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Innovations in violence risk assessment: What aviation can teach us about assessing and managing risk for rare and serious outcomes

Stephanie R. Penney

Campbell Family Mental Health Research Institute, Division of Forensic Psychiatry, Centre for Addiction and Mental Health, University of Toronto, 1001 Queen Street West, Toronto, Ontario M6J 1H4, Canada

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ABSTRACT

This paper describes several ongoing challenges in the field of violence risk assessment (VRA), particularly with respect to establishing acceptable levels of measurement reliability and validity of commonly used risk assessment instruments, and demonstrating their ability to reduce risk and avert harmful outcomes. Drawing on analogous concepts from the risk assessment and management process in the aviation industry, several key lessons and aspirational principles for research and practice in the field of VRA are described. It is argued that significantly more attention is required to evaluate the ability of VRA tools to generate effective risk management plans that measurably lower risk and rates of violent outcomes. Three propositions for advancing common VRA research designs are discussed: (1) improved operationalization of risk management plans and their ability to reduce violence; (2) improved measurement of change in risk status over prospective follow-up periods, and (3) a stronger emphasis on short-term assessments with closer temporal proximity between risk factors and outcomes. Collectively, these advancements may enhance the validity and utility of VRA instruments by permitting better specification of the conditions under which risk factors exert effects, and the development of effective risk management plans that join together explanatory frameworks for the causes of violence with strategies to avoid their recurrence.

1. Introduction

Twenty-five years ago, John Monahan and Henry Steadman wrote a seminal article appearing in the American Psychologist on the clinical practice of violence risk assessment (VRA; Monahan & Steadman, 1996). In it, they compare the fields of meteorology and mental health law with respect to the assessment of risk for rare and harmful events; in the former, severe weather, and in the latter, serious violence perpetrated by human beings. The analogy drawn between the two fields was compelling: like clinicians who carry out VRAs, meteorologists are credentialed professionals who assess risk factors that are known predictors of severe weather events, they process these risk factors with the assistance of statistical prediction models, construct a likelihood estimate (specifically, a weather forecast), and communicate this estimate to relevant decision makers and the general public.

Monahan and Steadman argued that the practice of VRA could benefit significantly from various tenets characterizing the profession of meteorology, such as the emphasis on temporal and contextual specificity (i.e., short-term [12–24 h lead time] weather forecasts that are confined to specific geographical locations), and conversely, the recognition that the accuracy of forecasts "falls off rapidly" (Ahrens, 1991, p. 382) when they are made more than 3 or 4 days in advance. Importantly, the communication of risk statements for severe weather events (e.g., a flash flood warning) is necessarily accompanied by recommendations or prescriptions for specific action to avoid harm (evacuation, moving to higher ground). These tenets, as applied to the practice of VRA, highlighted the utility of short-term, recurrent, and contextualized assessments of risk, as well as the necessity of joining descriptive risk information (e.g., low, moderate, high) with prescriptive and specific risk management strategies to prevent harm.

As noted by Monahan and Steadman (1996), "predicting the weather is easy compared with predicting violence, and taking easy examples is a good way to start thinking through a difficult topic" (p. 932). Indeed, a key benefit of analogical reasoning is that it allows one to draw new inferences or explanations about a less well-understood domain by using an analogous, more familiar domain. Analogical reasoning, commonly defined as the ability to perceive and use relational similarity between two situations or events (Gentner & Smith, 2012), is a fundamental aspect of human cognition and recognized as a central process in scientific discovery. The power of analogical reasoning to provide a deeper

E-mail address: stephanie.penney@camh.ca.

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understanding about a concept or event, as well as assist in problem-solving by enabling new insights and creative solutions, has been well-documented (Dunbar, 1995; Gick & Holyoak, 1980; Holyoak, 2012).

Arguably, considerable progress has been made in the practice and science of VRA since Monahan and Steadman wrote their article, and their pessimism that "weather prediction (could) serve as an ideal case illustration of what risk assessment in mental health law would look like if we really knew what we were doing" (p. 932) may be less warranted today than it was then. In the past two decades, significant advances have been made in identifying robust and reliable risk factors for violence, and these advances have been translated into empirically-validated instruments for assessing and managing violence risk (e.g., the Historical, Clinical, and Risk Management-20 [HCR-20]; Douglas, Hart, Webster, & Belfrage, 2013, the Short-Term Assessment of Risk and Treatability [START]; Webster, Martin, Brink, Nicholls, & Desmarais, 2009) as well as enhancing safety (e.g., the Structured Assessment of Protective Factors for Violence Risk [SAPROF]; de Vogel, de Ruiter, Bouman, & de Vries Robbé, 2009).[1] Still, concerns about the accuracy, fidelity, and appropriateness of VRAs remain (DeMatteo et al., 2020; Hart & Cooke, 2013; Hart, Michie, & Cooke, 2007; Murrie et al., 2009), and these concerns are often heightened in forensic and legal settings where the outcomes associated with VRAs are weighty (e.g., restrictions in liberty, criminal sentencing decisions). While it is clear that the field has advanced, the complexity of VRAs and the behavioral outcomes they are concerned with, coupled with the far-reaching impacts they have on people's lives and liberties, necessitates ongoing attention to how the science and practice of VRA can be improved, advanced, and innovated.

Practical concepts from aviation, and aviation safety in particular, may offer novel and useful points of analogy to VRA research and practice. In contrast to the field of meteorology, where outcomes of interest (e.g., severe or harmful weather) inevitably unfold without human intervention, aviation safety may offer a more precise analogy to VRA in the sense that risks for hazardous outcomes are continuously assessed and actively managed to reduce the likelihood of their occurrence. Although a full exposition of the risk assessment and management process in aviation is beyond the scope of this paper (and the expertise of this writer), a description of key concepts can illustrate important points of analogy to VRA in the hopes of promoting new insights and direction for research and practice. The next section of this paper outlines specific issues in VRA instrument reliability and validity that represent ongoing challenges for the field, and then turns to describe points of analogy between the risk assessment and management processes in aviation safety and clinical VRA.

1.1. *Reliability and validity of VRA instruments*

Alongside recent advancements, experts have called attention to the ongoing need to establish the reliability and validity of VRAs and the instruments that they are based upon. Test reliability reflects fidelity and consistency in measurement (e.g., across raters, or over time), and is a prerequisite for validity, or the degree to which a test provides a true or accurate measurement of the phenomenon being assessed (e.g., violence risk). As applied to assessment instruments such as the HCR-20, reliability is most commonly demonstrated through inter-rater or inter-clinician concordance, while validity is frequently investigated by the predictive ability of the tool – that is, the degree to which risk ratings are associated with future violence.

Recent studies have called into question previously accepted findings establishing the reliability and validity of many VRA instruments. For example, findings of so-called allegiance effects (Murrie et al., 2009; Murrie & Boccaccini, 2015; Murrie, Boccaccini, Guarnera, & Rufino, 2013) highlight important differences between levels of inter-rater reliability across research-based and applied/clinical settings – the latter sometimes referred to as field reliability. The degree of reliability between actual practitioners in the field is consistently and significantly lower as compared to trained research assistants; furthermore, forensic clinicians' ratings on many risk assessment tools are sometimes found to drift towards the party retaining their services (i.e., defense versus prosecution; Murrie et al., 2009, Murrie et al., 2013).

There has also been growing recognition of the limits of predictive accuracy achieved by most published VRA instruments. A "sound barrier" to predictive validity has been described, with the observation that correlations between risk estimates and violence measures rarely exceed 0.40 (Monahan & Skeem, 2014), and with most instruments achieving comparable, yet modest, levels of predictive accuracy (Yang, Wong, & Coid, 2010). Predictive accuracy is further hampered when the task at hand is to forecast outcomes that occur infrequently (e.g., severe or stranger violence), despite that these events are those of most concern to the public and which carry the expectation that trained professionals should be able to avert. Appelbaum (2011), among other scholars in the field (e.g., Webster, Haque, & Hucker, 2013), made the intuitive assertion that the "contingencies of life" will necessarily place an upper limit on what can be achieved in many risk assessment contexts, acknowledging that human behavior is too complex to forecast with more certainty than we are currently able.

These concerns are relevant considering both legal and ethical requirements to demonstrate, in an ongoing manner, the reliability and validity of VRAs and the instruments they are based upon. In the legal arena, most jurisdictions have rules governing the admissibility of scientific and expert evidence that hinge on the reliability, validity, transparency, and peer acceptance of the scientific methodology or instrument in question (e.g., in the U.S., *Daubert v. Merrell Dow Pharmaceuticals,* 1993; in Canada, *R v Mohan 1994*). This would apply, for example, to expert testimony concerned with a person's risk for future violence and which is guided by one or more assessment tools. Ethical considerations similarly oblige that the risk factors assessed by clinicians are statistically and meaningfully connected to future violence; otherwise, they will have limited utility in terms of risk management and harm reduction, and the collection of such information will not serve the purpose for which it is intended. In general, ethical principles dictate that persons' legal rights to privacy and liberty must be impacted only on the basis of well-founded (i.e., reliable and valid) risk decisions (Douglas, Pugh, Singh, Savulescu, & Fazel, 2017; Douglas & Skeem, 2005).

Identified limits on the reliability and validity of commonly used VRA instruments are therefore problematic in these contexts, but at present there is no clear consensus as to the next steps in clinical practice or research methodology to begin improving upon them and advancing the field. Indeed, the very concept of a "sound barrier" as described above implies that we have reached an upper limit, or plateau, in terms of the accuracy of our risk assessments and their corresponding ability to manage risk and avert harmful outcomes.

2. The sound barrier and other lessons from aviation safety

In aviation, the sound barrier refers to the sudden increase in aerodynamic drag and other undesirable effects experienced by an aircraft when it approaches the speed of sound (approximately 767 mph in dry air at 20 °C). When aircrafts were first able to reach close to the speed of

[1] The above referenced instruments reflect one of two major approaches to VRA, termed *structured professional judgment* (SPJ). Within the SPJ approach, decision-making in regard to violence risk is assisted by guidelines that are informed directly by the scientific and professional literature. SPJ guidelines are comprehensive and cover the range of VRA activities, including the identification of risk factors, their functional relevance for a given individual, the development risk management plans, and the communication of final opinions regarding risk. In contrast, instruments that reflect the *actuarial* approach to VRA are mathematically optimized to predict violent outcomes in a specific population over a specific time period. A discussion of the actuarial approach to VRA is not elaborated upon in this paper, as these tools are focused primarily on the prediction of violence and have limited ability to assist in formulating violence risk or developing risk management plans (Hart & Logan, 2011).

sound, these effects were seen as a barrier making faster speeds difficult or impossible. However, as the science of high-speed flight progressed, a number of changes led to the understanding that the sound barrier is easily penetrated, *with the right conditions* (mainly having to do with improvements to the physical design of the aircraft). Today, modern aircrafts can transit the barrier without control problems, although few do so. As noted, the notion of a sound barrier has been referenced by VRA scholars to describe the analogous upper limits we seem to have approached in regards to the predictive accuracy of existing tools. At the same time, the aeronautical concept of a sound barrier – and specifically, the conditions that allow it to be penetrated – encourage us to consider what may be the circumstances that will permit the science and practice of VRA to advance beyond these identified limits.

How is risk assessed and managed in the aviation industry? Even a beginner's foray into the field of aviation safety quickly reveals familiar concepts to those defining the practice of VRA. The Federal Aviation Administration (FAA), as well as other regulatory bodies (e.g., the International Civil Aviation Organization [ICAO], European Union Aviation Safety Agency [EASA], Transport Canada), commonly define a *hazard* as "a present condition, event, object, or circumstance that could lead to or contribute to an unplanned or undesired event such as an accident; it is a source of danger", while *risk* is defined as "the future impact of a hazard that is not controlled or eliminated" (i.e., the assessed potential for adverse consequences resulting from a hazard and the severity of those outcomes) (FAA, 2000; ICAO, 2018). It is emphasized that some risk is never known. The nomological net of all possible hazards, rather than being conceptualized as static and finite, is assumed to be dynamic and evolving. Although likely unnerving for the anxious airline passenger, it is assumed that the scope of all possible hazards in the aviation environment is wide and not always able to be catalogued a priori.

Hazard identification is the first step in the safety risk management process. It precedes a risk assessment and requires a clear understanding of hazards and their related consequences. While the goal is to proactively (e.g., through safety surveys and operational audits) identify hazards before they lead to accidents, hazards are also commonly identified through reactive means (e.g., accident and incident investigations) (ICAO, 2012). Hazard identification is followed by a *risk analysis* (whereby hazards are analyzed and risks are identified) and a *risk assessment* (whereby risks are analyzed in terms of probability of occurrence and severity of hazard effects). *Risk management* is the method used to control, eliminate, or reduce the effects of identified hazard(s) within parameters of acceptability and tolerability.

A Likelihood by Severity (L × S) matrix is commonly used to chart areas of risk acceptability and tolerability (Fig. 1) (FAA, 2016; ICAO, 2018). Likelihood refers to the probability of a risk materializing, and is often qualitatively operationalized as Improbable (very unlikely), Remote (unlikely, but possible), Occasional (likely to occur at times), and Probable (likely to occur often). Quantitative descriptions, estimated in terms of the number of times that a hazard may arise per hours of flight, are also sometimes offered. Severity, on the other hand, pertains to the consequences associated with a risk/accident, and is rated as Negligible (less than minor injury and/or systems damage), Marginal (minor injury and/or systems damage), Critical (severe injury and/or major systems damage), and Catastrophic (resulting in fatalities and/or loss of the system). When evaluating risk, there is a trade-off between likelihood and severity: the more severe the consequences of an accident (e.g., in terms of dollars, injury, or reputational risk) the lower the probability of its occurrence must be for the risk to be acceptable. Notably, estimations of likelihood and severity are infrequently guided by statistical models alone. More commonly, informed judgments of risk are developed from structured reviews by people with extensive experience in their respective fields and applied to a standard classification scheme (ICAO, 2018).

The purpose of these steps is to ensure a *closed loop* process of identifying hazards and managing risks (Fig. 2). This feedback loop is critical to ensure that all identified hazards have been linked directly to a risk management or mitigation strategy, and that the results of these strategies have been formally evaluated to confirm that any residual risk falls within an acceptable range. This effort is continuous: risk management strategies are evaluated in terms of their ability to lower risk, while data collection and analysis (e.g., on accidents and other safety incidents) are conducted throughout the life cycle of the safety system to identify any new or additional hazards, and to develop further mitigation plans (ICAO, 2018). Although not formally depicted in Fig. 2, aircraft accident investigations are an important piece of this process and have as their central objectives to determine the probable causes of such events and make specific recommendations to avoid their recurrence. The recommended safety actions and risk management strategies that emerge from these causal explanations link action directly to understanding, and are therefore most likely to be effective in reducing the risk of accident recurrence.

2.1. *Lesson #1: closing the loop – evaluating the effectiveness of risk management plans*

Here is probably the first useful lesson for VRA. Although clinicians and researchers in the field are well acquainted with the process of

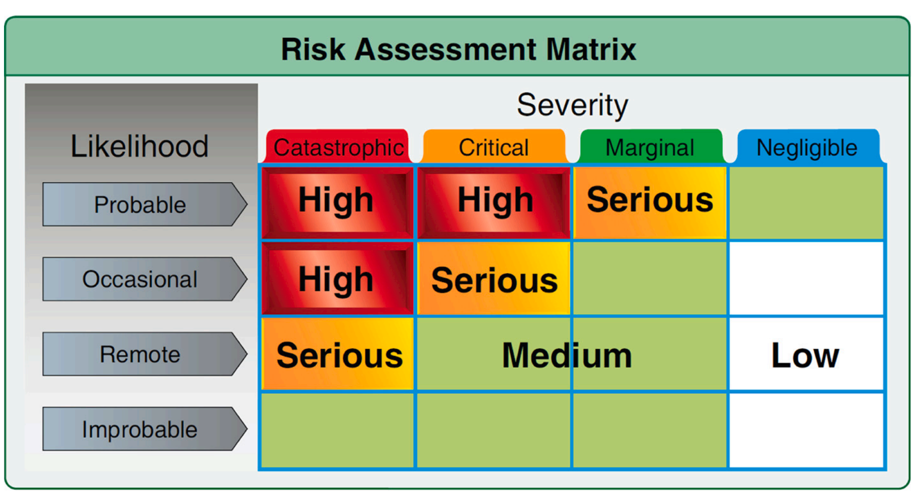

Fig. 1. Likelihood by severity (L × S) matrix.
Reprinted from *System Safety Process,* by the Federal Aviation Administration, retrieved from https://www.faasafety.gov/gslac/alc/libview_normal.aspx?id=6877.

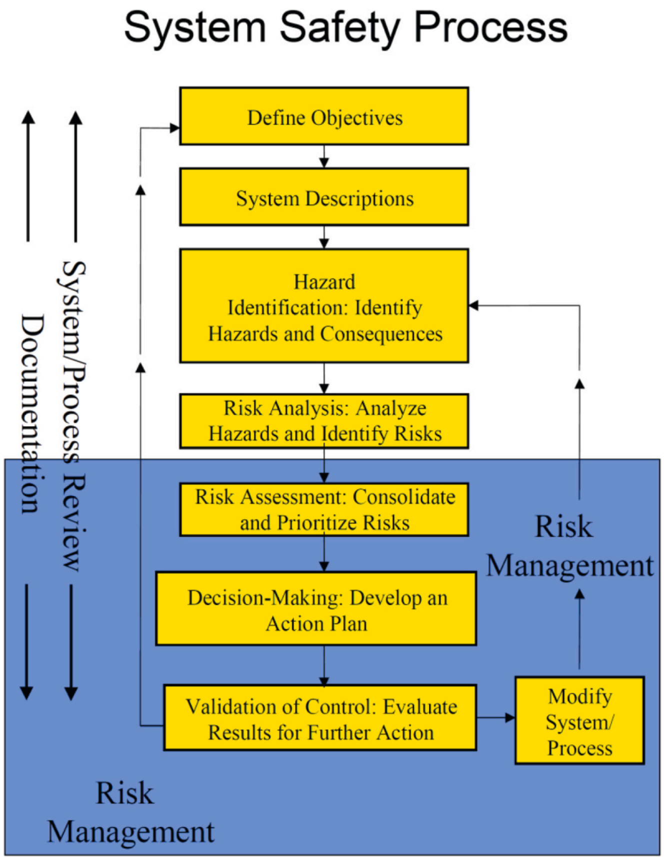

Fig. 2. Closed feedback loop of identifying hazards and managing risks. Reprinted from *System Safety Process,* by the Federal Aviation Administration, retrieved from https://www.faasafety.gov/gslac/alc/libview_normal.aspx?id=6877.

identifying hazards (*risk factors*) and assessing risk (how *likely* that the identified risk factors will materialize into violence; how *severe* will the violence be if it occurs), we are arguably less consistent in linking all identified risk factors to appropriate management strategies and "closing the loop" (Peterson-Badali, Skilling, & Haqanee, 2015; Viljoen, Cochrane, & Jonnson, 2018; Wand, 2012). Whether due to limited resources, staff turn-over, or a lack of adequate education and training in VRA, it is sometimes the case that risk factors are identified, but not adequately managed. More commonly, good management plans are put forward, but the risk factors themselves are not regularly re-assessed to evaluate the effectiveness of the management plans in terms of risk reduction (and safety enhancement). Consequently, the amount and acceptability of any "residual risk" remains unknown. As argued by Monahan and Skeem (2014), it is insufficient to simply demonstrate that a variable is a risk factor for violence. Rather, it must also be shown that the variable reduces violence risk when successfully managed or changed (e.g., through treatment). Ideally, this will be underpinned by at least a rudimentary understanding of causation; that is, a set of working hypotheses about *how* the identified risk factors materialize into violence; and conversely, *why* risk is reduced if effectively managed.

The clinical and forensic practice of *case formulation* seeks to answer these questions and is increasingly recognized as an essential link between the assessment of risk factors for violence and their overall management (Logan, 2014). In the context of VRA, a case formulation is a narrative statement that aims to synthesize all available information and explain the precipitants, causes, and maintaining influences of a person's violence, and then generate linked hypotheses for action to facilitate positive change (Logan, 2016; Sturmey & McMurran, 2011). In parallel, aircraft accident investigations bring together data from multiple sources (e.g., flight data and cockpit voice recorders, air traffic control recordings) to establish the sequence of events leading to an accident, produce a multi-layered explanation of *why* the accident occurred (e.g., spanning human- and systems-level failures), and outline what safety actions (e.g., changes to specific pre-flight routines or other in-flight procedures) need to be implemented to avoid a recurrence.

Recent literature on case formulation in forensic settings emphasizes the necessity of understanding the explanatory causes of an individual's past (and envisaged) violence in order to develop effective risk management plans and evaluate their utility (Logan, 2016; Sturmey, McMurran, & Daffern, 2019). To date, however, there is little research to show whether, or to what extent, risk management plans are guided by case formulations, nor the extent to which case formulations improve the effectiveness of risk management plans in terms of violence reduction or safety enhancement (Hart, Sturmey, Logan, & McMurran, 2011; Hopton, Cree, Thompson, Jones, & Jones, 2018). This is a critical avenue for future research: only when the efficacy of risk management plans are reliably evaluated will the "residual risk" be correctly estimated, and the feedback loop closed.

It is also worth evaluating how consistently new or additional risk factors permeate our VRAs. That is, how often do clinicians venture outside of the pre-determined checklists represented by VRA tools and consider other risk factors that may be relevant, even if unique, to an individual case? In contrast to actuarial risk assessment instruments, SPJ tools such as the HCR-20 and START give clinicians the ability to code case-specific risk factors; however, this still appears to be an infrequent practice in light of guidelines that expressly recommend against it, with the concern that consideration of additional or idiosyncratic risk factors will dilute the predictive accuracy of the assessment (Harris, Rice, & Quinsey, 2008). Although airline pilots and crew frequently use standardized checklists to identify known hazards and areas of potential risk (e.g., for ramp, maintenance, or flight operation events), as described above, the overarching assumption is that the safety system must be flexible enough to incorporate and evaluate the impact of novel hazards as they arise. It is broadly recognized that the inventory of hazards is large and estimates of risk are continuously evolving (FAA, 2016). We may be wise to consider this and be cautious not to artificially enumerate or condense the inventory of risk factors for something as complex and multi-determined as violence.

2.2. Lesson #2: prevention versus prediction – focusing on the process, not the outcome

Another important lesson may be gleaned from the overarching premise of risk assessments conducted in the aviation industry. It is commonly acknowledged that these assessments possess no intrinsic value; they acquire value through their ability to influence the decisions made by users of the assessments (FAA, 2016; ICAO, 2018; Transport Canada, 2008). Like forecasts for severe weather, aviation risk assessments are necessarily joined by prescriptive statements for action to manage risk and reduce harm. In this context, the predictive "validity" of hazards are not measured in terms of their associations with adverse outcomes, but rather with how well their identification facilitates decision-making, promotes effective and practical risk management strategies, and *averts* dangerous outcomes. Arguably, what matters not is the strength or consistency of the association between a hazard and an outcome. Provided there is a reasonable or obvious connection between the two (e.g., not wearing seatbelts, resulting in passenger injury during unexpected turbulence), the focus is on the risk management and risk reduction process, and not the unmanaged outcome. The relative disinterest in the predictive association between an identified hazard and an adverse safety outcome is perhaps a reflection of the impracticality of studying this association in the context of active risk mitigation.

As in aviation, VRA specialists have a professional and ethical obligation to prevent harm rather than simply predict it (Buchanan, Binder, Norko, & Swartz, 2012; Hart & Logan, 2011). Despite this, it has been observed that the study of predictive validity in VRA (i.e., the magnitude of the statistical association between identified risk factors and violent outcomes) far exceeds research on the utility of VRA tools for risk management and risk reduction (Viljoen et al., 2018). In their systematic review of 73 studies, Viljoen and colleagues observed a disconnect between the activities of risk assessment and risk management, and noted that the completion of VRA instruments did not consistently flow through to risk management efforts and reduced rates of violence. Similarly, studies have found a poor match between youthful offenders identified risks and the corresponding interventions and management plans put in place to address them (Peterson-Badali et al., 2015; Vieira, Skilling, & Peterson-Badali, 2009).

Research studies concerned with the predictive validity of VRA instruments will also necessarily be impacted by the circumstances in which risk for violence is being actively managed (e.g., inpatient hospitals, correctional facilities, community supervision teams). With this in mind, it is remarkable that most studies investigating the predictive validity of VRA tools do not specify the intensity, duration, or effectiveness of any treatment or risk management plans being received over the follow-up period, rendering it difficult or impossible to estimate the actual opportunity for violence to materialize. Many outcomes in the domain of serious violence also naturally occur at low frequencies, thereby further complicating prediction models (Mossman, 1994, 2012).

While it is true that risk factors appearing on VRA tools must have some validity in predicting violence (otherwise, they will presumably have limited value for risk management), scholars have commented on the futility of the "Prediction Olympics" that appeared to characterize the early years of VRA research (e.g., Grann et al., 2005; Hart et al., 2007). Because it is unethical to have a study design where risk factors are identified but violent outcomes are permitted to unfold without intervention, it will usually not be possible to distinguish what might have been a false-positive error (i.e., a risk assessment concluding that someone is at elevated risk of violence when in fact they were never going to behave violently), or whether the management strategies effected to decrease risk (following a valid risk assessment) were successful.

Our friends in aviation seem to have long acknowledged and bypassed this conundrum by focusing more squarely on the process of risk management and not on the prediction of accidents. Parenthetically, it is recognized that accident rates are not an effective measurement of safety, as they are purely reactive and only meaningful indicators when accident rates are high enough (Transport Canada, 2008). Guided by the research that has amassed to date on the predictive validity of VRA instruments, it is now perhaps time to consider accepting a reasonable and common-sense relationship between risk factors and violent outcomes. Moving past the statistical association between risk factors and outcomes – which will be seriously attenuated due to active risk management interventions anyways – can encourage an enhanced and much needed focus on whether identified risks assist in creating effective risk management plans that measurably reduce risk and avert violence. Correspondingly, measurement reliability may be re-conceptualized in terms of the consistency of case formulations and risk management decisions that get made as a result of VRA use, rather than the simple concordance in risk ratings assigned by different assessors.

2.3. Lesson #3: focus on short-term, proximal risk

Weather systems are dynamic and fast moving, and weather forecasts are typically most accurate when made over short periods of time. Similarly, the dynamic nature of many aviation hazards necessitates short-term assessments (and re-assessments) of hazards using real-time data to accurately analyze and assess risk. Most of us would not wish to be passengers on a flight where the pilots were not receiving regular, real-time updates regarding active weather systems or air traffic patterns, for example.

It has been recognized for some time that VRAs should incorporate dynamic (i.e., modifiable) markers of risk to properly inform management efforts and focus treatment most effectively (Hogan & Olver, 2016; Skeem & Mulvey, 2002), and that assessments be seen as having a limited "shelf-life" with a need for regular re-assessments (Vincent & Grisso, 2005). The measurement of change in dynamic risk indicators can facilitate better-timed interventions, as well as help evaluate the effectiveness of already implemented risk management strategies (Douglas & Skeem, 2005). In practice, however, the uptake of these recommendations is inconsistent, and study designs have been slow to incorporative time-sensitive methodologies that can capture fluctuations in dynamic risk factors over time, and which can assess the relationship between *changes* in dynamic risk factors and the likelihood of violence (Penney, Marshall, & Simpson, 2016). Although person-based risk factors for violence such as substance use, impulsivity, or active psychosis may not change as quickly as the weather, they are amenable to change, and assessments must capture this change: is the risk factor lessening in response to intervention? Are patterns of increase or decrease in the risk factor aligning with the likelihood and/or severity of violence or other adversities? Even among ultra high-risk patients, violence risk ebbs and flows over time (Odgers et al., 2009), and the oscillation of dynamic risk factors is found to be a better predictor of violence as compared to static risk indicators (or dynamic risk factors measured in a one-time, static fashion; Penney et al., 2016; Skeem et al., 2006).

Recently, scholars in the field have asserted that a focus on risk markers that are not only dynamic, but that are also temporally proximal to violence, will render assessments more precise and help clarify causal relationships between risk factors and outcomes (Kennedy, O'Reilly, Davoren, O'Flynn, & O'Sullivan, 2019; Monahan & Skeem, 2014). One reason underlying this assertion is that many dynamic risk factors do in fact fluctuate and respond to treatment – some very rapidly – and that consequently, they will forecast violence only in the short-term. A longer time window will fail to show predictive effects because many dynamic markers (e.g., active symptoms of illness, impulsivity, treatment non-compliance) would have since stabilized due to successful management strategies or simply the passage of time (Chu, Thomas, Ogloff, & Daffern, 2013; Gray, Taylor, & Snowden, 2008). It has been suggested that some risk factors populating commonly-used VRA tools are, in fact, distal and indirect risk factors rather than proximate, causal factors (Kennedy et al., 2019) and therefore questionable foundations for treatment and risk management plans (Ullrich, Keers, & Coid, 2014).

In this context, a small number of VRA instruments for short-term, imminent violence have been developed (e.g., the Dynamic Appraisal of Situational Aggression [DASA; Ogloff & Daffern, 2006]), and have shown impressive predictive capacity over follow-up periods ranging from 8 to 24 h (Chu, Daffern, & Ogloff, 2013; Dickens, O'Shea, & Christensen, 2020; Lockertsen et al., 2020), as well as relative superiority for predicting inpatient violence over VRA instruments designed for longer-term follow-up periods (Ramesh, Igoumenou, Vazquez Montes, & Fazel, 2018). These tools are constructed based on behavioral changes frequently observed to occur in the hours and days preceding a violent incident (e.g., confusion, irritability, physical and verbal threats), and have content that appears more "causal" – that is, observable behaviors that are antecedent, proximate and explanatory for subsequent violence. Still, the evidence base showing their ability not just to *forecast* acts of imminent violence, but to also *reduce* the frequency of violence when implemented, remains limited (see van de Sande et al., 2011 for an exception, reporting declines in rates of aggression and seclusion resulting from frequent, short-term risk assessments in a controlled trial). Furthermore, the utility of these tools will be mainly limited to the inpatient context, where frequent (hourly, daily) behavioral observations are possible and where rapid fluctuations in acute risk variables is more common. Still, in the context of outpatient VRAs, greater attention can be given to the chronology of change in identified risk factors, and how these change patterns link to intervention and risk. Even if assessed retrospectively, eliciting detailed information on the presence and functional role of risk factors most proximal to incidents of violence will likely yield further improvements in the precision and utility of VRAs conducted in outpatient settings.

3. Penetrating the VRA sound barrier: the 'right' conditions

The field of VRA appears to have reached a point of diminishing returns in terms of instrument development and the forecasting of (non-imminent) violence. Traditional methods of assessing instrument reliability (i.e., trained inter-rater concordance of scores) and validity (i.e., predictive associations with violence) appear unable to capture the utility of VRA activities that occur in a context of violence prevention and risk management, rather than violence prediction. At present, "breaking the sound barrier" as it relates to VRA necessitates re-conceptualizing how instrument reliability and validity are measured, and moving beyond evaluations of the psychometric properties of commonly-used VRA tools.

What might such a re-conceptualization look like? Flowing from the points of analogy enumerated above, a proposed solution may be to measure the reliability and validity of the discrete steps involved in the risk assessment and management process, rather than assessing the psychometric properties of our tools as wholes. That is, we could pose the following questions: (1) how consistent (reliable) and accurate (valid) are VRA instruments like the HCR-20 and START in identifying the relevant risk factors to manage for a given individual? (2) once these risk factors are identified, how likely is it that the same two practitioners will produce a similar case formulation (i.e., field reliability) and does that formulation capture the individual's risk factors accurately and comprehensively? (3) from the case formulation, how often do clinicians produce the same risk management plans (reliability), and are these plans available, viable, and effective for managing the identified risk (validity)? and finally, (4) does the overall process result in decreased violence? This shift in focus will permit a better understanding how existing VRA knowledge is applied to guide real-world decisions, and in turn, how those decisions actually avert violence and other adversities (Monahan & Skeem, 2014; Viljoen et al., 2018).

4. Conclusion

As in aviation, a priority for mental health professionals is one of "no accidents" (i.e., a nil base rate of violence). However, a certain amount of risk is necessary to evolve, whether it be advancing the limits of commercial air travel or managing persons at risk for violence in a way that also promotes their rehabilitation, dignity, safety and well-being (Simpson & Penney, 2011, 2018). It is easy to achieve a nil rate of accidents if air travel ceases completely (a statement that rings eerily true as I write this manuscript during the COVID-19 pandemic); analogously, we can have a nil rate of community violence if all persons posing a risk of violence are detained indefinitely. The production of accurate risk estimates and associated management plans necessitate careful, creative, and innovative research. As noted, although much attention has so far been paid to producing valid risk estimates, far less has been devoted to constructing effective risk management plans and studying their ability to reduce rates of violence (Viljoen et al., 2018).

The "lessons" enumerated above describe principles and practices that may further advance the field of VRA, and specifically, achieve a better balance between risk assessment and risk reduction efforts, and between risk reduction and safety promotion. They are meant to have simultaneous relevance for both research and clinical practice. For example, incorporating regular re-assessments of risk into routine practice, and systematically evaluating changes in risk status over time, will permit a data-driven approach to studying the efficacy of risk management plans in terms of risk reduction. A more comprehensive approach to measuring outcomes that goes beyond counting "accidents" (i.e., violent incidents) will also facilitate the study of how risk management plans relate to safety enhancement (e.g., positive and strengths-based outcomes such as meaningful employment and relationships). Bolstering individual strengths and safety-promoting factors can work to proactively reduce and maintain low levels of risk in the long run. As noted in aviation, there are more fulsome ways of measuring safety than the absence of accidents.

Furthermore, a stronger focus on the processes of case formulation and risk management, rather than on the prediction of outcomes, may encourage the "validity" of risk factors to be re-conceptualized in terms of their ability to help create effective and practical risk management plans that can be implemented proactively and consistently (e.g., across patients with similar risks and needs, or across different clinical teams). A more overt acknowledgment that many existing study designs cannot capture the true predictive validity of risk factors in the context of active risk mitigation is needed. At the same time, study designs that incorporative time-sensitive methodologies to capture fluctuations in risk over time, and short-term measures of imminent risk, appear better-equipped to inform potentially causal pathways between risk factors and violence, and to directly reduce the frequency of violence when implemented successfully.

Key concepts from other fields of study where risk assessment occupies a critical position may be usefully applied to advance the VRA field, and the analogies drawn to aviation in this paper will hopefully provide food for thought and stimulate progress among both researchers and clinicians. Of course, there are limits and imperfections to the analogies presented in this paper. While aviation deals largely in scientific constants, the practice and science behind VRA is necessarily bound by the "contingencies of life" and the irrationalities of human behavior. Aircrafts are reliably and predictably influenced by external variables such as temperature, speed, and air pressure, which then informs universal management strategies that can be implemented in a "one size fits all" fashion. Human beings, by contrast, will be uniquely and differentially affected by known risk factors for violence such as substance misuse and active symptoms of psychotic illness, and management strategies will need to be correspondingly tailored. Nevertheless, the fundamental purpose of risk assessments in aviation safety and mental health appear similar, and echo the description of meteorological warning systems provided by Monahan and Steadman in 1996: "to maximize the number of people who take appropriate and timely actions for the safety of life and property. All warning systems start with detection of the event and end with getting out of harm's way" (p. 937).

Ethical statement

There has been no institutional ethics review associated with the current manuscript as it is a review/theoretical piece and does not report on any quantitative or qualitative results stemming from humanor animalsubjects research.

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