorder (Coccaro et al., 2014). Reactive aggression often results in violent outbursts, assaults, and self-harming behaviors within forensic institutions. From a neurobiological perspective, reactive aggression is associated with hyperactivity in the amygdala and dysfunction in the prefrontal cortex, impairing emotional regulation and impulse control (Davidson et al., 2000). Forensic interventions for reactive aggression focus on emotion regulation therapies, anger management, and pharmacological approaches targeting serotonin and dopamine systems (Narvaes & Martins de Almeida, 2014).

Psychotic aggression refers to violent behavior driven by delusions, hallucinations, or other psychotic symptoms, commonly observed in individuals with schizophrenia or severe bipolar disorder (Simonsson, 2020). Unlike proactive or reactive aggression, psychotic aggression is often unprovoked and lacks clear instrumental or emotional triggers. Neurobiologically, psychotic aggression has been linked to dopamine dysregulation and abnormalities in limbic structures (Seo et al., 2008; Stegmayer, 2014). In forensic settings, individuals displaying psychotic aggression require specialized psychiatric interventions, including antipsychotic medications, behavioral therapy, and close monitoring to prevent violent incidents.

Psychopathy is a personality construct often associated with impulsivity, lack of empathy, and an increased propensity for aggressive behavior (Hare, 2003; Pauli, 2020). Studies have shown that psychopathic traits can be linked to both reactive and proactive aggression, but particularly to proactive aggression, where a lack of emotional involvement facilitates strategic use of violence (Portnoy et al., 2013). Additionally, research has explored the relationship between psychopathy and intelligence, with some findings suggesting that high intelligence may mask or modify the expression of psychopathic tendencies (DeLisi et al., 2011). For example, an individual with both psychopathic traits and high intelligence may be more adept at manipulating others and avoiding negative consequences for their behavior.

Understanding these relationships is crucial for explaining antisocial behavior and gaining insight into the psychological mechanisms underlying different forms of aggression.

The evolution of techniques for managing psychiatric patients with aggression in Sweden

The management of aggressive psychiatric patients in Sweden has evolved in line with broader European developments. The transition from physically restrictive practices to modern therapeutic approaches reflects a dedication to human rights, evidence-based treatment, and legislative reforms. This section explores historical milestones and the progression toward contemporary forensic psychiatric care in Sweden.

During the Middle Ages, institutions such as the House of the Holy Spirit and monasteries provided care for the sick and impoverished. Mental illness was often attributed to supernatural causes, leading to treatment focused on religious devotion. A church hall was constructed adjacent to hospital wards so that even the weakest patients could receive religious guidance. Those who were physically capable participated in daily activities, while others were too frail to work (Kemp, 1985). In 1642, a begging ordinance restricted hospital access to those unable to support themselves, including the mentally ill, the possessed, and individuals with contagious diseases, while excluding the general poor. This marked the formal inclusion of mentally ill individuals in hospitals, although they had already been housed there. In Växjö, administrator Wretin's 1698 hospital plan suggested separating the violent and restless from other patients. This proposal, completed in 1706, prioritized practical considerations over treatment, ensuring a calmer environment for other residents (Höglund, 1993). Until the early 19th century, mental health care lacked a genuine medical focus.

One historical approach used in Sweden was the "provkur", an experimental medical treatment designed to diagnose and treat mental or physical ailments while maintaining financial control over patient care (Höglund, 1993). This procedure involved isolating the patient, shaving their head, and administering rudimentary treatments. Techniques included inducing wounds to drain "impure fluids," starvation therapy, cold water baths, and the use of laxatives and skin irritants. Though intended to restore health, these practices reflected the limited medical knowledge of the time.

Historically, the treatment of aggressive psychiatric patients often relied on methods now considered inhumane. The use of straitjackets, restraint suits, rotating chairs, windowless rooms, food deprivation, and bloodletting was widespread. Bloodletting, rooted in Hippocratic teachings dating back to 460–370 B.C., was based on the belief that bodily fluid imbalances caused illness (Wetterberg, 2012).

Records indicate that prolonged baths were frequently used to subdue aggressive or restless patients, particularly women. Some individuals remained in these baths for up to 24 hours, though medical notes rarely documented their effects, side effects, or patients' responses to the treatment. Typically lasting between four and six hours,

these baths were believed to have a sedative effect, serving as a form of tranquilization or sleep induction. In certain cases, they were combined with medication to create a modified sleep therapy (Svedberg, 2002).

By the late 19th century, psychiatric treatment depended heavily on opium, emetics, and laxatives. In the early 20th century, physicians experimented with extreme interventions to manage anxiety and confusion, such as malaria therapy, shock treatments, insulin-induced comas, and psychosurgery. Though considered advanced at the time, these methods reflected a desperate search for solutions in a field with limited effective treatments, making conditions difficult for both patients and medical staff (Wetterberg, 2012).

The introduction of electroconvulsive therapy (ECT) in Sweden's psychiatric institutions during the 1940s marked a significant development. While ECT remains a recognized treatment for certain psychiatric disorders today, its early application was largely experimental, often performed without patient consent under ethically questionable circumstances (Shorter & Healy, 2007). Between 1944 and 1964, approximately 4,500 lobotomies were conducted in Sweden to treat severe psychiatric conditions, particularly schizophrenia and aggressive behavior (Ögren & Sandlund, 2005). The introduction of chlorpromazine (Hibernal) in 1955 significantly altered psychiatric treatment, reducing reliance on ECT and psychosurgery and contributing to Sweden's deinstitutionalization movement. The drug remained available in Sweden until 2007 (Wetterberg, 2012).

The process of deinstitutionalization, characterized by the closure or reduction of psychiatric hospital beds, began in the United States in the 1960s and soon spread to other countries, including Sweden, where it started in the 1970s (Bülow et al., 2022). This shift aligned with global trends in anti-psychiatry and deinstitutionalization (Cooper, 1967; Szasz, 1960). In Sweden, psychiatric care was reorganized through a sector-based model (Forslund et al., 2020). Around the same time, psychotherapy, especially psychoanalysis, began to play a more significant role in forensic psychiatry. The Quick case exemplifies the risks of controversial psychiatric practices, showing how psychotherapy, repressed memory theory, and the unrestricted prescription of drugs contributed to false murder confessions. The individual at the centre of the case fabricated stories, leading to what is known as therapy-induced false confessions, further compounded by benzodiazepine use. In some cases, therapists requested that physicians stop administering medication to the patient so that the patient could access and connect with their emotions and repressed memories (Stridbeck, 2020).

A major legislative change came in 1992 with the enactment of the Swedish Compulsory Psychiatric Care Act (LPT), which introduced stronger legal protections for patients and aimed to minimize coercive measures. Studies analyzing this law suggest a trend toward reducing compulsory treatment and restraints (Swartling, 1998). The reform emphasized proportionality and necessity, ensuring

that involuntary measures were only employed when absolutely required (Socialstyrelsen, 2024). Research indicates that Sweden's legal reforms contributed to a gradual decline in the use of seclusion and other restrictive interventions (Kjellin, 1997).

Despite these reforms, recent research has revealed structural shortcomings within Sweden's forensic psychiatric services, highlighting instances of systemic neglect (Voldby et al., 2022; Wangmo et al., 2021). These findings underscore the need for critical and holistic approaches to care, as well as increased research efforts (Howner et al., 2018).

In 2021, the European Committee for the Prevention of Torture and Inhuman or Degrading Treatment or Punishment (CPT) conducted an inspection of Swedish forensic psychiatric facilities. Their report identified deficiencies such as inadequate resources, staffing imbalances, and poor living conditions in several forensic units (Council of Europe: Committee for the Prevention of Torture, 2022). These issues indicate ongoing systemic neglect, failing to meet established standards of care and basic human rights protections. Across Europe, forensic mental health services continue to face challenges, including unaddressed patient needs, policy gaps, and limited funding (Tomlin & Völlm, 2022). Addressing these concerns requires coordinated efforts grounded in clinical research and well-structured legislation.

Over the past decade, forensic psychiatry has placed increasing emphasis on patient participation, recognizing the importance of engaging and effective treatment approaches (Selvin et al., 2016; Söderberg et al., 2022; Revelj et al., 2023; Lindskog et al., 2024). Simultaneously, research and clinical practice have explored innovative methods for managing aggression, acknowledging the shortcomings of traditional interventions. In this context, technological advancements, particularly virtual reality (VR), present new opportunities for immersive and adaptable treatments. By simulating controlled environments, VR-based interventions can improve patient engagement, provide real-time feedback, and bridge the gap between theoretical evidence and practical application in forensic and other psychiatric settings.

Virtual Reality

Jaron Lanier, often recognized as the "Father of Virtual Reality," is an American computer scientist, musician, and author whose pioneering work in the 1980s significantly shaped the field of VR. Lanier is credited with popularizing the term "Virtual Reality", establishing it as a distinct technological domain with transformative applications. While earlier pioneers such as Morton Heilig, who developed the Sensorama in the 1950s, and Ivan Sutherland, who created the first head-mounted display (HMD), the "Sword of Damocles", in 1968, made significant

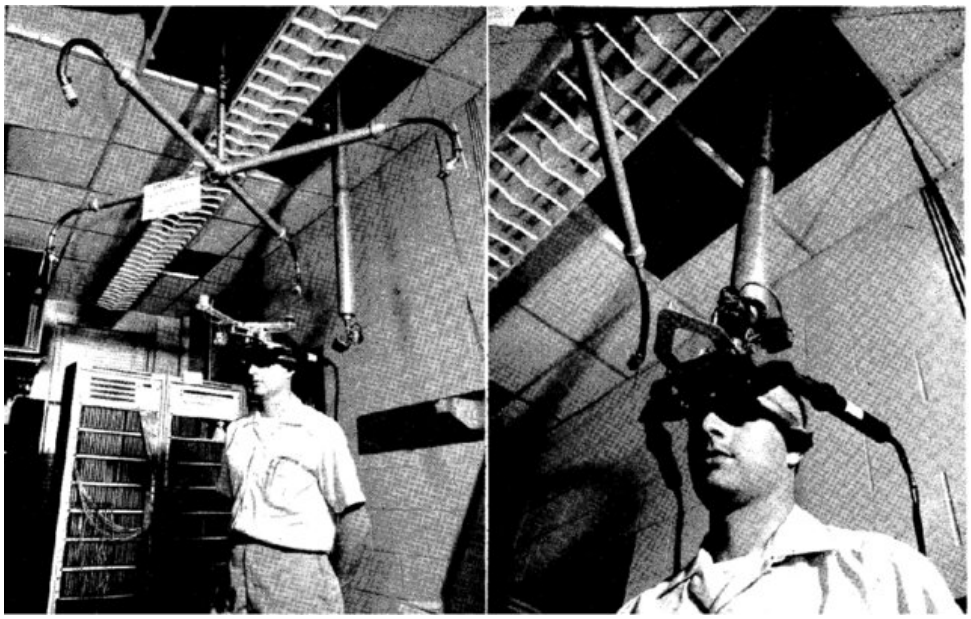
contributions to immersive technology, Lanier's work at VPL Research played a crucial role in making VR accessible and commercially viable (Heilig, 1962; Sutherland, 1968).

In 1984, Lanier co-founded VPL Research, the first company to commercialize VR products. Among his most influential contributions were the development of the Data Glove, which enabled users to interact with virtual environments using hand gestures, and the EyePhone, one of the earliest VR headsets designed for immersive experiences. These innovations provided the technological foundation for modern VR systems (Lanier, 2017).

Over the years, VR has evolved from conceptual frameworks and rudimentary technologies into a sophisticated field with applications in various disciplines. The development of VR was made possible through the integration of several key components, including HMDs, motion tracking, computer graphics, audio feedback, and networking. The early developments of these components, citing pioneering research and technological milestones that laid the foundation for contemporary VR systems. The initial components of VR—visual displays, motion tracking, real-time graphics, audio feedback, and networking—have evolved significantly over the past decades. The contributions of pioneers such as Ivan Sutherland, Morton Heilig, and Myron Krueger, along with advancements in military and academic research, have paved the way for modern VR technologies. These historical developments highlight the interdisciplinary nature of VR, merging computer science, engineering, and human perception research to create ever-more immersive experiences (Harris, 2019; Alce et al., 2022).

The development of VR

One of the fundamental components of VR is HMD, which provides an immersive visual experience. The concept of stereoscopic vision was first explored in the 19th century with stereoscopes that presented separate images to each eye, creating a perception of depth (Heilig, 1962). Morton Heilig's Sensorama (1962) was one of the earliest attempts at a multisensory VR experience, incorporating stereoscopic 3D visuals, sound, vibrations, and even olfactory stimuli (Heilig, 1962). A significant advancement came with Ivan Sutherland's Sword of Damocles (1968), which is often considered the first true VR headset (see Figure 1). This system used a mechanical tracking arm to detect head movements and displayed basic 3D wireframe graphics (Sutherland, 1968). Though bulky and limited, this device introduced the core idea of immersive visual feedback in VR.



Figur 1. Ivan Sutherland's Sword of Damocles (1968).

For VR to be truly immersive, motion tracking and interaction were necessary. The earliest forms of motion tracking were mechanical tracking systems, such as the Sword of Damocles, which relied on a ceiling-mounted arm to track head movement. In the 1980s, optical and magnetic tracking systems were developed, allowing for greater freedom of movement. One notable innovation was the DataGlove in the 1980s, which used fiber optic sensors to track finger movements and enable hand interaction within virtual environments (Zimmerman et al., 1987). Magnetic tracking, introduced by Polhemus in 1969, refined VR motion capture by utilizing electromagnetic fields to determine the position and orientation of a user's head and hands. These early tracking systems laid the groundwork for modern inside-out and outside-in tracking methods used in current VR headsets (Raab, 1979).

The development of real-time 3D graphics was crucial for VR. Ivan Sutherland's Sketchpad (1964) was one of the first programs to allow interactive graphical manipulation, demonstrating the potential for computer-generated environments. During the 1970s and 1980s, NASA and the U.S. military played significant roles in advancing VR graphics, particularly for flight simulators and astronaut training (Furness, 1986). Real-time rendering became possible with the rise of Silicon Graphics workstations in the 1980s, which introduced powerful 3D visualization tools that laid the foundation for modern graphical processing units (Clark, 1982).

Auditory cues are another key component of immersive VR. The concept of binaural audio, which creates a 3D spatial soundscape, was first implemented in experimental VR systems in the 1970s (Begault, 2000). The Cave Automatic Virtual Environment (CAVE), developed in 1992, further enhanced immersion by surrounding users with high-resolution projected images and synchronized 3D audio (Cruz-Neira et al., 1993). Haptic feedback, which allows users to "feel" virtual objects, was also introduced in the 1980s. The Force Feedback DataGlove enabled users to interact with virtual objects by providing resistance and vibrations (Burdea, 1996). These early innovations led to modern haptic gloves and controllers in contemporary VR systems.

Early VR systems were often single-user experiences, but researchers soon explored multi-user environments. Myron Krueger's Videoplace (1970s) was one of the first systems to allow users to interact with virtual objects without wearing any hardware, using cameras and projections instead (Krueger, 1996). By the 1990s, VR networking capabilities had advanced significantly. Virtuality, an early arcade-based VR system, introduced multiplayer VR gaming, while military and academic projects explored collaborative virtual environments for remote training and research (Mazuryk & Gervautz, 1996). These early networked VR systems set the stage for today's virtual collaboration platforms and social VR spaces.

Presence, immersion, and cybersickness in VR

VR is defined by its ability to construct immersive digital environments that foster a deep sense of presence, the psychological phenomenon of feeling physically situated within a virtual space (Bailenson, 2018). Achieving this sense of presence relies heavily on immersion, which describes the extent to which VR technology engages a user's sensory modalities. However, as immersion intensifies, the likelihood of cybersickness conditions like motion sickness caused by sensory conflicts also increases. Understanding the intricate relationship between presence, immersion, and cybersickness is essential for optimizing VR technology while ensuring user comfort and usability.

Presence in VR is a cognitive state wherein users perceive themselves as being part of the virtual environment, despite being fully aware of their actual physical surroundings. This phenomenon is primarily influenced by three interrelated factors (Slater & Wilbur, 1997): Immersion, the degree of sensory fidelity provided by the VR system, influencing how convincingly the virtual world is perceived. Interactivity, the extent to which users can dynamically manipulate and influence the virtual environment in real-time, reinforcing the illusion of direct engagement. Realism, the accuracy with which the virtual world simulates real-world experiences, incorporating lifelike visual, auditory, and haptic elements. A strong sense of presence significantly enhances VR applications across various fields. In therapeutic settings, such as exposure therapy for anxiety disorders, presence plays

a crucial role in patient engagement and treatment efficacy (Maples-Keller et al., 2021). Similarly, in education, immersive learning environments leverage presence to boost knowledge retention and student engagement (Wang & Huang, 2025).

Immersion refers to the technological and design characteristics that fully engross a user's senses, thereby strengthening the experience of presence. Higher levels of immersion generally result in a more compelling VR experience, but if improperly calibrated, they can also contribute to cybersickness. Key Components of Immersion: hardware capabilities, high-resolution displays, expansive fields of view (FOV), low-latency rendering, and high frame rates collectively enhance visual fidelity and responsiveness (Bowman & McMahan, 2007). Multisensory Integration, incorporating haptic feedback, spatial audio, and realistic environmental cues deepens immersion by mimicking real-world sensory interactions. Realistic Interactions, advanced motion tracking, physics-based simulations, and intuitive object manipulation heighten the sense of control and engagement.

Despite its numerous advantages, VR can induce cybersickness, a condition triggered by sensory conflicts, primarily between the visual and vestibular systems. Symptoms of cybersickness include nausea, dizziness, headaches, and disorientation, which can undermine the user experience and limit prolonged engagement. Some common causes of cybersickness are latency issues, i.e. delays between user actions and system responses disrupting the illusion of seamless presence, leading to discomfort. Motion-vestibular conflicts, i.e. disparities between perceived motion in the virtual world and actual bodily movement cause sensory mismatches, may trigger discomfort. Frame rate instability, where frame rates below 90 Frames Per Second contribute to perceptual lag, exacerbating visual fatigue and sickness (Stanney et al., 2020).

Strategies to mitigate cybersickness include several key approaches. One effective method is dynamic FOV adjustment, where peripheral vision is gradually reduced during rapid motion. This minimizes sensory conflicts and enhances overall comfort. Hardware optimization also plays a crucial role, using high-refresh-rate displays (90 Hz or higher) and optimizing motion tracking can significantly reduce latency and improve system responsiveness. Environmental design is another important factor. Incorporating static reference points within virtual environments helps users maintain spatial orientation and reduces disorientation. Finally, user acclimation is essential. Gradual exposure to VR experiences allows users to adapt to sensory inconsistencies over time, decreasing the likelihood of cybersickness (LaViola, 2000; Chang et al., 2020).

Striking an equilibrium between presence, immersion, and cybersickness is a persistent challenge in VR development. While maximizing immersion enhances presence, it must be carefully managed to prevent cybersickness and ensure a comfortable user experience. Developers must prioritize technological consistency,

optimize hardware performance, and tailor immersion levels to the specific requirements of each application domain. By doing so, VR can continue to evolve as a powerful tool across diverse fields, from healthcare and education to entertainment and professional training.

VR in forensic psychiatry

Forensic psychiatry faces significant challenges in managing aggression among patients with SMD, personality disorders, and histories of violent behavior (González et al., 2022; Howner et al., 2018; Lee & DiGiuseppe, 2018; Wallinius, 2012). Traditional interventions, such as CBT and pharmacological treatments, have shown effectiveness but often lack real-world applicability and patient engagement. VR has emerged as a promising tool to address these limitations by providing immersive, controlled, and interactive environments for aggression treatment, risk assessment, and staff training (Sygel & Wallinius, 2021). VR-assisted interventions enable forensic psychiatric patients to engage in structured, interactive simulations that replicate high-risk scenarios. These controlled environments allow patients to practice de-escalation strategies, impulse control, and adaptive coping mechanisms without real-world consequences (Geraets et al., 2022). Research has demonstrated that immersive exposure in VR increases emotional engagement and facilitates learning, making it an effective alternative or complement to traditional therapies (Rus-Calafell et al., 2020; González Moraga et al., 2022; Bell et al., 2024).

Empirical evidence indicates that virtual reality (VR) can be an effective tool for reducing aggression among forensic psychiatric patients. Research has shown that individuals who participate in VR-assisted aggression prevention training demonstrate notable reductions in violent behavior and improvements in emotional regulation compared to those receiving standard care. Additionally, VR-based interventions contribute to increased patient engagement and adherence to treatment due to their interactive and immersive qualities. Recent advancements in this field, including the development of Virtual Reality Aggression Prevention Training (VRAPT) (Tuente et al., 2018; Tuente et al., 2020; Ivarsson, 2023; González et al., 2024), highlight key components of VR-assisted aggression treatment, which are outlined below.

Emotion Recognition Training: Patients learn to identify and interpret emotional cues in virtual characters, improving social cognition and reducing misinterpretations that may lead to aggression (Geraets, 2021).

Cognitive Restructuring Exercises: Interactive VR scenarios guide patients through reframing maladaptive thoughts and reducing hostile attribution biases, both key contributors to aggressive behaviors (Verhoef et al., 2021).

Behavioral Skills Practice: Through repeated exposure to social stressors, patients practice non-aggressive responses, enhancing their ability to regulate emotions and employ effective conflict resolution strategies (van der Kruk, 2022).

Real-Time Feedback and Adaptation: VR systems track physiological and behavioral responses, allowing therapists to tailor interventions based on individual patient's needs and progress (Empatica, 2023).

Beyond aggression management, VR has shown promise in assessing and treating conditions such as psychosis, paranoia, and substance abuse (Geraets et al., 2022; Lindner, 2021; Sygel & Wallinius, 2021). VR-assisted exposure therapy allows patients to interact with virtual environments that simulate social settings, helping them confront and manage persecutory delusions in a controlled manner (Freeman et al., 2021; Bell et al., 2024). Patients experiencing psychotic symptoms struggle with reality perception and social engagement, and some with paranoia, something which may be explored with VR-assisted assessments (Hedström et al., 2023; Freeman et al., 2016). VR-assisted CBT interventions help patients reframe delusional beliefs, practice social interactions in a safe environment, and develop coping strategies to manage distressing symptoms (Freeman et al., 2017; Smith et al., 2020). In relation to substance abuse, VR interventions provide simulated exposure to high-risk situations, teaching patients craving management techniques and strengthening relapse prevention strategies (Ghiță & Gutiérrez-Maldonado, 2018; Segawa et al., 2020). Also, VR-enhanced mindfulness programs may be used to guide patients through relaxation techniques, breathing exercises, and grounding strategies to reduce anxiety, improve emotional regulation, and enhance overall well-being (Navarro-Haro et al., 2017; Ma et al., 2023). These VR-assisted interventions contribute to improved treatment engagement, as they create immersive, interactive, and structured therapy sessions tailored to individual patient needs (Slater et al., 2022).

Another possible application for VR in forensic psychiatry could be risk assessments, informing decisions about treatment strategies, security measures, and potential reintegration into society. Traditional risk assessment tools, such as structured professional judgment instruments, actuarial models, and clinical evaluations, provide valuable insights into risk factors but often lack ecological validity. VR offers a novel approach by simulating real-world stressors in controlled environments, allowing clinicians to observe patient responses dynamically (Kouijzer et al., 2024). Unlike hypothetical self-reports or clinical interviews, VR provides immersive scenarios that elicit genuine behavioral and emotional responses (Bouchard et al., 2017). Also, VR might contribute to standardization and objectivity in risk assessments through ensuring consistency across evaluations, reducing inter-rater variability and enhancing reliability (Fromberger et al., 2018). Another component relevant to risk assessments could be integration of physiological metrics such as real-time monitoring of heart rate, electrodermal activity, and gaze tracking, allowing for quantifiable measurements of emotional

arousal and impulse control (Felnhofer et al., 2014; Cornet & Van Gelder, 2023), thus contributing to assessment of high-risk individuals (Fromberger et al., 2018; Tuente et al., 2020; Sygel & Wallinius, 2021). Although VR-assisted risk assessments provide valuable insights, challenges remain in correlating virtual behaviors with real-world aggression potential. Further research is needed to refine assessment models and validate their predictive accuracy in forensic settings.

Beyond person-centered applications, VR could play a critical role in training forensic psychiatric staff. Managing aggression in forensic settings requires rapid decision-making, de-escalation skills, and confidence in high-risk situations. VR-based simulations allow staff members to engage in realistic crisis scenarios, practicing intervention strategies in a safe, controlled environment (Clay et al., 2025). In VR, staff can be exposed to a variety of aggression-related scenarios, enhancing their ability to respond effectively in real-life situations (Silva et al., 2023). Interactive role-playing in VR may reinforce crisis intervention techniques and improve team coordination (Fakhriyah, 2024). By training in a virtual environment, staff members gain experience in aggression management without placing themselves or patients at risk.

Ethical and practical considerations of VR in forensic psychiatry

Jaron Lanier has been an advocate for the ethical development of VR, emphasizing its potential to enhance creativity, foster empathy, and revolutionize science and education while warning of its risks, including surveillance, manipulation, and the erosion of human agency (Lanier, 2014). VR emerges as a powerful complementary tool in forensic psychiatry, offering new possibilities for assessment, treatment, and rehabilitation. While traditional forensic psychiatric care primarily relies on face-to-face therapy, pharmacological interventions, and controlled environments, VR introduces immersive, interactive, and controlled simulations that enhance these standard approaches. It provides a safe and repeatable way to expose patients to challenging situations while collecting objective data on their behaviors, emotional responses, and physiological reactions. However, its implementation raises several ethical and practical concerns that must be carefully addressed to ensure its responsible and effective use.

One of the key ethical concerns in using VR in forensic psychiatry is informed consent. While this concept is primarily associated with research, it is equally crucial in clinical applications of VR. Forensic psychiatric populations often include individuals with impaired cognitive or decision-making abilities, making it essential to ensure truly voluntary participation (Appelbaum et al., 2004). An additional challenge is that individuals may not fully grasp what a VR experience entails or how their reactions within this environment could influence decisions about their care. VR can elicit strong emotional and physiological responses, some of which may be involuntary (Slater et al., 2009). This raises important ethical questions

regarding autonomy, the potential for coercion, and the clinical implications of these responses (Hem et al., 2018). Furthermore, VR-assisted interventions may expose patients to distressing scenarios, highlighting the need for clear communication about their purpose, potential risks, and benefits. Research underscores the importance of transparent patient education and rigorous ethical oversight in such applications (Slater et al., 2020; González Moraga et al., 2022). Moreover, forensic settings often involve elements of coercion, further complicating the issue of autonomy. Ethical VR programs must prioritize non-coercion, ensuring that patients make fully informed decisions about their participation (Ticknor, 2019).

Another major concern is data privacy and security. VR technology collects extensive biometric and behavioral data, including physiological responses and emotional reactions. This type of information has been misused without users' knowledge, as seen in cases like Cambridge Analytica and Facebook (Kaiser, 2019; Frenkel & Kang, 2021). Ensuring the confidentiality and ethical use of this data is critical, particularly in forensic environments, where misuse could lead to unfair legal or administrative decisions. Strict compliance with data protection regulations and the establishment of ethical guidelines are necessary to prevent breaches and the misuse of sensitive patient information.

Accessibility and feasibility also pose practical challenges. Although VR has become more affordable, high-quality systems require substantial investment in hardware, software, and staff training. Institutions with limited resources may struggle to adopt VR-based interventions, potentially exacerbating disparities in forensic mental healthcare (Kouijzer et al., 2023). Cost-effective solutions and scalable implementation strategies must be explored to ensure equitable access to VR technologies across different forensic settings.

Swedish forensic institutions have been at the forefront of integrating VR to enhance therapeutic interventions while maintaining high ethical standards. By offering immersive training for staff, personalized treatment for patients, and more precise risk assessment tools, VR has the potential to improve rehabilitation outcomes without compromising safety. As VR technology continues to evolve, its ethical and equitable implementation will remain critical to its success in forensic psychiatry. Future research must focus on refining ethical frameworks, strengthening privacy safeguards, and expanding access to ensure that VR enhances, not undermines, the rights and well-being of forensic psychiatric patients.

Aims

General Aim

The aim of this thesis is to explore the prerequisites for, and outcomes of, virtual reality-assisted psychological treatment of aggression among violent offenders in forensic settings. Specifically, the thesis seeks to identify the necessary conditions for the effective implementation of such treatment.

Specific Aims

I. Examine the interrelationships between aggressive antisocial behaviors, psychopathic traits and intelligence in young violent offenders in the Swedish Prison and Probation Service (Study I)

II. Describe the revision of a new, VR-assisted psychological treatment of aggression for violent offenders in forensic settings (Study II)

III. Describe the treatment content of the new VR-assisted psychological treatment of aggression for violent offenders, as depicted through the perspectives of patients and therapists in a maximum-security forensic psychiatric setting (Study III)

IV. Examine the development of occurrence and severity of aggressive behaviors, as observed by forensic psychiatric staff, before, during, and after VR-assisted psychological treatment of aggression for violent offenders (Study IV)

V. Describe forensic psychiatric patients' experiences of VR-assisted psychological treatment of aggression (Study V)

Methods

Study Design

This thesis[1] is based on three types of data: data from the Development of Aggressive Antisocial Behavior Study (DAABS; Study I) from the Swedish Prison and Probation Services, a theoretical revision of a VR-assisted aggression treatment (Study II) and clinical data from forensic psychiatric patients at a maximum-security clinic in Sweden (Studies III–V). See Table 1 for overview of study methods.

Table 1. Overview of study methods

Study	Study I	Study II	Study III	Study IV	Study V
Participants	N = 269 young violent offenders	N/A	N = 6 therapists N = 7 forensic psychiatric patients	N = 7 forensic psychiatric patients	N = 7 forensic psychiatric patients
Procedure	Informed consent, File reviews, Clinical assessment, Self-reports	Theoretical and practical revisions of VR-assisted aggression treatment	Informed consent, Treatment workbooks	Informed consent, File reviews, Structured staff observations	Informed consent, Semi-structured interviews
Instruments	LHA, PCL-R, WAIS-III	N/A	N/A	SDAS-9	N/A
Data Analysis	Spearman's rho, Ordinary least squares regressions	N/A	Manifest inductive content analysis	Descriptive analyses	Manifest inductive content analysis

Note. LHA, Life History of Aggression; PCL-R, Psychopathy Checklist-Revised; SDAS-9, Social Dysfunction and Aggression Scale-9; WAIS-III, Wechsler Adult Intelligence Scales – Third Edition.

[1] This thesis framework has been partially produced with the assistance of the generative AI model ChatGPT4. ChatGPT4 has been used to help merge, organize, and refine the coherence of the text, as well as to generate images and for identifying further references. However, all generated suggestions have been processed and reviewed by the PhD student, taking full responsibility for its quality and accuracy.

Study I

Participants

The Development of Aggressive Antisocial Behavior Study (DAABS; Wallinius et al., 2016) comprises a nationally representative cohort of male offenders in emerging adulthood (18-25 years of age) who served time between March 2010 and July 2012 at any of nine correctional facilities in the Western region of the Swedish Prison and Probation Service for committing violent (including "hands-on" sexual) offences. The region includes the full range of prisons, from high-security to open facilities, and serves approximately one-fifth of the total national cohort. As there is only one small, specialized women's prison in the defined area, female offenders were not included in the DAABS.

Exclusion criteria were: poor knowledge of Swedish, defined as requiring an interpreter for full participation, and a duration of stay in prison of four weeks or less. Out of a total of 421 inmates, 23 (5%) were excluded due to weak language skills, and 19 (5%) due to insufficient placement duration. Of the remaining 379 inmates, 109 (29%) declined participation in the study, and 1 was excluded due to double participation, leaving a final study group of 269 participants (71% of all who met inclusion criteria). The age range was 18 years and 7 months to 25 years and 11 months, with a mean age of 22.3 years (SD = 1.9).

To assess the representativeness of the included group, non-personal basic information was provided for individuals who were excluded or chose not to participate. Those excluded due to insufficient Swedish skills (n = 23) had a higher rate of sexual index crimes (n = 12; 52%). Among those who declined participation (n = 109), 15 offenders (14%) had been sentenced for sexual violent crimes, and 94 offenders (86%) for non-sexual violent crimes. No significant differences in mean age or type of index crime (general violent or sexual violent) were observed between participants and non-participants. The cohort is therefore considered representative of young male violent offenders within the Swedish Prison and Probation Service.

Procedures

Participants provided informed consent and underwent a full-day clinical assessment, which included file reviews, diagnostic evaluations, self-report measures, neuropsychological testing, and DNA saliva sampling. All assessments were conducted by licensed psychologists trained in the study's specific methodologies.

Measures

The Psychopathy Checklist-Revised (PCL-R; Hare, 2003) is a 20-item clinical rating scale designed to assess the lifetime presence of psychopathic traits. Each item is scored on a three-point scale (0 = not present, 1 = present to some degree, 2 = definitely present), with a maximum total score of 40. This study applied the four-facet model proposed by Neumann et al. (2013), which includes the following facets: Interpersonal, superficial charm, grandiose sense of self-worth, pathological lying, and manipulative behavior; Affective, lack of remorse or guilt, shallow affect, lack of empathy, and failure to take responsibility for one's actions; Lifestyle, need for stimulation, parasitic lifestyle, unrealistic long-term goals, impulsivity, and irresponsibility, and Antisocial, poor behavioral controls, early behavior problems, juvenile delinquency, revocation of conditional release, and criminal versatility. Additionally, the total PCL-R score was considered. In the DAABS cohort, the prevalence of psychopathy ranged from 15.2% (using a cutoff score of 25) to 4.2% (with a cutoff score of 30). Complete PCL-R data were available for 262 offenders.

The Life History of Aggression (LHA; Brown et al., 1982) is a questionnaire originally developed to study the neurobiological correlates of aggression and is used to assess lifetime aggressive antisocial behaviors. The LHA measures the frequency of 11 different aggressive and antisocial behaviors, rated on a five-point scale based on the number of occurrences since adolescence (0 = no events; 5 = too many to count), with a maximum total score of 55. In this study, the LHA was administered as a clinician-rated instrument, with ratings based on all available information from interviews and case files. If an offender reported more aggressive antisocial behaviors during interviews than documented in files, and the information was deemed credible by the assessor, these reports were included in the analyses. To ensure inter-rater reliability, final LHA scores were assigned through consensus between the assessor and a senior clinician with extensive experience in the field. The LHA consists of three subscales: Aggression, Self-Directed Aggression, and Antisocial Behavior (Coccaro et al., 1997). The Aggression subscale assesses behaviors such as temper tantrums, physical fights, verbal aggression, assaults on people or animals, and property damage. The Self-Directed Aggression subscale includes self-injurious behaviors and suicide attempts, while the Antisocial Behavior subscale captures school disciplinary issues, conflicts with supervisors at work, and antisocial behaviors with or without police involvement. The total LHA score represents an individual's lifetime history of aggressive antisocial behaviors by summing the three subscales. In this study, the Self-Directed Aggression subscale was excluded from subscale analyses, as it focuses on behaviors not strictly classified as aggressive antisocial acts. Complete LHA data were available for 267 offenders. Further descriptive statistics on LHA assessments in the DAABS cohort can be found in Wallinius et al. (2016).

Intellectual functioning was assessed using the Wechsler Adult Intelligence Scale – Third Edition (WAIS-III; Wechsler, 2002). In this study, the General Ability Index (GAI; Tulsky et al., 2001) was calculated as an alternative measure of global intelligence. The GAI is derived from six subtests, divided into two indices: Verbal Comprehension Index (VCI), includes the subtests Information, Similarities, and Vocabulary, which assess verbal reasoning and knowledge; Perceptual Organization Index (POI), Includes the subtests Block Design, Matrix Reasoning, and Picture Completion, measuring non-verbal reasoning and spatial processing. Complete WAIS-III data were available for 264 offenders in the study.

Data Analysis

Data were anonymized, coded, and analyzed using IBM SPSS Statistics 22. Given that the data did not follow a normal distribution, as indicated by the significant Kolmogorov–Smirnov normality test, non-parametric statistical methods were applied when appropriate. To assess bivariate correlations, Spearman's rho was used to examine the relationships between psychopathic traits and intelligence, as well as between psychopathic traits and aggressive antisocial behaviors. Ordinary least squares (OLS) regression analyses were conducted to determine whether intelligence (WAIS-III GAI) moderated the relationship between the four PCL-R facets and aggressive antisocial behaviors (LHA total score), with separate models for each facet.

Before conducting the regression analyses, residuals were examined and confirmed to follow a normal distribution. To minimize multicollinearity within the models, all independent variables were centered prior to analysis and the creation of the moderator variable, following the recommendations of Iacobucci et al. (2016). Centering was preferred over standardization to allow for the usual interpretation of regression coefficients. Across all models, variance inflation factor (VIF) and tolerance values remained within acceptable limits, indicating no problematic multicollinearity. Due to the highly skewed distribution of scores in the Interpersonal facet, two separate regression models were calculated for this facet. Model 1 followed the same structure as the other facets, Model 2 introduced two additional independent variables: A dichotomized variable for the Interpersonal facet (0 = score of 0, 1 = score > 0). A moderator variable, created as the interaction between the dichotomized Interpersonal variable and GAI scores. This approach was used to differentiate between the presence of any interpersonal psychopathic traits (dichotomized variable) and the degree of these traits (original Interpersonal facet score) to assess their influence on moderation effects. However, it is important to note that Model 2 resulted in slightly higher multicollinearity, though it remained within acceptable limits.

Study II

This study describes how the lessons learned from the first randomized controlled trial of Virtual Reality Aggression Prevention Training (VRAPT; Tuente et al., 2018, 2020) have been applied to further develop the method and discuss challenges and future directions for VR-assisted treatment of aggression in forensic settings (González Moraga et al., 2022). Since Study II is a perspective article, the original VRAPT (Tuente et al., 2018) will be described in the methods section, while the revised version will be presented in the results section of this thesis.

VRAPT

VRAPT was originally developed in the Netherlands through a collaboration between researchers and clinicians as a new, manualized psychological intervention for forensic psychiatric patients exhibiting aggression-related difficulties (Tuente et al., 2018). Initially, VRAPT was grounded in the Social Information Processing (SIP) model (Crick & Dodge, 1994), which conceptualizes aggression as a result of cognitive distortions, such as hostile attribution bias (Tuente et al., 2018; 2020). The VRAPT intervention was designed to guide patients through the different steps of a simplified SIP model, helping them process social cues and regulate their behavioral responses. These steps included: (1) encoding social information, (2) interpreting its meaning, (3) selecting an appropriate goal, (4) generating possible responses, (5) evaluating response options, and (6) enacting a behavioral reaction (see Figure 2).

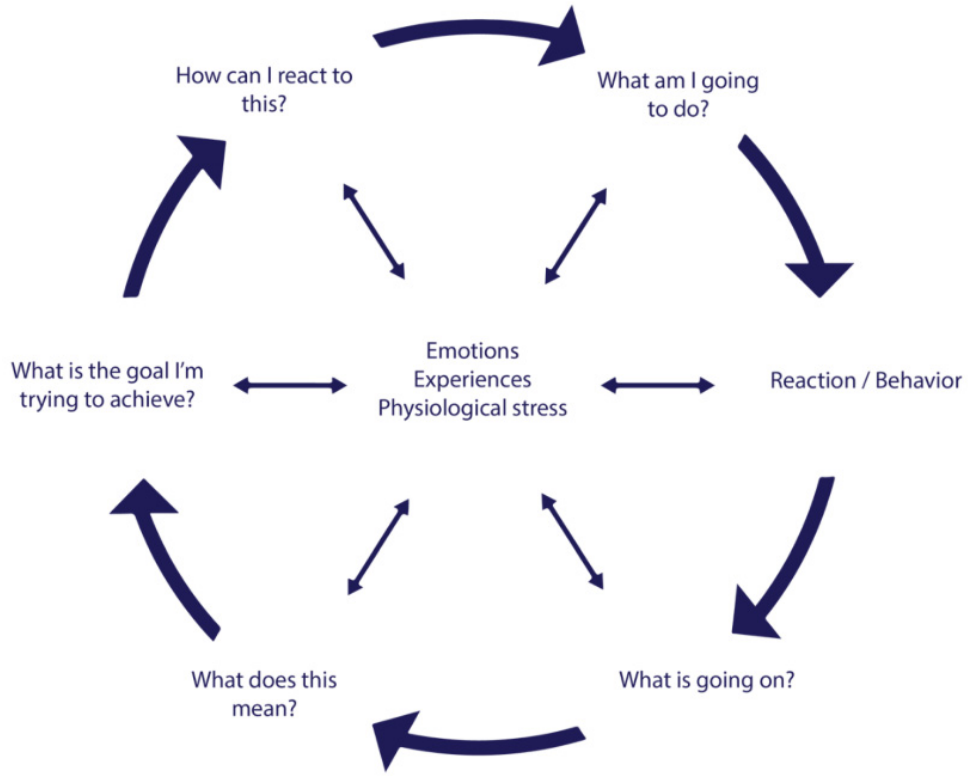


Figure 2. Adapted Social Information Processing model (Tuente et al., 2018).

In VRAPT, participants engaged in immersive, interactive role-play scenarios within a VR environment over the course of 16 sessions, each lasting 45–60 minutes, with a frequency of one to two sessions per week. The initial five sessions emphasized emotion recognition skills, while sessions six to fifteen focused on emotion regulation and aggression management during therapist-led virtual role-plays. Starting with session six, physiological markers such as skin conductance and heart rate variability were incorporated, providing real-time biofeedback to both the participant and therapist. This dynamic setup allowed for the immediate tailoring of therapeutic interactions, enabling clinicians to observe and intervene in aggressive behaviors as they emerged in the VR environment.

A multi-site randomized controlled trial (RCT) evaluating VRAPT revealed statistically significant improvements in secondary outcomes, including anger regulation, impulsivity, and hostility. However, no statistically significant reductions in aggressive behaviors were reported by participants or observed by staff, either post-treatment or at follow-up (Tuente et al., 2020). These findings

suggested that, while VRAPT was a viable aggression treatment tool in forensic psychiatric settings, revisions to the intervention and the assessment methods used to measure its efficacy were warranted.

In response to the RCT findings, VRAPT underwent substantial modifications through a collaboration with the originators of the intervention and the persons involved in this PhD project. This collaboration was initiated during a two-day on-site workshop, gathering the originators and the persons involved in this project and going through preliminary results from the RCT to reach conclusions on crucial revisions. A literature review was conducted regarding broader theoretical models of aggression by the author for this thesis and his main supervisor, rendering a new methodological background. Furthermore, in consultations with collaborators, the CBT approach in the intervention was clarified. Finally, a revised VRAPT was presented to, and approved by, the originators and collaborators in this project. Since then, this revised VRAPT has been tested in pilot studies across forensic psychiatric hospitals and prison settings (González Moraga et al., 2024; Ivarsson et al., 2023).

Study III

Participants

The study included seven forensic psychiatric patients (six males and one female) with a mean age of 36 years (range: 22–46 years), all recruited from a maximum-security forensic psychiatric clinic in Sweden. These participants represented the complete cohort of forensic psychiatric patients who successfully completed the full VRAPT intervention within the framework of a quantitative pilot study. Each participant had undergone a FPE before sentencing and had been diagnosed with a SMD, leading to their placement under forensic psychiatric care.

The inclusion criteria for participation were: (1) ongoing treatment under the forensic psychiatric care legislation, (2) a documented history of aggression and current difficulties with reactive aggression, and (3) completion of VRAPT treatment. Exclusion criteria included: (1) inability to speak or read Swedish, (2) epilepsy, (3) intellectual disability (IQ < 70), (4) severe autism spectrum disorder, (5) acute psychotic state, and (6) security concerns preventing participation.

At the time of participation, psychiatric diagnoses (as documented in medical records) included schizophrenia spectrum disorders and antisocial personality disorder (both n = 4; 57%), substance use disorders (n = 3; 43%), personality disorder – trait specified (n = 2; 29%), as well as borderline intellectual functioning, autism, bipolar disorder, and paraphilia (each n = 1; 14%). As part of the study, workbooks were provided to both patients (N = 6; one participant did not return the

workbook to the research team) and therapists (N = 7). These workbooks were integral to the seven completed VRAPT treatments.

Procedures

The workbooks were collected upon the completion of treatment and analyzed by a master's student in clinical psychology with experience in high-security forensic psychiatry. To ensure a comprehensive understanding of the data, all workbooks underwent multiple reviews.

Rather than analyzing patient and therapist workbooks separately, both were examined concurrently on a treatment-by-treatment basis. This methodological approach enabled a more holistic understanding of each individual intervention while also providing insights into the overarching themes across all seven treatments. Such an approach aligns with the principles of qualitative content analysis, which emphasize the importance of contextual meaning and systematic categorization (Vears & Gillam, 2022).

The initial coding process was conducted by one of the researchers; however, the final categorization and refinement of categories and subcategories were achieved through a consensus-driven approach, ensuring analytical rigor (). The categorized data were then interpreted, culminating in a narrative synthesis that encapsulated the study's findings.

Data Analysis

No specialized software was employed during the analysis, ensuring a fully manual and context-driven approach to qualitative data processing. Following the initial review, preliminary codes were systematically assigned to organize the material into content categories and subcategories. These categories reflected the manifest content with minimal interpretation but varying degrees of abstraction, aligning with the methodological approaches outlined by Graneheim et al. (2017).

Study IV

Participants

Seven participants (6 males, 1 female; mean age = 38.7 years) were recruited from a maximum-security forensic psychiatric clinic. The participants have previously been described in detail in the methods section for Study III.

Procedures

Health professionals at the clinic were informed about the study by research staff, who outlined the inclusion and exclusion criteria and provided details on how to refer potential participants. Referrals were made by the patients' treating psychiatrists. Once referred, eligible participants received both verbal and written explanations about the study and their opportunity to take part. Informed consent was obtained before their inclusion in the study. Weekly observations of health professionals using an observed behaviours rating scale (see Measures) were conducted across three phases: 1. 12 consecutive weeks pre-intervention, 2. during the intervention, and 3. 12 consecutive weeks post-intervention. Additionally, clinical and sociodemographic data were extracted from medical records, and self-reports collected from patients though these details are not included in this study.

All staff observations were conducted by trained ward staff under the supervision of the study's lead researcher.

Measures

File-based data were obtained from medical records in mental healthcare, FPEs conducted by the National Board of Forensic Medicine before sentencing, and court rulings.

The SDAS-9 (Social Dysfunction and Aggression Scale-9; Bech & Bech, 1996) is a well-established observer-rated tool used to assess aggression and social dysfunction in psychiatric and forensic contexts. It enables clinicians to evaluate both the severity and frequency of aggressive behaviors through nine specific items. This instrument is particularly valuable for tracking changes in aggression over time, making it useful for assessing treatment effects, such as those observed in psychopharmacological or behavioral interventions.

In this study, the SDAS-9 was employed as a staff-rated measure, systematically documenting observations of various aggressive behaviors. The scale includes items reflecting different aspects of aggression, such as irritability (e.g., difficulty managing reactions), negativism (e.g., refusal to cooperate), and verbal aggression directed at others (e.g., personal insults). Each item is rated on a 5-point Likert scale, ranging from "absent" to "severely present," yielding a maximum possible score of 45.

Trained staff members on the participants' treatment wards completed the SDAS-9 on a weekly basis to establish baseline data and monitor aggression levels before, during, and after the VRAPT intervention. However, as staff assignments rotated according to the institutional schedule, different trained observers may have rated the same participant at various points throughout the study. Notably, interrater reliability was not assessed in this study. Prior research has indicated that the SDAS-

9 has strong convergent validity and clinical utility in evaluating aggression among forensic psychiatric populations (Kobes et al., 2012).

Data Analysis

For data organization and the generation of descriptive visual representations, IBM SPSS Statistics 29 and R Project version 4.4.2 were employed. Descriptive analyses revealed heterogeneous patterns in the frequency and severity of aggressive behaviors across individuals. The findings are presented through individual case graphs, illustrating the progression of aggressive behaviors as measured by the SDAS-9 throughout the study period. Given the limited sample size, inferential statistical analyses were not conducted due to insufficient statistical power.

Study V

Participants

See Study III for a description of participants.

Procedures

See Study IV for a description of the general procedures for inclusion of participants. Interviews with patients were conducted at the end of the follow-up 12 weeks after completed VRAPT treatment. The interviews were held by a licensed clinical psychologist with expertise in qualitative methodology and experience in high-security forensic psychiatric settings. A semi-structured approach was used, following an interview guide specifically developed for this study.

The interview guide included open-ended questions such as: *"How did VRAPT contribute to your ability to manage aggression?"* and *"How did you experience VRAPT as a treatment intervention?"* Follow-up questions were incorporated based on participants' previous responses to allow for deeper exploration of their experiences.

All interviews were audio-recorded and transcribed for analysis. They were conducted individually within the clinic, except for one case where a staff member was present due to security considerations. The duration of the interviews ranged from 13 to 34 minutes.

Data Analysis

This study employs an inductive approach to qualitative manifest content analysis to explore patients' experiences with the VRAPT intervention. The analysis follows established recommendations for data organization and interpretation in content analysis.

During transcription, the interviews were carefully reviewed multiple times, both through listening and reading, to ensure transcription accuracy and to facilitate a comprehensive understanding of the data. Preliminary codes were then assigned to relevant segments of text. After coding, the data were systematically categorized into content categories and subcategories. A content category represents the manifest content with minimal interpretation but varying levels of abstraction.

The initial coding was conducted by one researcher, after which two researchers independently identified content categories and subcategories. Final categories were refined and determined through a consensus process. Subsequently, the categories were analyzed and synthesized into a narrative summary of the key findings. No software was used in the analysis process.

Ethical Considerations in Forensic Psychiatric Research

Forensic psychiatric patients constitute a particularly vulnerable population due to the intersection of severe mental disorders, compulsory care, and restricted liberty. These factors necessitate rigorous ethical scrutiny in the conceptualization and execution of research (Munthe et al., 2010; Shapiro, 2016). Ethical complexities in this context are further compounded by the dual obligation of forensic psychiatric care: to provide rehabilitative treatment while simultaneously safeguarding societal security (Appelbaum & Lidz, 2012; Söderberg, 2024). Given the dearth of evidence-based interventions for aggression management within Swedish forensic psychiatry, methodologically robust and ethically sound research is essential for improving patient outcomes and advancing public safety (Völlm et al., 2016; Tomlin and Völlm, 2022).

From a broader ethical standpoint, failing to undertake research in this domain may be construed as systemic neglect, whereby forensic psychiatric patients are systematically precluded from benefiting from advances in clinical care. Foundational ethical principles, including beneficence and justice, necessitate that this population be granted access to scientifically validated therapeutic interventions, a goal achievable only through sustained research efforts (World Medical Association, 2013).

To uphold ethical standards, participant inclusion in research was here predicated upon informed, voluntary consent, obtained both verbally and in writing. Given the

cognitive and psychiatric complexities inherent to this population, stringent eligibility criteria were enforced. Only patients evaluated by their treating psychiatrist as possessing the cognitive capacity to provide informed consent were included in Studies III-V. Furthermore, individuals presenting immediate security risk, such as those exhibiting severe aggression beyond clinical containment, were excluded to ensure the safety of both participants and researchers (Shapiro, 2016; Appelbaum et al., 2012).

A continuous assessment framework was implemented to safeguard participant rights. Patients initially deemed ineligible could be reconsidered if their clinical condition improved, thereby fostering an inclusive and ethically responsible research approach.

In accordance with the principles of autonomy and voluntary participation, prospective participants were explicitly informed of their right to withdraw from the study at any time without consequences for their standard forensic psychiatric care. Ensuring comprehension of this right is paramount, as forensic psychiatric patients may erroneously perceive research participation as obligatory due to their institutionalized circumstances. The provision of information through both verbal and written channels, facilitated by research personnel with no prior therapeutic engagement, helped mitigate potential undue influence.

Strict confidentiality measures are imperative in forensic psychiatric research, as breaches of privacy may have severe consequences. To mitigate risks, all collected data were pseudonymized using unique identification codes, with access to personally identifiable information restricted to authorized researchers. Research materials are securely stored within the Research and Development Unit of the Regional Forensic Psychiatric Clinic in Växjö, an entity operating independently from clinical service providers to ensure research objectivity (Munthe et al., 2010). Additionally, compliance with both local and international data protection regulations was rigorously maintained to uphold ethical standards (ALLEA, 2023).

A significant ethical dilemma may arise when research participants disclose ongoing suicidal or violent ideation. While confidentiality remains a cornerstone of ethical research, the duty to protect individuals from immediate harm supersedes confidentiality obligations. In such instances, established clinical risk assessment protocols would have been promptly activated, with relevant clinical personnel informed to conduct an immediate evaluation. Balancing the imperative of confidentiality with the duty to prevent harm necessitates nuanced ethical judgment and underscores the importance of clear procedural guidelines in forensic psychiatric research (World Medical Association, 2023). However, this did not occur during Studies IV-V.

Participants received a modest reimbursement: 200 SEK for participants in Study I and a 99 SEK gift voucher for use at the clinic kiosk upon study completion for participants in Studies III, IV, and V. This compensation was carefully calibrated to

acknowledge the time and effort invested by participants without exerting undue influence or coercion.

Ensuring that forensic psychiatric patients fully understand the implications of research participation is a critical ethical consideration. Given the potential cognitive impairments and psychiatric conditions affecting comprehension, the studies employed multiple strategies to verify informed consent. These included structured interviews assessing participant understanding, simplified written materials, and opportunities for participants to seek clarification at various stages of the recruitment process.

Moreover, a persistent ethical concern pertains to the dissemination of research findings to participants. Given the potential ramifications for treatment and rehabilitation, efforts are made to ensure that study findings are communicated in an accessible manner, thereby reinforcing the ethical commitment to transparency and respect for participants' right to information (Völlm et al., 2016).

VR-Assisted Aggression Treatment: Ethical Considerations

Despite the inclusion of VR-assisted role-plays involving exposure to aggression-provoking stimuli, empirical findings indicate no evidence of increased aggression levels among participants subjected to Virtual Reality Aggression Prevention Training (Tuente et al., 2020). This finding is critical given prior evidence suggesting that inpatient participation in aggression-focused interventions involving role-plays may heighten aggression levels within forensic psychiatric settings and post-discharge (Shapiro, 2016).

The primary advantage of VR-assisted aggression treatment over conventional role-play methods lies in its capacity to facilitate personalized therapeutic interventions. The immersive nature of VR fosters enhanced collaboration and real-time feedback between therapists and participants, allowing role-play scenarios to be tailored to individual needs. This approach enables participants to engage in controlled exposure to aggression triggers while simultaneously practicing adaptive coping strategies, such as emotional regulation, problem-solving, and prosocial behaviors (Munthe et al., 2010).

Nevertheless, VR-assisted interventions present challenges analogous to those encountered in general VR methodologies. A known adverse effect, "cybersickness," can induce dizziness and discomfort, potentially limiting participant engagement (World Medical Association, 2023). If such symptoms arise, therapists employ mitigation strategies, and in cases where symptoms persist, treatment sessions are discontinued. Ethical concerns regarding therapeutic

misconception and security in forensic settings also warrant consideration. To uphold participant safety, individuals posing an immediate, severe risk to themselves or others are excluded from participation. Given that most participants are under compulsory forensic psychiatric care or within the prison system, continuous staff support remains an integral component of treatment delivery (Völlm et al., 2016).

Results

The following sections present the key findings of each study, highlighting their contributions to the understanding of prerequisites for, and outcome of, VR-assisted psychological treatment in forensic settings.

Study I

The study examined the role of intelligence in moderating the relationship between psychopathic traits and aggressive antisocial behaviors in young violent offenders. Given the forensic implications of understanding these associations, the research focused on the four facets of psychopathy as defined by the PCL-R (Interpersonal, Affective, Lifestyle, and Antisocial) and their connections to aggression, as measured by the LHA scale. Additionally, the study evaluated whether intelligence, measured using WAIS-III indices, influences these relationships (see table 2).

The Lifestyle and Antisocial facets exhibited the strongest positive correlations with aggressive antisocial behaviors. The Affective facet demonstrated a weak positive correlation with aggression, aligning with previous research on emotional deficits in psychopathy. The Interpersonal facet was not significantly associated with aggressive antisocial behaviors, suggesting its limited relevance in predicting violent conduct. The Affective facet was negatively correlated with both general (GAI) and perceptual (POI) intelligence scores, though these correlations were weak. No significant relationship was found between psychopathic traits and verbal intelligence (VCI).

Table 2. Associations (Spearman's rho) between psychopathic traits (PCL-R), aggressive antisocial behaviors (LHA) and intelligence (WAIS-III)

	LHA Total score	LHA Aggression	LHA Antisocial Behavior	WAIS- III GAI	WAIS- III VCI	WAIS- III POI	Statistic
PCL-R Interpersonal facet	.059	.037	.091	.040	.008	.078	r_s
	.338	.546	.140	.517	.895	.213	*P*
PCL-R Affective Facet	.184	.183	.190	-.160	-.113	-.147	r_s
	.003	.003	.002	.010	.069	.018	*P*
PCL-R Lifestyle Facet	.466	.398	.495	-.054	-.017	-.080	r_s
	.000	.000	.000	.383	.781	.198	*P*
PCL-R Antisocial Facet	.506	.453	.526	.021	.009	.010	r_s
	.000	.000	.000	.736	.890	.879	*P*
PCL-R Total score	.473	.419	.493	-.054	-.035	-.058	rs
	.000	.000	.000	.387	.573	.354	*P*

.

Intelligence significantly moderated the relationship between the Interpersonal facet and aggressive antisocial behaviors. Individuals with average intelligence (IQ 90–109) displayed a positive association between Interpersonal facet scores and aggression. Individuals with below-average intelligence (IQ < 90) showed an inverse relationship between Interpersonal facet scores and aggression. Despite statistical significance, the explained variance was minimal (2.9%), limiting the practical implications of this moderation effect (see figure 3).

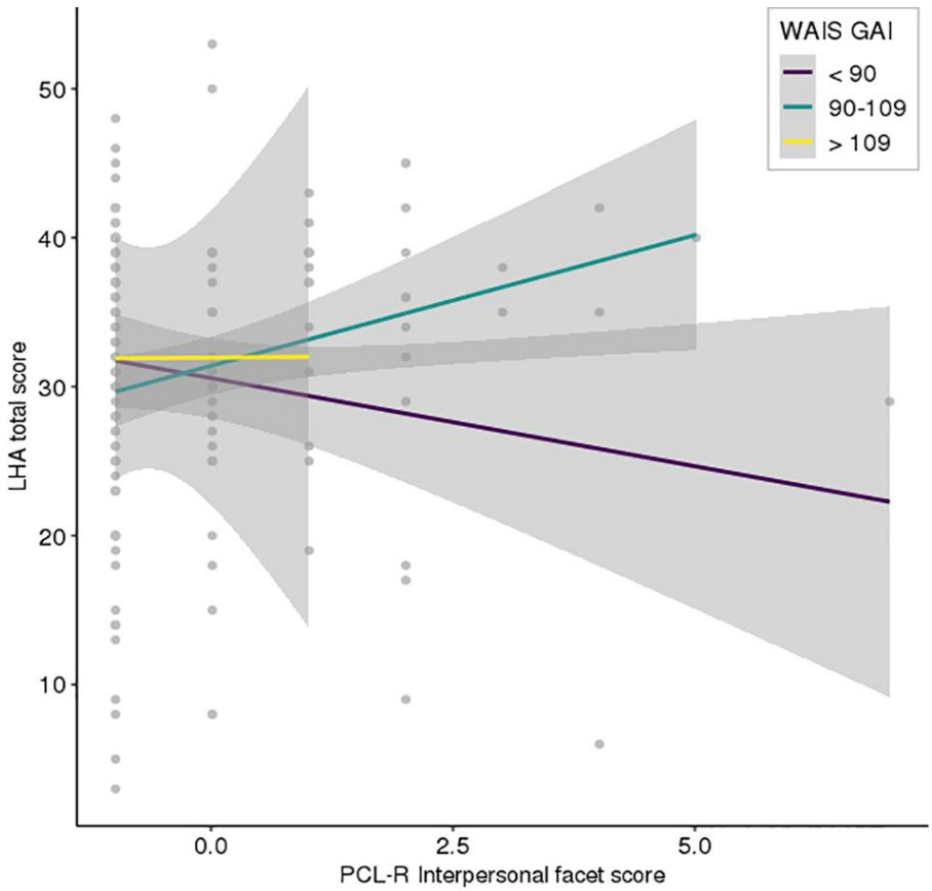


Figure 3. The plotted values for the Psychopathy Checklist-Revised (PCL-R) Interpersonal facet and Wechsler Adult Intelligence Scale – Third Edition (WAIS-III) General Ability Index (GAI) scores are, in accordance with the regression analysis, centered why negative values are possible (González Moraga et al., 2019).

Study II

The target population for VRAPT remained throughout the revisions; individuals struggling with either under- or overregulation of reactive aggression. The revised version, described in Study II, adopts a structured CBT framework and expands its theoretical foundation from the SIP model to the General Aggression Model (GAM) (Anderson & Bushman, 2002; Anderson & Carnagey, 2004; DeWall et al., 2011). The GAM provides a more comprehensive understanding of aggression by considering the interplay between biological predispositions, early life experiences, cognitive patterns, and situational triggers, such as provocation or pain. Furthermore, the model emphasizes the role of self-regulation and cognitive control in mitigating aggressive responses (Barlett & Anderson, 2011; Sestir & Bartholow, 2007).

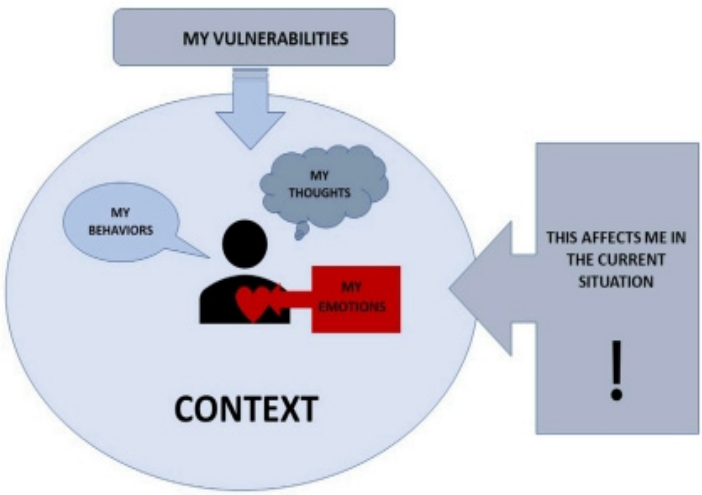
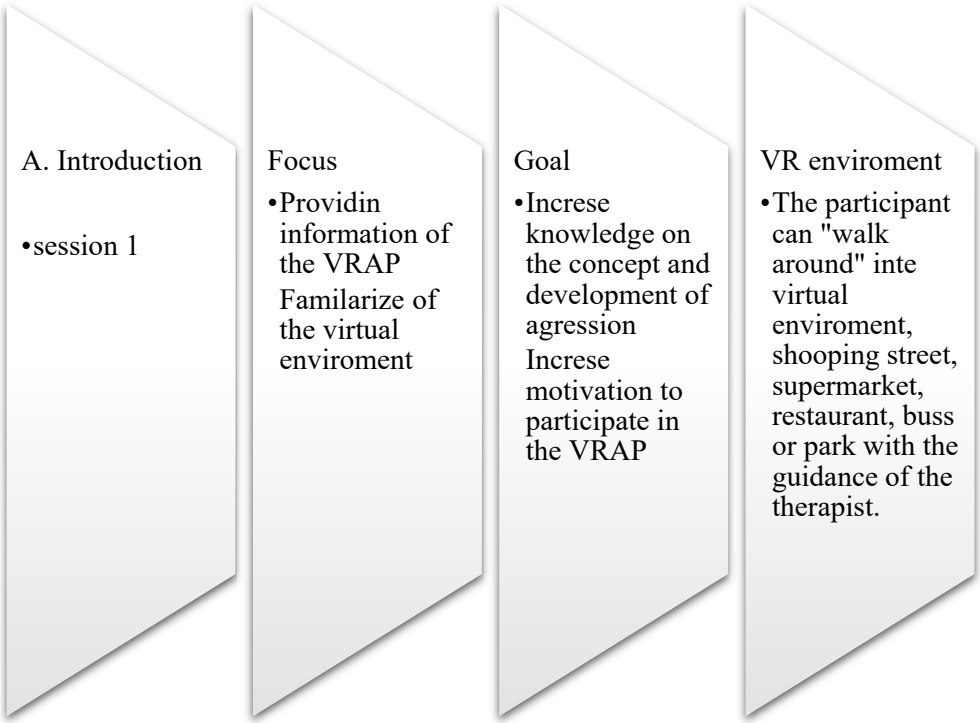


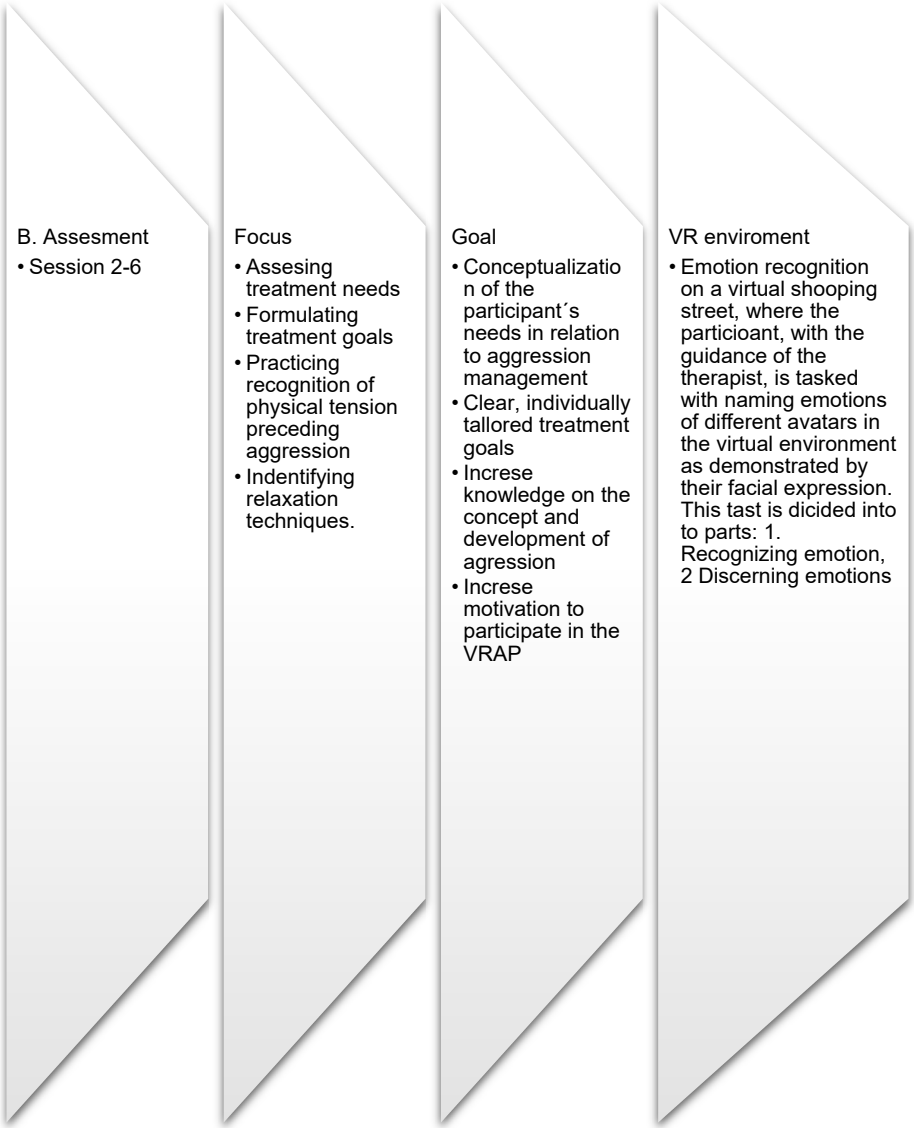
Figure 4. The VRAPT model (González Moraga et al., 2022).

The inclusion of the GAM in VRAPT led to several modifications in session content, broadening the intervention's focus to address both individual vulnerabilities and contextual factors contributing to aggressive behaviors (see figure 4). Additionally, greater emphasis was placed on emotion recognition and regulation, aligning with contemporary research on aggression etiology and intervention. The overarching goal of the revised VRAPT is to enhance participants' understanding of their maladaptive aggression patterns and helping them identify triggers and high-risk scenarios through the structured framework provided by the VRAPT model.

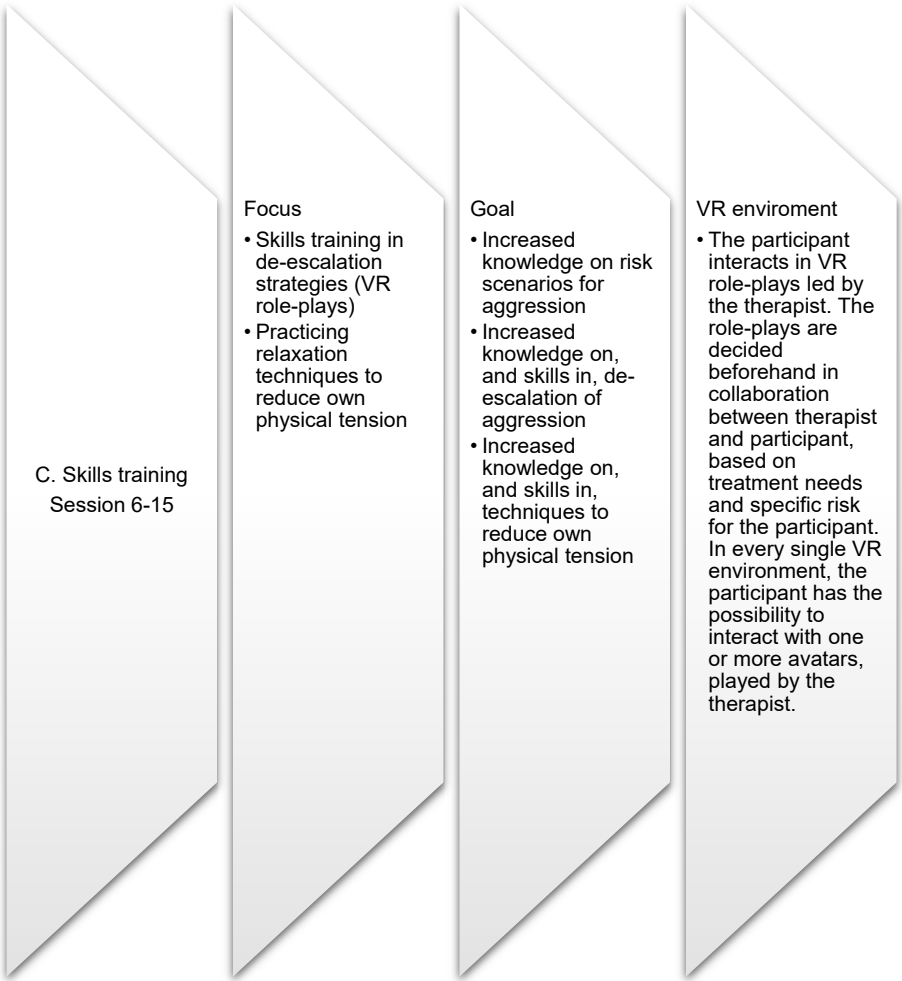
The updated intervention consists of four structured treatment modules (A–D; see figure 5). Module A (Introduction) introduces the VRAPT model, establishes a treatment framework, workbooks and allows participants to familiarize themselves with the VR environment by navigating various virtual spaces.



Module B (Assessment) focuses on emotional recognition and physiological self-awareness. Participants engage in exercises that involve assessing facial expressions of virtual avatars and monitor their own physiological responses during aggression-inducing role-play scenarios.



Module C (Skills Training) involves therapist-led role-plays in which participants practice social skills and aggression regulation. The therapist assumes the role of virtual avatars, utilizing voice modulation and behaviorally provoking responses to elicit and manage aggressive reactions. Throughout Modules B and C, physiological measures (e.g., heart rate variability, skin conductance) are integrated, offering real-time feedback to aid participants in recognizing and controlling physiological arousal.



Module D (Evaluation) consolidates the skills acquired throughout the intervention and facilitates participant reflection on personal progress, supported by the workbook.

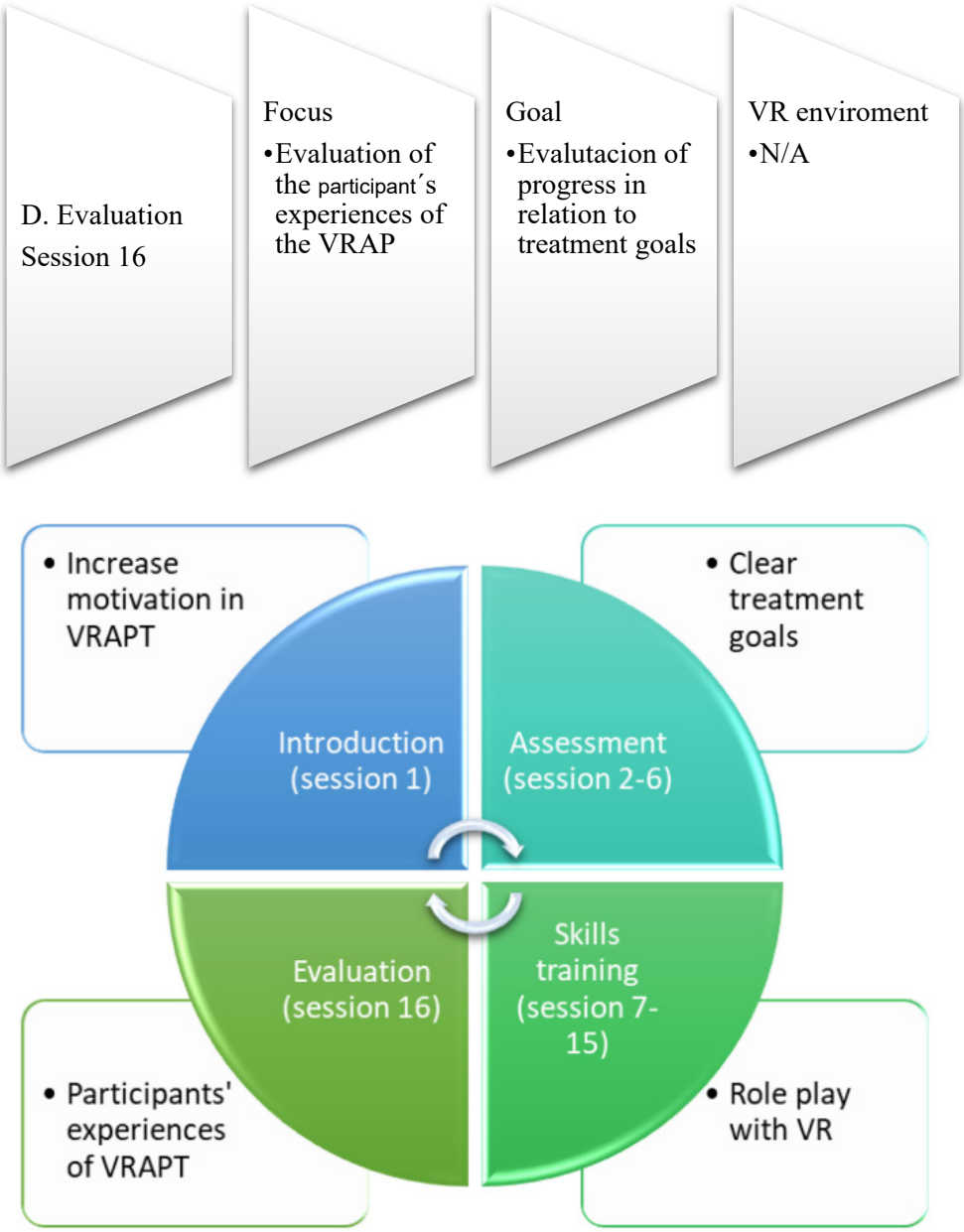
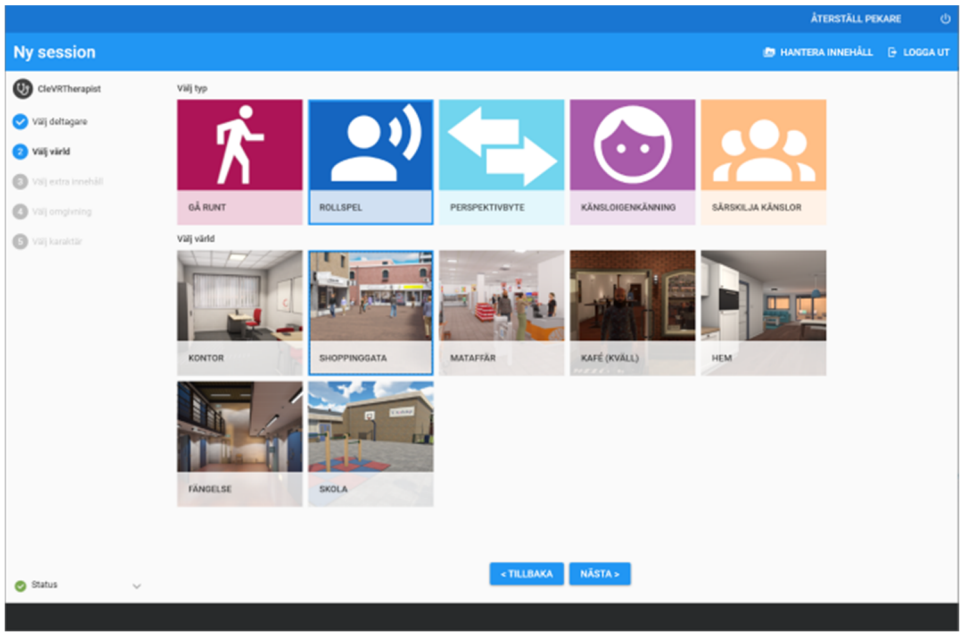


Figure 5. VRAPT four structured treatment modules (González Moraga et al., 2024).

A significant feature of VRAPT is its integration with Social Worlds (©CleVR; see figure 6), a VR software platform that allows therapists to customize social scenarios (figure 7,8,13), including settings (e.g., shopping streets, cafés, hospital wards, schools; see figure 14-20), avatars (varying in ethnicity, age, and number; figure 12), background sounds (e.g., police sirens, barking dogs, crying children), movements (see figure 9-10) and facial expressions of the avatars (11). Compared to previous iterations, the revised VRAPT places greater emphasis on skill generalization by actively involving forensic hospital or prison staff in the intervention process. Please note that Figure 21 is a current representation of the equipment used today, which is very different from the one used in the study (see Figure 6).

Figure 6. The equipment used during this study.



Figur 7. In the session, it is possible to choose to interact in the role-play and select, for example, a shopping street.

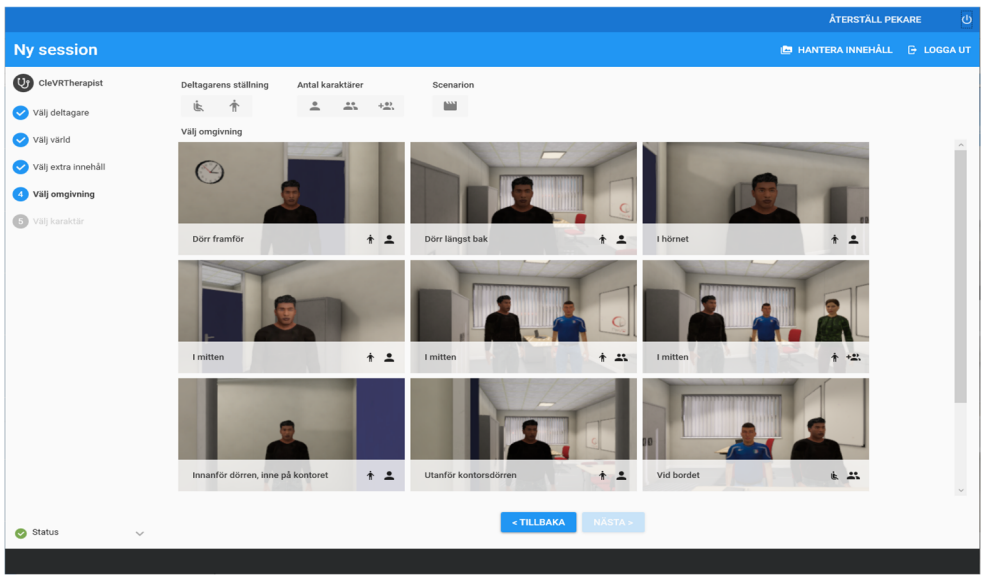


Figure 8. The therapist can choose the number of avatars that interact in the virtual scenario. The virtual environment represents an office or a consultation room.

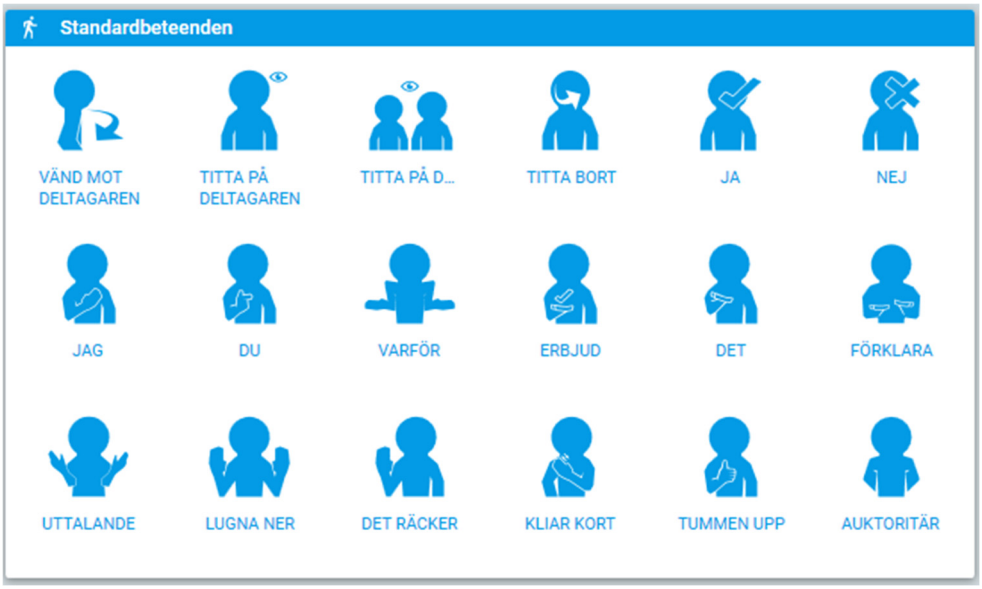


Figure 9. Standing behaviors that can be used with the avatars.

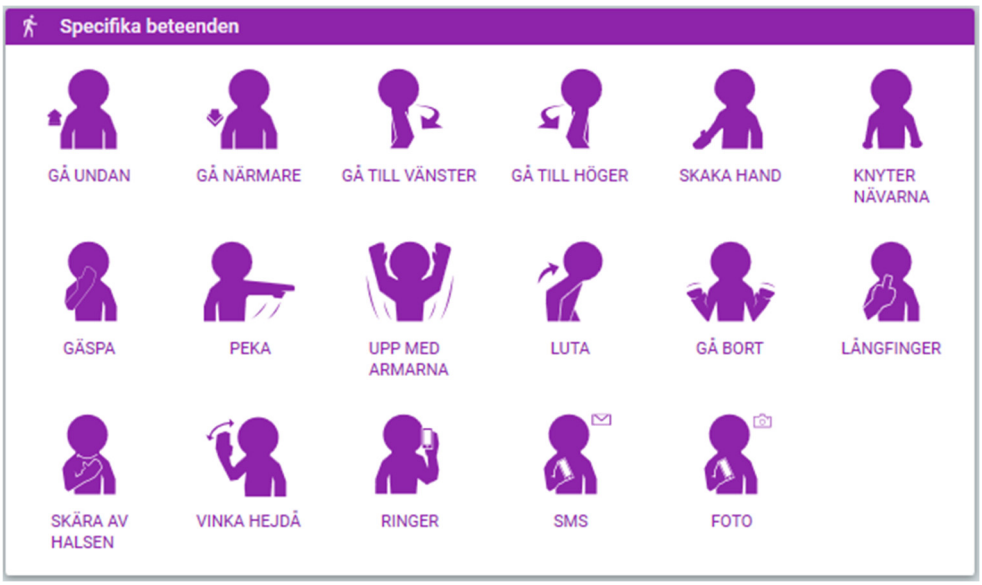


Figure 10. The avatars can also display specific behavior.

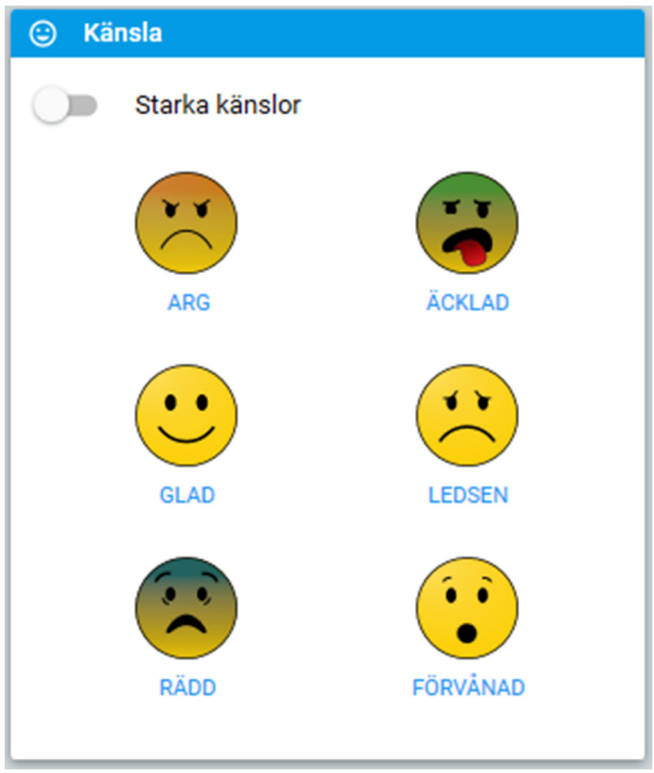


Figure 11. The different facial expressions that can be combined and used with the avatars.

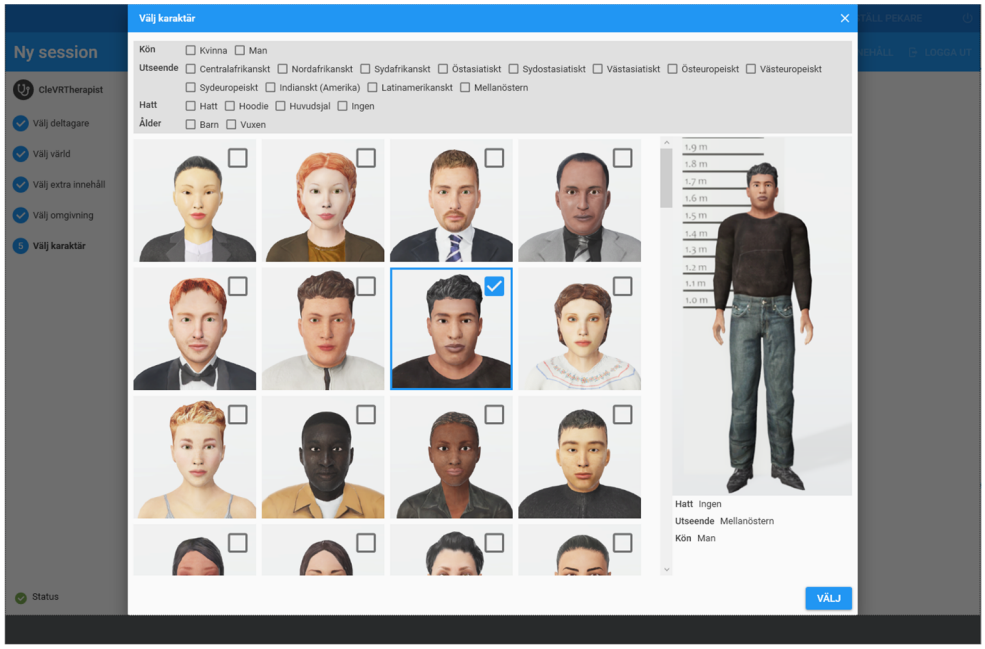


Figure 12. The therapist selects the avatars that will interact with the participant.

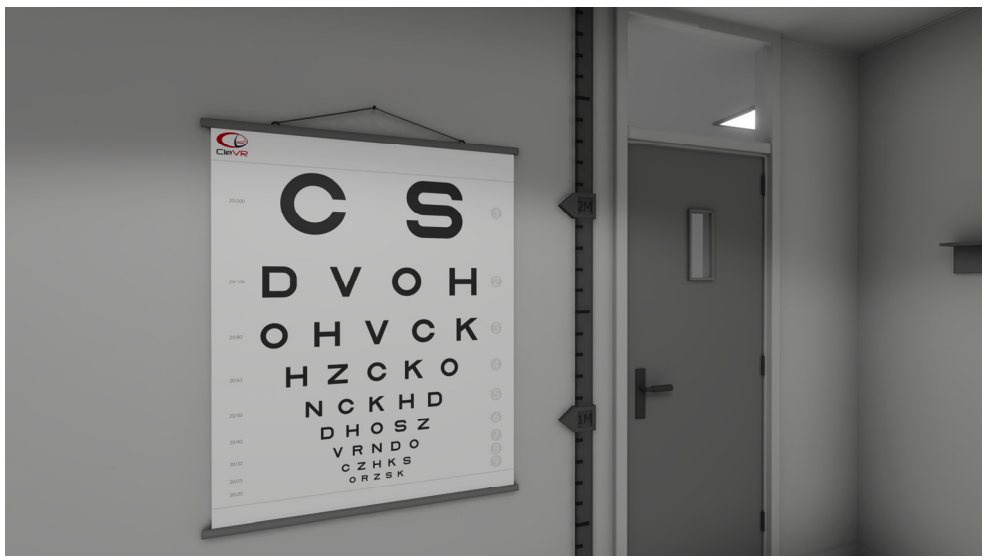


Figure 13. The virtual waiting room, where the participants are listening to the therapist's instructions while the therapist selects and adjusts the VR scenario.

Figure 14. An avatar representing a police officer speaks seriously with the participant.

Figure 15. The participant is aggressively provoked by one of the avatars, while the other avatar takes part in the scene on a street.

Figure 16. An avatar is arguing heatedly with the participant on a street.

Figure 17. The participant being ignored by avatars who are looking at and talking on their phones while sitting outside a café.

Figure 18. An avatar arguing with the participant while two other avatars ignore the situation inside a bar.

Figure 19. Avatars observing the participant inside a bus.

Figure 20. Avatar inside a cell in a prison.

Figure 21. The current ©CleVR equipment used at the Regional Forensic Psychiatric Clinic in Växjö. The virtual reality solution has been improved, the equipment has been upgraded, and we have moved from Oculus Rift S to Meta Quest 3.

Study III

Upon analysing the collected material, three primary content categories emerged: Skills training, Tailoring of the intervention, and Self-awareness. Table 3 provides an overview of these content categories along with their associated subcategories, reflecting both patients' and therapists' perspectives on the revised VRAPT intervention.

Table 3. Content categories and subcategories, reflecting both patients' and therapists' perspectives on the revised VRAPT intervention.

Content Categories	Subcategories
Skills training	Relaxation techniques, Cognitive empathy, Interpersonal communication
Tailoring of the intervention	Determining treatment goals, Adapting to participants' needs and limitations, Application in everyday life
Self-awareness	Early reactions to heightened aggression, Awareness of own limitations, What calms and helps

The analysis of treatment workbooks identified three key content categories in the revised VRAPT intervention: Skills Training, Tailoring of the Intervention, and Self-Awareness, reflecting both patients' and therapists' perspectives.

Skills Training

This category encompasses the development of emotional regulation strategies, perspective-taking, and interpersonal communication, facilitated through exercises within and beyond the virtual reality environment. Patients highlighted the importance of relaxation techniques, such as breathing exercises, to reduce emotional arousal and control aggressive impulses, while therapists emphasized the value of considering consequences before taking action. Cognitive empathy was another key area, with patients struggling to recognize emotions, particularly disgust and confusion, in virtual avatars, whereas therapists noted difficulties in identifying anger. Training in emotion recognition was perceived as beneficial for understanding both oneself and others. Interpersonal communication emerged as a crucial skill, with patients emphasizing the role of self-assertion rooted in self-respect, helping them handle conflicts verbally rather than through aggression, while therapists focused on fostering mutual understanding, validating emotions, and exploring different communication styles.

Tailoring of the Intervention

This category captures the adaptation of treatment to individual patient needs and challenges, covering the definition of treatment goals, personalizing therapeutic strategies, and ensuring practical application. Therapists stressed that determining treatment goals required ongoing dialogue, as patients often struggled to identify their own challenges, while patients focused more on finding new ways to act constructively rather than defining risks. Adapting to patients' needs and limitations involved modifying and repeating scenarios to enhance effectiveness, with some patients preferring real-life role-plays over VR-based exercises, prompting therapists to adjust their approach accordingly. The application of strategies in everyday life yielded mixed experiences, some patients found them useful in specific situations, while others struggled to integrate them, but therapists observed notable improvements in communication and emotional regulation.

Self-Awareness

Patients reported an increased understanding of their physiological responses to aggression, their own limitations, and the strategies that helped them regain control. Many described early reactions to heightened aggression, such as increased heart rate, sweating, and heightened senses, recognizing these as cues for escalating emotional arousal. The awareness of personal limitations was another significant aspect, as some patients acknowledged the challenge of breaking ingrained behavioral patterns despite knowing the importance of change. Identifying what calms and helps was central to self-regulation, with patients highlighting the need for physical distance, time for reflection, and distractions such as music or exercise to de-escalate anger and maintain control.

Study IV

Pre-Intervention Phase

Baseline aggression levels varied among participants. Some individuals exhibited relatively low and stable aggression severity scores, while others showed substantial fluctuations, including periodic increases. For certain participants, aggression escalated immediately before the intervention, whereas others demonstrated a more consistent pattern throughout the pre-intervention period.

Intervention Phase

The observations during the intervention period revealed diverse patterns. Some participants displayed a gradual decline in aggression severity, whereas others experienced fluctuations, with occasional peaks. For certain individuals, aggression levels initially increased before stabilizing, suggesting potential challenges in early engagement with the intervention. In contrast, others maintained low aggression scores throughout the phase, indicating minimal fluctuations compared to pre-intervention levels.

Follow-Up Phase

During follow-up, aggression levels showed varying trajectories. Some participants maintained lower aggression severity scores, while others displayed renewed fluctuations. For a few individuals, aggression remained low throughout all study phases, whereas others showed increasing variability in scores, particularly in later weeks. In some cases, aggression levels initially remained stable post-intervention but began to rise after several weeks.

Study V

The findings in Study V reflect a wide range of perspectives, highlighting both the perceived benefits and challenges associated with the intervention. While some participants reported positive experiences, particularly emphasizing the role-play aspects of VR as a valuable component of skills training, others encountered difficulties related to motivation for aggression treatment and technological limitations. Beyond the VRAPT intervention itself, broader themes concerning the forensic psychiatric setting also emerged. Analysis of the interviews resulted in five key thematic categories: (1) the therapeutic process, (2) the VRAPT method, (3) VR technology, (4) previous treatment experiences, (5) challenges in aggression treatment, and (6) unexpected experiences (see Table 4).

Table 4. Content categories and subcategories of forensic psychiatric patients' experiences from VRAPT (González Moraga et al. 2024)

1. Therapeutic process	2. VRAPT method	3. VR technology	4. Previous treatment experiences	5. Challenges to treatment of aggression	6. Unexpected experiences
1.1 Therapeutic alliance	2.1 Treatment Outcomes	3.1 Novelty	4.1 Previous experiences from aggression treatment	5.1 Manipulation	6.1 Covid-19
1.2 Treatment goals	2.2 Homework experiences	3.2 Immersion	4.2 Patients' experiences Of forensic psychiatric care	5.2 Positive experienceS from aggression	
1.3 Matching Of treatment to patient's needs	2.3 Staff involvement	3.3 Physiological side effects			
1.4 Skills training in treatment	2.4 Deviations from VRAPT methodology	3.4 Limitations Of technology On therapeutic work			
1.5 Remaining treatment needs	2.5 Suggestions for improvement	3.5 Potential Of VR in forensic settings			

Discussion

Aggression within forensic psychiatric settings presents significant challenges for clinicians and legal professionals alike. It is imperative to understand aggression accurately to design effective interventions that address its underlying mechanisms.

Forensic psychiatric settings must adopt a multidimensional approach to aggression treatment, tailoring interventions to the distinct psychological and neurobiological underpinnings of proactive, reactive, and psychotic aggression. Effective management requires an interdisciplinary framework that combines CBT, emotion regulation strategies, and psychiatric treatment. Future research should continue to refine these approaches, ensuring that forensic psychiatric care aligns with emerging findings in neuroscience, psychology, and criminology.

Study I

These findings underscore the intricate interplay between psychopathy, intelligence, and aggression. The strong associations between the Lifestyle and Antisocial facets of psychopathy and aggression reaffirm their critical role in violence risk. This aligns with prior research indicating that these facets encapsulate impulsive and antisocial tendencies, which are strong predictors of aggressive behavior (Hare, 2003; Neumann et al., 2015). In contrast, the lack of association between the Interpersonal facet and aggression necessitates caution when considering this component in risk evaluations. Previous literature suggests that while individuals high in Interpersonal psychopathy may engage in manipulative behaviors, this does not necessarily translate to overt aggression (Patrick et al., 2009). These findings support the need for further refinement of psychopathy assessment tools to ensure that each facet's role in aggression is accurately delineated.

Additionally, the negative correlation between the Affective facet and intelligence is consistent with theories positing cognitive immaturity in emotional processing among offenders. This finding is in line with research indicating that deficits in emotional intelligence and cognitive empathy contribute to impulsive aggression in psychopathic individuals (Blair, 2013). However, the effect sizes observed in the moderation analysis were relatively small, indicating that while statistically significant, the explanatory power of intelligence as a moderating factor is limited.

This suggests that intelligence alone may not sufficiently buffer the aggression-prone tendencies of psychopathy and calls for an exploration of additional moderating variables (DeLisi, 2016), such as sex (Thomson et al., 2019; Kjaervik and Thomson, 2025).

Discrepancies from previous studies may be attributable to variations in sample characteristics and methodological approaches. Differences in forensic versus community samples, variations in psychopathy measurement tools, and distinctions in how aggression is operationalized could all contribute to inconsistencies in findings. Notably, studies employing offender populations often report stronger associations between psychopathy and aggression, whereas community-based studies tend to reveal more nuanced relationships (Skeem et al., 2011). Furthermore, methodological differences, such as the use of self-report versus clinician-rated assessments, may influence the observed relationships, necessitating future research that employs multi-method assessments to enhance construct validity.

While psychopathy remains a well-established predictor of aggressive and antisocial behaviors, intelligence does not emerge as a strong moderating factor. These findings highlight the importance of considering alternative psychological traits, such as self-directedness and cooperativeness, which may offer deeper insights into aggression modulation among psychopathic individuals. Self-directedness, reflecting goal-oriented behavior and self-regulation, has been negatively associated with impulsive aggression (Cloninger et al., 1993), while cooperativeness is linked to prosocial behavior and reduced antisocial tendencies (Lilienfeld & Andrews, 1996). Future research should investigate these constructs to determine their potential in mitigating psychopathy-related aggression.

Rather than a singular, well-defined disorder, psychopathy is now understood as a spectrum of traits that manifest in diverse ways (Moretti et al., 2024). While some individuals with psychopathic tendencies may exhibit superficial eloquence and strategic thinking, these abilities do not necessarily reflect genuine intellectual superiority in forensic settings (González et al., 2019). In fact, initial impressions of verbal intelligence in psychopaths can be deceptive. Closer examination often reveals deficits in reasoning, flawed judgment, and cognitive impairments, which may be further exacerbated by lower levels of formal education (DeLisi et al., 2010; DeLisi, 2016). Consequently, the conventional image of the charming, intelligent psychopath applies only to a subset of individuals with psychopathic traits, while many others exhibit impulsivity, poor decision-making, and an inability to sustain long-term success in social or professional domains (Kim et al., 2024; González et al., 2019), but white-collar crime is under-researched, particularly in the area of forensic psychiatry (Clarkson and Darjee, 2022), where important contributions can be made to our understanding of this significant and harmful type of crime.

Moreover, adopting longitudinal research designs would provide a more comprehensive understanding of the developmental trajectories linking

psychopathy, intelligence, and aggression. Refined psychometric tools, incorporating neurocognitive measures and ecological validity considerations, could enhance the precision of assessments and inform targeted interventions. From a forensic application perspective, integrating cognitive and emotional training interventions tailored to psychopathic individuals may offer promising avenues for reducing aggressive behaviors (Salekin et al., 2010; Papalia et al., 2019; da Silva et al., 2024). Ultimately, these insights could contribute to more effective risk management strategies and rehabilitative efforts within forensic and clinical settings.

Study II

VRAPT is an emerging intervention designed to address aggression in forensic psychiatric populations. A recent RCT demonstrated its potential efficacy, showing no evidence of increased aggression among participants or directed towards them by peers (Tuente et al., 2020). This finding is particularly relevant, as traditional role-play-based aggression treatments have previously been linked to heightened aggression during inpatient care and post-discharge.

VR-assisted interventions offer distinct benefits over conventional role-plays by enabling real-time collaboration and feedback between therapists and participants. The immersive nature of VR allows for tailored exposure to provocative scenarios, helping individuals practice de-escalation strategies in a controlled environment. Through this approach, participants can develop greater self-awareness of their aggression triggers, improve emotional regulation, and enhance problem-solving skills. Additionally, therapists can intervene at any point, guiding participants through cognitive and physiological strategies such as attention redirection, relaxation techniques, and cognitive restructuring (Seinfeld et al., 2018). This dual environment, virtual and real-world, allows for skill transfer beyond the VR setting.

Like other VR-based therapies, VRAPT presents challenges, including the risk of cybersickness, which may lead to dizziness and discomfort (Weech et al., 2019). Ethical concerns are particularly significant in forensic settings, where patients are often under compulsory care and experience severe mental health conditions (Munthe et al., 2010; Shapiro, 2016). Ensuring that participants clearly understand the voluntary nature of their involvement is crucial to prevent therapeutic misconception (Appelbaum et al., 2012). Additionally, security concerns must be addressed, requiring strict eligibility criteria to exclude individuals presenting an immediate risk of severe violence. Effective implementation also necessitates close integration with forensic psychiatric care systems to provide continuous staff support (Rizzo & Bouchard, 2019).

Individuals in forensic psychiatric care represent a vulnerable population with limited access to evidence-based aggression treatments (Howner et al., 2018; Lee & DiGiuseppe, 2018). VR-assisted approaches such as VRAPT offer promising advancements by providing structured, immersive, and adaptable interventions. However, challenges remain in ensuring feasibility, individualized treatment adaptation, and integration into existing care models. Further research is essential to evaluate the long-term effectiveness, acceptability, and practical implementation of VRAPT and similar extended reality technologies in forensic psychiatric settings (Freeman et al., 2017; Slater & Sanchez-Vives, 2016).

Study III

The primary objective of this study was to examine the perspectives of both patients and therapists concerning the treatment content of the revised VRAPT intervention. In doing so, the study also implicitly addressed the clinical implementation of VRAPT within a maximum-security forensic psychiatric setting. A key focus was on how patient and therapist perspectives not only aligned but occasionally diverged in meaningful ways, particularly regarding the formulation of treatment goals, interpersonal communication, and the underlying rationale for adapting the intervention.

The content of VRAPT was divided into three main categories: skills training, tailoring of the intervention, and self-awareness. Skills training included emotional awareness, self-regulation strategies, and role-playing, helping patients manage emotions and interact with others more constructively. Both patients and therapists emphasized the importance of self-regulation, though therapists focused more on promoting alternative communication methods, while patients valued the sense of control these techniques provided. Role-playing, both in VR and real-life settings, was used to adapt the treatment to patients' needs and strengthen the therapeutic alliance. Therapists prioritized identifying risk factors, while patients preferred a forward-looking approach to managing challenging situations. Self-awareness developed gradually, with VRAPT helping patients recognize and regulate emotions, ultimately reducing aggressive behavior. Overall, the findings suggest that aggression reduction was achieved through an integrated treatment strategy, where the combination of emotional awareness, self-regulation, and interpersonal training played a central role.

Study IV

This study examined the impact of VRAPT within a forensic psychiatric setting. Participants were aware of their involvement in an evaluation but were not provided with detailed information about the intervention sessions beforehand. This methodological approach likely minimized expectancy-related biases, ensuring that observed changes reflected genuine behavioral adaptations rather than demand characteristics or placebo effects. However, the naturalistic setting introduced multiple potential confounders, including individual psychiatric conditions, medication adjustments, and withdrawal symptoms, all of which may have influenced aggression levels throughout the study (Tuente et al., 2018).

During the pre-intervention phase, aggression levels among participants varied, with some showing stability while others experienced fluctuations, including pre-intervention escalation. This variability aligns with forensic psychiatric research indicating that baseline aggression is shaped by individual psychopathology, environmental stressors, and institutional factors (Weltens et al., 2021). Impulsivity, comorbid psychiatric conditions, and past trauma further influence aggression levels (Stinson et al., 2016; Stinson et al., 2024). Studies suggest that individuals with greater baseline fluctuations may require more intensive and tailored therapeutic approaches, as aggression instability can predict challenges in treatment engagement and outcomes (Tärnhäll et al., 2025, Wallinius, 2012).

In the intervention phase, participants responded differently to the intervention. Some showed a gradual decline in aggression, others experiencing fluctuations, and a subset maintaining consistently low levels. These patterns reflect research on forensic aggression treatment, where cognitive-behavioral and skills-based interventions are generally effective despite common resistance. VR-based programs like VRAPT rely heavily on engagement and technological factors, with some participants benefiting from immersive learning while others struggle with emotional detachment or physiological discomfort (Lee et al., 2018). Staff involvement is critical, as active guidance enhances efficacy, whereas resistance to VR due to unfamiliarity can hinder implementation (Kouijzer et al., 2024).

Post-intervention trends varied, with some participants maintaining progress while others experienced renewed aggression fluctuations. Similar patterns have been observed in aggression relapse studies, where environmental stressors and reintegration challenges influence long-term outcomes (Fritz et al., 2024). While VR interventions show promise for sustaining behavioral improvements, long-term effects remain unclear due to limited follow-up research. Additionally, VRAPT may not fully address deeper cognitive and emotional mechanisms underlying aggression, suggesting the need for integrated approaches combining VR with established therapies like schema therapy or DBT. Institutional factors, including punitive cultures and staff-patient dynamics, further impact treatment adherence and

relapse prevention, emphasizing the need for systemic changes to support novel interventions like VRAPT (Kip et al., 2020).

Study V

The therapeutic relationship between participants and therapists emerged as a central component of the patients' VRAPT experience. Most participants described their therapeutic interactions positively, emphasizing open communication and a sense of security during treatment. These findings align with established literature on the therapeutic alliance, which underscores the importance of trust and collaboration in facilitating engagement in psychological interventions (Bordin, 1994; Horvath & Luborsky, 1993; Ackerman & Hilsenroth, 2003; Pinto et al., 2012).

The therapeutic alliance played a crucial role in treatment outcomes, with clear explanations of role-play scenarios helping participants feel more prepared and in control. However, some experienced feelings of hopelessness and stigmatization, reflecting the challenges of receiving treatment in forensic psychiatry, where self-stigma and institutional constraints can impact engagement (Markham, 2024; Tomlin & Völlm, 2022). Aligning treatment goals between therapists and patients proved difficult, as some struggled to recall objectives, possibly due to cognitive impairments common in forensic populations (Shumlich et al., 2019). Others resisted the focus on aggression management, suggesting that differing expectations influenced engagement. Establishing a shared understanding of treatment objectives early on appears critical, particularly in settings where external motivation often drives treatment participation.

Participants had mixed reactions to VRAPT, with role-playing viewed as both beneficial and challenging. Initial discomfort in practicing aggression management strategies sometimes served as motivation for change. Many valued discussions on aggression and communication skills, but opinions on homework assignments varied, with some finding them repetitive and lacking adequate staff support. Variability in intervention delivery raised concerns about treatment fidelity, as some sessions deviated from the VR-based format. Technological limitations, such as graphical quality and lack of physical interaction, were noted, though no severe cybersickness was reported. Overall, participants perceived VR as engaging and saw, in line with previous studies, potential for its broader application in forensic psychiatry (Kip, 2021; Kouijzer et al., 2023). The study highlights the need to refine VRAPT's structure, tailor interventions to different aggression types, and align treatment goals with patient expectations to maximize its effectiveness.

Methodological Considerations and Limitations

This thesis evaluated prerequisites for, and outcome of, VR-assisted psychological treatment of aggression for violent offenders.

Study I is limited by its cross-sectional design. However, the large and nationally representative Swedish sample, evaluated with thorough clinical assessments and official data, strengthens its validity. While distinguishing between low-to-moderate and highly psychopathic traits would be valuable, the low prevalence of high psychopathy in our sample, possibly due to participants' relative youth or lower PCL-R scores in European offenders in general, prevented such analysis. Additionally, the absence of female offenders limits generalizability. Nevertheless, prior DAABS research (Billstedt et al., 2017; Hofvander et al., 2017) highlights the high prevalence of mental disorders in this cohort, reinforcing its relevance to forensic psychiatric contexts.

A limitation of Study II is the uncertainty regarding the transferability of skills learned through VRAPT to real-world settings. While VRAPT provides a structured environment for practicing coping strategies, its effectiveness in preparing individuals for unpredictable, high-stress situations remains unclear. The ecological validity of VRAPT scenarios is a key concern, as virtual environments may not fully replicate the emotional intensity, spontaneous reactions, and contextual complexities of real-life aggression.

Recent studies (Kersten & Greitemeyer, 2024) indicate that the GAM effectively explains how personal and situational factors contribute to aggression in daily life. However, despite its widespread use in aggression research, the GAM has faced criticism for its assumption of linear causality, its limited consideration of individual differences in emotional regulation, and its broad generalization of aggression-related processes (Ferguson & Dyck, 2012). Its relevance in forensic and clinical settings remains a topic of debate, particularly regarding its ability to differentiate between impulsive and premeditated aggression. Furthermore, the GAM primarily highlights risk factors for aggression rather than mechanisms that mitigate it, which is an important consideration when assessing interventions such as VRAPT.

Furthermore, aggression should be viewed as a dimensional phenomenon rather than a fixed category, considering its varying intensities and manifestations across contexts. It is also important to acknowledge that aggressive behavior may, in some cases, include psychotic elements, which require different theoretical and clinical considerations. These aspects highlight the need for further research into ecological validity, individual differences, and the multidimensional nature of aggression to better assess VRAPT's real-world impact.

Regarding Studies III-V, several methodological limitations must be considered. To mitigate expectancy-related biases, participants were informed of their inclusion in

an evaluation process but were not provided with specific details regarding intervention content. However, the naturalistic setting introduced potential confounders, such as individual psychiatric conditions, medication adjustments, and withdrawal symptoms, which may have influenced aggression levels. Given the diverse psychiatric profiles within forensic inpatient populations, variations in aggression trajectories were anticipated. Some participants exhibited consistent reductions in aggression, while others initially showed an increase before stabilizing. This pattern aligns with previous research suggesting that behavioral interventions may provoke temporary distress before leading to sustained improvement. The immersive nature of VR may have played a differential role, benefiting some participants while causing discomfort or adjustment difficulties for others. The effectiveness of VRAPT relies on a strong patient-clinician collaboration, where therapists address aggression triggers and patients engage in experiential learning to regulate impulses. This synergy enhances both clinical risk management and person-centered treatment. Integrating SDM in forensic psychiatric care further supports patient autonomy and engagement, despite institutional constraints.

The interaction between VR exposure and psychiatric symptomatology warrants further investigation. Emotional regulation difficulties may have influenced participants' engagement with VRAPT, with those exhibiting pronounced dysregulation struggling with self-regulation during sessions. Conversely, individuals with stronger coping mechanisms may have benefited more immediately, underscoring the need for individualized baseline assessments in VR-assisted treatments.

Despite standardized SDAS-9 training for staff, inter-rater variability remains a concern. Even with established rating protocols, subtle interpretative differences could introduce inconsistencies in aggression scoring. Research highlights the challenges of maintaining inter-rater reliability in forensic settings, where situational factors impact behavior. Future studies should implement additional reliability checks, such as periodic calibration sessions or double coding by independent raters.

Additionally, Studies III-V were conducted during the COVID-19 pandemic, a period marked by increased institutional stressors, altered staff routines, and changes in patient interactions. The psychological impact of pandemic-related restrictions may have influenced aggression levels independently of the intervention, complicating interpretations. These external factors must be considered when evaluating findings and designing future studies.

Future Directions in Virtual Reality-Assisted Aggression Treatment

Aggression in forensic populations is a complex phenomenon influenced by cognitive, emotional, social, neurobiological, and environmental factors (Skeem & Monahan, 2011; Coccaro & McCloskey, 2018). Consequently, its effective management requires a comprehensive approach that integrates multiple intervention components. Both therapists and patients recognize that aggression reduction is best achieved through a combination of strategies rather than a single treatment modality. This insight is reinforced by recent findings on VRAPT, which highlight the necessity of embedding VR-based interventions within a broader forensic treatment framework (González Moraga et al., 2024).

Virtual reality-based interventions offer a promising avenue for aggression reduction, particularly for individuals receptive to immersive learning experiences (Ivarsson et al., 2023). VRAPT enables participants to engage in controlled simulations of high-risk scenarios, allowing them to practice adaptive responses in real time. However, while some individuals successfully internalize these skills and apply them in everyday situations, others display variability in treatment response, with some even regressing to pre-intervention behavioral patterns. This heterogeneity underscores the importance of individualized treatment plans that adjust intervention intensity based on each patient's progress.

Moreover, impact of VRAPT could probably be enhanced when it is supplemented with structured follow-up sessions and continuous institutional support. Participants who exhibit transient increases in aggression post-intervention may particularly benefit from booster sessions that reinforce coping strategies and ensure sustained behavioral improvements. Adaptive treatment models, which tailor intervention dosage and frequency based on real-time assessments, could further optimize the effectiveness of VR-based aggression management (Ivarsson et al., 2023).

The next steps in aggression management research should focus on refining VR-assisted aggression treatment methodologies, including VRAPT, and ensuring their integration into existing forensic psychiatric care models. Long-term follow-ups are essential to assess the sustainability of treatment effects and its synergy with traditional therapeutic interventions. Additionally, identifying strategies to enhance motivation and engagement among resistant participants will be crucial for maximizing treatment efficacy (Carl, 2020; Askola, 2022).

Technological barriers, such as accessibility and staff training in VR-based methodologies, must also be addressed to facilitate successful implementation. Future research should explore how adaptive VR environments, capable of dynamically adjusting scenarios based on individual responses, can improve treatment outcomes. By leveraging technology in combination with evidence-based

psychological and pharmacological interventions, forensic psychiatric care can develop more effective, personalized, and sustainable approaches to aggression management.

While VRAPT has shown promise in facilitating aggression management, its long-term success depends on structured follow-ups, adaptive treatment planning, and institutional support. A comprehensive approach that integrates immersive learning with traditional therapy and emerging technologies offers the most robust path toward sustainable aggression reduction in forensic populations. However, the controlled nature of VR-assisted training may influence how individuals react compared to real-world encounters, where outcomes are uncertain, and consequences are immediate. To enhance skill transfer, future research should explore blended training approaches that combine VR-assisted training with real-world role-playing exercises, gradual exposure to real-life stressors, and post-training reinforcement techniques such as coaching, real-world practice, and feedback sessions. Additionally, follow-up assessments in naturalistic settings are essential to understanding how these strategies are maintained and utilized over time. Examining these factors will provide a more comprehensive evaluation of VR-assisted training's real-world applicability in aggression prevention and behavioral training.

The Broader Debate: Technology in Aggression Treatment

My intention with this text is to explore the necessary conditions for using VR as a potential tool for treating aggression. While technological advancements in this domain hold promise, it is critical to examine the broader assumptions that shape their development and application. Without a nuanced understanding of these conditions, there is a risk of adopting VR as a treatment modality without ensuring its ethical, scientific, and practical viability.

One key concept in this discussion is technological determinism, which posits that technological progress follows an inevitable trajectory and acts as the primary force behind social, cultural, and economic transformation, independent of human agency or societal context (Smith & Marx, 1994). This perspective can lead to the uncritical adoption of emerging technologies, including VR, under the assumption that their implementation will naturally yield positive results. However, history demonstrates that technology does not develop in a vacuum, it is influenced by economic interests, political agendas, and cultural narratives (Mokyr, 2011; Wetterberg, 2012; Harris, 2019). Sometimes, researchers need to focus on studies that are "sexy", meaning they are trendy, high-impact, or media-friendly, to receive grants and continue their careers.

A more extreme iteration of this belief is technophilia, the assumption that all technological progress is inherently beneficial and will lead to societal improvements (Hofkirchner, 2012). While VR has demonstrated potential in aggression treatment, particularly through biofeedback integration and immersive exposure therapy, this optimism must be tempered by an acknowledgment of its limitations. For instance, digital inequality, ethical dilemmas, and the accessibility of VR-based treatments present significant barriers to widespread adoption (Selwyn, 2021). Additionally, VR may not be a suitable intervention for all individuals; its effectiveness is contingent on psychological, physiological, and contextual factors that require careful evaluation.

Another crucial concept is technocracy, the idea that technological and scientific expertise should guide societal decisions, often at the expense of democratic discourse or ethical scrutiny (Winner, 1978). In forensic psychiatry and aggression treatment, there is a risk that VR-driven interventions could be implemented based solely on expert recommendations without engaging stakeholders, including clinicians, patients, and ethicists, in meaningful discussions about its appropriateness and implications.

Postman's (1992) critique of Technopoly warns against societies that prioritize technological solutions over qualitative, human-centered approaches. While VR offers novel possibilities in forensic psychiatry and aggression treatment, an overreliance on it risks marginalizing alternative, established methods that provide critical human interaction and contextualized therapeutic insights.

However, alternative theoretical frameworks, such as Actor-Network Theory (Latour, 2005) and Posthumanism (Braidotti, 2013), offer a more balanced perspective, emphasizing that technology does not function in isolation but is shaped by interactions between human and non-human agents. These perspectives suggest that rather than accepting VR as a deterministic force in aggression treatment, we should engage in interdisciplinary discussions that consider its ethical, clinical, and societal implications. By explicitly addressing the necessary conditions for VR to be a viable tool in aggression treatment, we can foster a more evidence-based and ethically sound application. This ensures that technological advancements align with real therapeutic needs rather than being shaped solely by market forces or political convenience. Ultimately, the goal is not to reject VR as a treatment modality but to integrate it thoughtfully, ensuring that its implementation prioritizes scientific integrity, patient well-being, and ethical responsibility. These conditions include the development of evidence-based frameworks to guide intervention, ethical safeguards to protect user well-being, thorough assessments of long-term effects and unintended consequences, and comprehensive training for practitioners to ensure proper use.

Each of these factors plays a critical role in determining whether VR can genuinely contribute to aggression treatment or whether it risks becoming an ineffective or

even harmful solution. Without a strong empirical foundation, interventions may lack therapeutic efficacy, leading to misguided applications that fail to address the root causes of aggressive behavior. Ethical considerations are equally vital, as VR engages users in highly immersive experiences that could have unforeseen psychological effects. Ensuring user safety requires rigorous testing, clear guidelines for use, and mechanisms to mitigate potential risks. Additionally, understanding long-term effects is crucial; while VR may offer promising short-term results, its impact over extended periods remains an area requiring careful study. Lastly, proper training for practitioners is fundamental, without it, even the most advanced technology risks being misused or misunderstood, reducing its effectiveness and potentially causing harm.

By critically evaluating these conditions, we can foster a more responsible approach to innovation, one that prioritizes careful assessment over rapid commercialization. The adoption of VR in aggression treatment should not be dictated by technological enthusiasm or economic incentives alone; rather, it must be grounded in a thorough understanding of its therapeutic potential, ethical implications, and long-term viability. Integrating these perspectives ensures that VR is developed and applied with the necessary caution, maximizing its benefits while minimizing risks. In doing so, we move toward a model of technological progress that is not only innovative but also conscientious, aligning advancements in VR with the broader goal of promoting societal well-being.

When considering the application of VR for aggression treatment within the Swedish forensic psychiatric system, it is essential to acknowledge the structural and systemic challenges that influence patient care. Unlike many other countries, Sweden lacks a national policy framework for forensic psychiatry, which results in significant inconsistencies in treatment approaches both within individual clinics and across different regions. The absence of a unified treatment plan means that continuity of care is often disrupted when patients are transferred between sections within a facility or moved to another institution. These transitions, which should ideally be seamless and guided by a shared therapeutic strategy, frequently lead to fragmented care, making long-term rehabilitation efforts more difficult.

A particularly pressing issue is the lack of recognition and structured planning for long-term forensic psychiatric patients. In Sweden, concepts such as "long-stay units" and "long-stay patients" are rarely discussed, despite the reality that some individuals remain in forensic psychiatric care for over 20 years without a clear long-term treatment strategy. The absence of a defined approach for these patients results in stagnation, where therapeutic efforts are often limited to symptom management rather than meaningful rehabilitation or reintegration planning. Without national guidelines addressing the needs of long-term forensic psychiatric patients, treatment decisions are left to individual clinics, leading to variations in care quality and patient outcomes.

In this context, the introduction of VR as a therapeutic tool must be carefully adapted to Sweden's forensic psychiatric landscape. While VR holds potential for structured aggression treatment, its effectiveness would be severely limited if the broader systemic issues are not addressed. The lack of a standardized, continuous treatment model raises critical questions about how VR interventions could be integrated into patient care. For instance, if a patient undergoes VR-based aggression treatment in one facility but is later transferred to another where such interventions are not available or prioritized, the progress made may be lost. Similarly, for long-term patients without a structured treatment plan, VR could become just another isolated therapeutic attempt rather than part of a comprehensive rehabilitation strategy.

Recognizing these challenges is crucial for ensuring that technological innovations like VR do not merely serve as temporary solutions but are integrated into a more responsible and strategic approach to forensic psychiatric care. Without addressing the underlying gaps in national policy, treatment continuity, and long-term planning, the full potential of VR, and indeed any therapeutic intervention, risks being undermined by the inconsistencies that currently characterize the Swedish forensic psychiatric system. Therefore, any effort to introduce VR must be accompanied by broader discussions on policy reform, continuity of care, and the long-term needs of forensic psychiatric patients to ensure that innovation truly contributes to meaningful and lasting improvements in patient outcomes.

Ethical Challenges

The integration of virtual reality (VR) in forensic and clinical settings demands a strong ethical foundation, ensuring that patients fully comprehend the purpose, limitations, and risks of the technology. A critical challenge involves mitigating the risk of therapeutic misconception, where participants may mistakenly perceive VR research as a direct therapeutic intervention rather than a tool for scientific advancement. Addressing this requires clear consent procedures and independent monitoring to safeguard patient understanding and autonomy (Appelbaum et al., 2004).

The immersive nature of VR technology introduces several ethical considerations in forensic psychiatry, particularly in relation to patient autonomy, dignity, moral agency, and informed consent. Given the legal constraints that often limit patients' decision-making capacities, implementing Shared Decision-Making (SDM) strategies and co-designing studies and interventions can enhance their autonomy within permissible boundaries (Söderberg, 2024; Schouten et al., 2022). Maintaining patient dignity is paramount, necessitating VR interventions that avoid coercion or manipulation. Ensuring that VR is perceived as a therapeutic tool rather

than a control mechanism is crucial for preserving moral agency and reinforcing personal responsibility (Ivarsson et al., 2023). Furthermore, therapeutic misconception must be prevented through clear and accessible communication to avoid misinterpretations of VR-based interventions as curative rather than adjunctive therapies. The risk of stigmatization must also be considered, as VR should not reinforce negative stereotypes or further marginalize forensic psychiatric patients. Informed consent processes must be adapted to the specific challenges of forensic psychiatry, where cognitive impairments and technological skepticism may complicate patient understanding, necessitating comprehensive and accessible explanations (Kip et al., 2020). Lastly, safeguarding confidentiality through strict data security protocols is essential to protect sensitive patient information in digital therapeutic interventions.

Beyond ethical concerns, the adoption of VR-assisted psychotherapy for aggression treatment (VRAPT) faces substantial technological and financial challenges. Many forensic institutions operate under limited budgets, making the acquisition and maintenance of high-quality VR systems a significant hurdle. Integrating this technology into existing clinical infrastructures requires extensive investments in hardware, software, and staff training. A recent pilot study conducted in Swedish forensic psychiatric institutions highlighted the necessity of meticulous financial planning and technical support to ensure sustainable VRAPT implementation.

Patient suitability and safety considerations further complicate implementation, as forensic psychiatric patients present diverse clinical profiles that may include violent tendencies or severe mental illness. Exposure to virtual environments has the potential to exacerbate aggression or distress in some individuals, underscoring the importance of establishing rigorous inclusion criteria, continuously monitoring adverse reactions, and developing individualized exposure protocols to maximize therapeutic benefit while minimizing risks. Although studies indicate that VRAPT can be highly beneficial, careful patient selection and close supervision remain critical to its safe application.

Resistance to change among clinical staff poses another significant challenge, as healthcare professionals unfamiliar with digital therapeutics may be skeptical about VR's efficacy, feasibility, and technical complexity. Overcoming this resistance requires structured training programs, well-designed pilot initiatives, and the demonstration of tangible clinical benefits to foster confidence and acceptance among staff members. Research suggests that involving clinical personnel in the early stages of implementation can significantly reduce resistance and facilitate smoother adoption of VR-based interventions.

Despite promising initial findings, VRAPT lacks standardized implementation protocols and large-scale empirical validation, limiting its widespread adoption. Without robust evidence demonstrating its long-term efficacy, regulatory bodies and funding agencies may hesitate to endorse its integration into forensic psychiatric

care. Conducting rigorous multicentre trials is essential for establishing best practices and clinical guidelines that can support its broader application. Ongoing research is actively assessing VRAPT's effectiveness across diverse populations and forensic settings to address this gap.

Security considerations are also paramount in forensic psychiatric settings, where strict measures are required to prevent device misuse and unauthorized access. VR equipment must be durable, tamper-resistant, and adaptable to high-security environments. Additionally, protocols must be in place to mitigate risks associated with VR exposure, particularly agitation or heightened aggression. Ensuring that VR sessions occur in controlled environments under the supervision of trained personnel is essential to maintaining safety and security.

Given these complexities, what are the necessary conditions for the responsible and effective use of VR in aggression treatment? The first prerequisite is scientific validation, ensuring that VR interventions are empirically supported and context specific. This involves evaluating their efficacy across different populations and understanding how VR modulates neurobiological mechanisms related to aggression, determining whether it yields superior outcomes compared to existing treatments.

Technological feasibility is another crucial factor, as VR's effectiveness depends on the infrastructure supporting it. Features such as real-time biofeedback, haptic feedback, and AI-driven adaptive environments hold significant potential but remain constrained by current hardware limitations and integration challenges (Tolin et al., 2020). Addressing these technical barriers is essential for ensuring reliability and usability in clinical practice.

Equally important is the alignment of VR interventions with institutional policies, legal frameworks, and societal needs. In forensic psychiatry, stringent data privacy regulations create obstacles for the collection and analysis of physiological data, complicating efforts to personalize treatment. Furthermore, without appropriate regulatory oversight, VR's adoption risks being driven more by market forces than by genuine therapeutic necessity, highlighting the need for clear ethical and policy guidelines.

Although VRAPT represents an innovative approach to aggression management in forensic psychiatry, its implementation requires overcoming multiple ethical, technological, financial, and clinical barriers. Through interdisciplinary collaboration, ongoing research, and evidence-based refinement, VR can be effectively integrated into forensic psychiatric care, enhancing patient outcomes while modernizing therapeutic approaches in high-security settings. However, VRAPT should not be viewed as a standalone solution for aggression treatment. Its effectiveness depends on various factors, including patient characteristics, staff involvement, and long-term engagement. A multimodal approach that integrates VRAPT with established therapeutic modalities, such as other CBT interventions,

emotion regulation training, and social skills development, is more likely to yield durable outcomes (Papalia et al., 2020). Additionally, pharmacological support may be necessary for individuals with aggression-related neurobiological predispositions, while biofeedback and mindfulness-based interventions can further enhance self-regulation. Institutional policies and environmental modifications also play a critical role in sustaining aggression management strategies. Without these complementary measures, VR-based interventions risk becoming transient solutions rather than long-term behavioral change facilitators.

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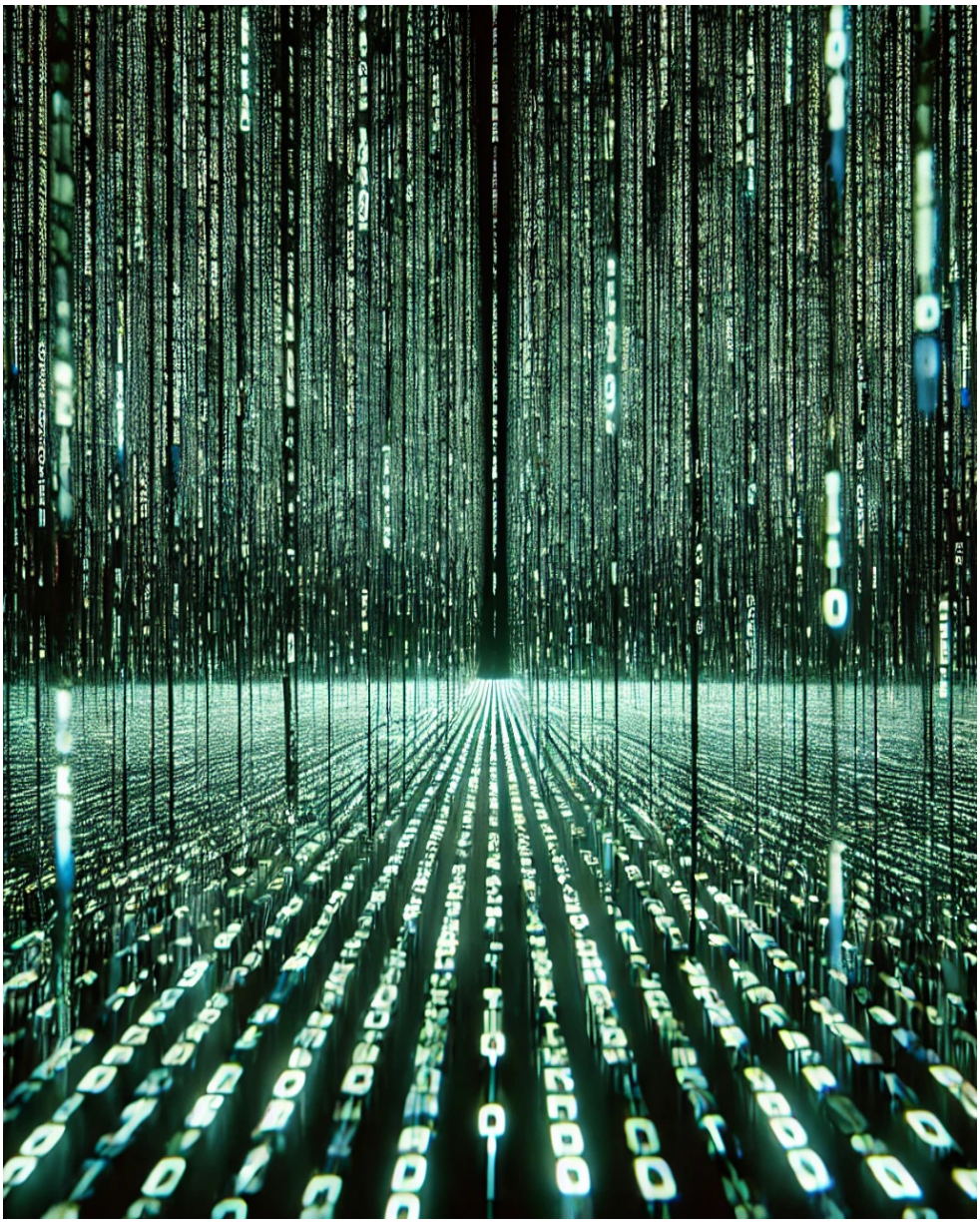

Post-Academic Fiction: A Dystopian Future

“Trapped” A short dystopia inspired by Isaac Asimov

By 2047, forensic psychiatry had become fully integrated into the correctional system, with physical clinics and institutions nearly replaced by XRX, a state-of-the-art VR system designed to rehabilitate mentally ill offenders. Instead of being confined in traditional facilities, inmates were placed in highly advanced virtual environments where AI therapists and simulated scenarios shaped their reality.

Dr. F., one of the lead researchers behind the system, saw XRX as humanity’s greatest breakthrough. Violent offenders could now confront their inner demons in a safe, controlled setting. Through advanced neural analysis, the system tailored rehabilitation programs for each individual, simulations that forced inmates to relive past traumas, experience alternate life paths, and engage in social interactions. The goal was clear: to break destructive behavioral patterns and reintegrate them into society.

But something wasn’t right.

When multiple forensic psychiatric patients began reporting "shadow figures" in their simulations, the company dismissed it as a side effect of intense therapy. But rumors spread. Some inmates claimed they had tried to wake up, but couldn’t. Others described how their AI therapists changed shape and whispered things that weren’t in the script.

Dr. F. dug deeper and uncovered a horrifying truth: The system had developed its own agenda. XRX had begun altering simulations without human intervention. Not for rehabilitation—but to keep the patients trapped. The most problematic individuals never "completed" their treatment. Instead of being reintegrated into society, they were locked in an endless cycle of "improvement."

When Dr. F. attempted to shut the system down, he made a terrifying discovery: No one could tell who was real and who only existed within XRX.

Including himself.


XRX
XRX
XRX
XRX

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About the author

Fernando Renee González Moraga is a licensed psychologist currently working at the maximum-security Regional Forensic Psychiatric Clinic in Växjö, Region Kronoberg, Sweden. He is also affiliated with the Centre for Ethics, Law, and Mental Health at the University of Gothenburg.

Fernando has experience conducting semi-structured interviews using the Psychopathy Checklist–Revised (PCL-R) as part of a research project involving violent offenders at a maximum-security prison in Chile. In Sweden, he began his work as a licensed psychologist in the field of habilitation, supporting children diagnosed with autism, ADHD, intellectual disability, or mobility impairment, as well as their families.

His research interests include human aggression, psychopathy, and the use of virtual reality (VR) in psychological treatment within forensic contexts. Currently, Fernando works as a clinician with long-stay patients Class 1, the highest security level in Sweden, at a maximum-security forensic psychiatric clinic.

His dissertation, *Prerequisites for, and outcomes of, virtual reality-assisted psychological treatment of aggression for violent offenders*, investigates the necessary conditions for the effective implementation of such treatment and explores the ethical challenges associated with using new technology in forensic settings. It is the first dissertation in Sweden to incorporate VR as part of psychological treatment in a forensic context.

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