Time Sequencing the TRAP-18 Indicators

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Abstract

A time sequence analysis is conducted on 125 lone actor terrorists, most of whom
mounted attacks in Europe and North America, utilizing the TRAP-18 (Terrorist
Radicalization Assessment Protocol), a structured professional judgment
instrument with demonstrable interrater reliability and criterion, discriminant, and
predictive validity. Both frequency filters (≥ 3) and coefficient filters ($>.50$) were
applied to the data. Results indicate that virtually all distal characteristics, such as
criminal violence, mental disorder, and ideology, preceded the proximal warning
behaviors, such as pathway, fixation, identification, leakage, last resort, and directly
communicated threats. Indicators that were "gatekeepers" and "turning point
events" were also identified (Taylor et al., 2008). The time sequence analysis
further validates the model of the TRAP-18 as a risk instrument for the assessment
and management of lone actor terrorist violence.

Public Interest Statement

This study applies a terrorist risk assessment instrument, the TRAP-18, to a large

sample of lone actor terrorists using time sequence analysis: a method

by which indicators of risk are organized in a temporal relationship with one

another. It allows counterterrorism investigators to better understand

the unfolding of risk indicators over time on the way to a terrorist attack, and helps

prioritize the most dangerous cases.

Timothy McVeigh slowly drove the Ryder truck down Northwest 5th Street. He pulled over to the curb, pulled out a disposable lighter, and lit the 5-minute detonation cord. He stopped at a stoplight and lit his second fuse. The stoplight took 30 seconds to change. With the light now green, he maneuvered the vehicle under the overhang of the Murrah Federal Building in Oklahoma City, Oklahoma, just below the children's daycare center. He was calm. His heart did not race. He was a soldier on a mission. McVeigh stepped out of the Ryder truck, locked the door, and walked, then jogged several blocks behind the adjacent YMCA building--just before the 5,000 pound ammonium nitrate and fertilizer bomb exploded, killing 168 men, women, and children. It was 0902 local time on April 19, 1995 (Meloy case files; Michel & Herbeck, 2001; Serrano, 1998).

This is a time sequence analysis, based upon the known record of the psychological state of mind and final pre-offense behaviors of the perpetrator of the largest act of domestic terrorism in US history. Such analyses have been done in case studies of terrorists (Böckler, Hoffmann & Zick, 2015; Erlandsson & Meloy, 2018; Cotti & Meloy, 2019; Meloy, Habermeyer & Guldimann, 2015; Meloy & Genzman, 2016; Gill, 2015; Serrano, 1998), and provide dramatic, and in some cases, very informative behavioral records of an individual in the final moments of an attack. However, research of large groups of violent extremists and the sequencing

of their behaviors—whether proximal or distal to the event—are very infrequent (Corner & Gill, 2019; Corner, Bouhana & Gill, 2019; Jacques & Taylor, 2007; Taylor et al., 2008), and have only recently begun to shine an illuminating light on the daily tasks of threat assessors: to risk manage in real time a person of concern and prevent a violent outcome. The specific prediction of such acts is highly improbable, but within the law of large numbers (Bernoulli, 1713) we can see patterns, and the recognition of patterns can lead to prevention.

According to Taylor et al. (2008), "Criminal acts and investigative decisions occur not as variables to be counted but as events to be understood within a larger sequence of events" (p. 54). Such an undertaking requires temporal sequencing methodologies. The addition of proximity coefficients allows for the quantification of key risk and mediating factors that mark trajectories of behaviors over time (Beune, Giebels & Taylor, 2010; Taylor, 2006; Taylor et al., 2008).   Such analyses exist for other forms of interpersonal violence, including alcohol related and sexual violence (Taylor, Keatley & Clarke, 2017; Fossi, Clarke & Lawrence, 2005), and even terrorism (Corner et al., 2019; Corner & Gill, 2020) . What distinguishes this study from others is the layering of a validated threat assessment tool on top of these methodologies. The present study investigates the temporal sequencing of 125 lone-actor terrorists, with purported ideologies ranging from Extreme Right Wing (XRW) to Islamic Jihadist terrorism, to further understand the generalized pathway to acts of targeted violence.

Method

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Sample

We employ an existing data set of 125 lone-actor terrorists (Corner et al., 2019). See demographics in Table 1. 'Lone-actor terrorists' were included in the sample if they carried out or planned to carry out, alone, an attack in service of some form of ideology, for which they were convicted or died in the attempt (Gill et al., 2013).

< Insert Table 1 >

The dataset has undergone several iterations of data collection to update the original codebook and to include new cases. First collated by Gill, Horgan and Deckert (2013), the original dataset included both individuals who committed their offense autonomously, with or without links to an organization, and isolated dyads (which are pairs of individuals operating independently of a group). It contained over 180 variables including behavioral indicators spanning the radicalization, attack preparation, attack, and attack aftermath stages of the event process. Independent coders collectively spent 5500 hours working on data collection and coding.

Three independent coders worked on coding the presence/absence of each codebook question for each lone-actor terrorist. Their work was reconciled in two stages. First, coder A's work was compared to Coder B's and discrepancies were arbitrated by the project's senior researcher. Second, reconciled AB's work was compared to Coder C's work, and again discrepancies were arbitrated by the project's senior researcher. For both stages, the senior researcher consulted the source documentation. This decision-making was guided by a 'continuum of reliability' in which each source was plotted

along a scale from 'most reliable' to 'least reliable' (Gill et al., 2017). Most reliable sources included court transcripts and associated documents. Other reliable sources included competency evaluations, sworn affidavits, and indictments. Somewhat reliable sources included offender/affiliated group statements (verbal or written), as well as warrants and expert witness reports (which may be subject to bias). Media sources were also subject to a reliability continuum spanning non-tabloid newspapers (most reliable) to personal blogs and tabloid publications (least reliable).

The data used in this paper constitute the 3rd wave of data collection, which has been updated to account for new cases, and removed cases from the original dataset if: (1) the perpetrator was a part of a two-man cell (e.g. a dyad) or (2) if the individual had some form of command and control link with a terrorist organization (Corner et al., 2019).

The present analytical strategy necessitates sequences of behaviors organized over time. All available behavioral indicators were formed into "chains" or sequences of behaviors by Corner and colleagues (Corner et al., 2019) from those which occurred first to those which occurred last. These behavioral indicators (and hence sequences) were 'mapped onto' the specific distal and proximal indicators of the TRAP-18, according to the methodology developed and implemented by Meloy & Gill (2016) previously. However, this methodology presented several challenges in the current paper: first, a number of the TRAP-18 indicators emphasize underlying *motivation*, whereas the original coding of the 111 terrorists emphasized *behaviors*; and second, the TRAP-18 focuses on patterns of behaviors, rather than discrete acts. For example, under the TRAP-18 paradigm, an offender's *pathway* to violence is assessed, to better understand

the potential threat, its credibility, and hypothesized motivation, while discrete behaviors, such as the procurement of weapons, would inform that assessment.

This led to the necessity of judgment, and in some cases, extrapolation, to identify clusters of behaviors in the original coding that theoretically and pragmatically aligned with a specific TRAP indicator. Both of these problems increased the subjectivity of the research task, which was addressed in two ways: (1) The researchers conferred on the choice of codebook variables for each of the TRAP indicators, capitalizing on their respective understanding of the TRAP-18 and its definitional framework (i.e., based on the TRAP-18 published indicator definitions; Meloy, 2017); and (2) the discrete variables from the original codebook assigned to each TRAP-18 indicator can be found in Meloy & Gill (2016); the complete mapping of the TRAP-18 indicators on all the codebook variables used for this study is available from the first author. Hence the data for analysis were 125 sequences of TRAP-18 indicators.

Measurement Instrument

The Terrorist Radicalization Assessment Protocol (TRAP-18) is composed of 8 proximal warning behaviors and 10 distal characteristics which were theoretically and rationally derived from the extant research on terrorism (Meloy et al., 2011; Meloy & Yakeley, 2014; Meloy & Gill, 2016; Meloy, 2017). The model assumes that the proximal warning behaviors are more closely related in time to the violent act of the terrorist than the distal characteristics – a theory further investigated in this study. Monahan and Steadman (1996) proposed a very helpful weather analogy for violence prediction. They opined that, among other things, there is a usefulness to the meteorological terms, *Watch*

and *Warn*, in both specificity and imminence when thinking about and communicating violence risk (Monahan & Steadman 1996). This analogy has been applied to the juxtaposition of the proximal warning behaviors and the distal characteristics for the TRAP-18 model (Meloy, 2017). Any presence of a cluster of distal characteristics would suggest a *Watch* strategy: there are storm clouds forming on the horizon, but one does not know if or when they will constellate into a fierce weather event. The presence of one proximal warning behavior suggests that the storm is in one's backyard. In other words, monitoring of a potential event shifts to active management of a more imminent event, culminating in the *Warn* strategy. There are no empirically derived cutoffs for the TRAP-18 since it is a structured professional judgment instrument and not a psychological test. Nevertheless, the model advances the hypothesis that one proximal warning behavior is necessary for active risk management, and data indicate that all targeted violence subjects to date have exhibited multiple warning behaviors prior to their attacks (Meloy, 2018; Meloy et al., 2019; Bockler et al., 2021).

These 18 indicators are considered *patterns* of risk to correct for the assessor's tendency to focus upon a discrete variable, and to facilitate a more wide-angle view by capitalizing on our natural ability to see patterns and organize stimuli. Pattern analysis has its roots in gestalt psychology (Koffka, 1921; Kohler, 1929; Wertheimer, 1938) and capitalizes on our normal cognitive perception to organize bits of detail into meaningful patterns.

The foci of these 18 indicators are present behaviors of concern, the core of threat assessment, rather than the traditional mental health approach of an initial diagnostic

formulation often based upon fairly remote historical data (Meloy & Hoffmann, 2021) to determine general violence risk. Each indicator is coded as present, absent, or insufficient data. The typology consists of the following 8 proximal warning behaviors:

1.*Pathway Warning Behavior* is research, planning, preparation for, or implementation of an attack. This first warning behavior combines the concept of a *pathway* for targeted violence (Fein & Vossekuil, 1999) with the late stage markers formulated by Calhoun & Weston (2016).

2. *Fixation Warning Behavior* is an increasingly pathological preoccupation with a person or a cause, accompanied by a deterioration in social and/or occupational life that may precede, coincide and/or follow the development of a fixation. Fixations on average precede >80% of all targeted violence attacks (Meloy & Rahman, 2020).

3. *Identification Warning Behavior* is a psychological desire to be a pseudo-commando (Dietz, 1986) or have a warrior mentality (Hempel, Meloy & Richards, 1999); closely associate with weapons or other military or law enforcement paraphernalia; identify with previous attackers or assassins; or in the case of the individual terrorist, to identify oneself as an agent to advance a particular cause or belief system.

4. *Novel Aggression Warning Behavior* is an act of violence that appears unrelated to the intended act of concern and is committed for the first time; it is typically done to test the subject's ability to carry out his or her act of violence.

5. *Energy Burst Warning Behavior* is an increase in the frequency or variety of any noted activities related to the target, even if the activities themselves appear relatively innocuous, usually in the weeks, days, or hours before the attack.

6. *Leakage Warning Behavior* is communication to a third party of an intent to do harm to a target through an attack (Meloy & O'Toole, 2011); the third party may be an Internet audience and/or any social media audience.

7. *Last Resort Warning Behavior* is evidence of a "violent action and/or time imperative" (Mohandie & Duffy, 1999). It may be a signal of desperation or distress. Often it is the result of an unexpected triggering event, or one which is anticipated, which involves a loss in love or work. The subject believes he has no other choice and must act now. He may feel trapped (S. White, personal communication, October, 2020).

8. *Directly Communicated Threat Warning Behavior* is the communication of a direct threat through any means to the target or law enforcement beforehand.

The 10 distal characteristics are as follows:

1. *Personal grievance and moral outrage* is the joining of both personal life experience and specific historical, religious, or political events. Personal grievance is often defined by a major loss in love or work, feelings of anger and humiliation, and the blaming of others. Moral outrage is typically a vicarious identification with a group which has suffered, even though the lone actor terrorist usually has not experienced the same suffering.

2. *Framed by an ideology* is the presence of beliefs that justify the subject's intent to act. It can be a religious belief system, a political philosophy, a secular commitment, a one-issue conflict, or an idiosyncratic justification. Beliefs are usually superficial and selected to justify violence.

3. *Failure to affiliate with an extremist or other group* is the experience of rejecting or

being rejected by a radical, extremist, or other group with which the subject initially wanted to affiliate.

4. *Dependence on the virtual community* is the use of the Internet through social media, chat rooms, emails, listservs, texting, tweeting, posting, searches, etc., for virtual interaction (for example, reinforcement of beliefs) or virtual learning (for example, planning and preparation)(Gill, 2015).

5. *Thwarting of occupational goals* is a major setback or failure in a planned academic and/or occupational life course.

6. *Changes in thinking and emotion* is a pattern over time wherein thoughts and their expression become more strident, simplistic, and absolute. Argument ceases and preaching begins. Persuasion yields to imposition of one's beliefs on others. There is no critical analysis of theory or opinion, and the mantra, "don't think, just believe," is adopted. Emotions typically move from only anger to contempt for others' beliefs, and disgust toward the outgroup, culminating in a willingness to homicidally aggress against them (Matsumoto et al., 2015). Violence is cloaked in self-righteousness and the pretense of superior belief. Humor is lost.

7. *Failure of sexually intimate pair bonding* is a historic (i.e., lifetime) failure to form any lasting sexually intimate relationship.

8. *Mental Disorder* is evidence of a major mental disorder in the past or in the present.

9. *Creativity and innovation* is evidence of tactical thinking "outside the box." The planned terrorist act is creative (i.e., a major behavioral aspect of the attack has not been carried out before in contemporary times) and/or innovative (i.e., it may have been, or is likely to be, imitated by others). This indicator is omitted from the analysis below due to

the fact that the interpretation of this variable in the current data is ascribed post-terrorist event, rather than being something that is behaviorally noted in the build-up to the event (Meloy & Gill, 2016).

10. *Criminal violence* is evidence of instrumental criminal violence in the subject's past, demonstrating a capacity and a willingness to engage in predation for a variety of reasons, such as a history of armed robberies or planned assaults on others for material gain.

More complete elaboration of the proximal warning behaviors and distal characteristics can be found at Meloy (2017), Meloy & Gill (2016), and Meloy and Holzer (in press). The proximal warning behaviors are assumed to be both *sensitive* and *specific* to lone actor terrorist acts, while distal characteristics are assumed to be *sensitive* to acts of terrorism, but not necessarily *specific* to terrorism and may manifest in other adverse behavior, such as criminal violence. However, these assumptions need further empirical validation.

Empirical findings continue to support the interrater reliability and criterion, content, discriminant, and predictive validity of the TRAP-18 (Bockler, Allwinn, Metwaly, Wypych, Hoffmann & Zick, 2021; Guldimann & Meloy, 2019; Meloy, 2018; Meloy & Gill, 2016; Meloy, Goodwill, Meloy, Amat, Martinez & Morgan, 2019). Multidimensional scaling (MDS) analysis has demonstrated the differential two-dimensional clustering of proximal warning behaviors when comparing North American terrorist attackers and other subjects of national security concern (Goodwill & Meloy, 2019). Questions have been raised concerning its ability to comprehensively code jihadist terrorists from open source data in Europe (Bruge, Desmarais & Simons-Rudolph, 2020).

However, another study found the TRAP-18 to have high sensitivity and specificity in the prediction of violence among a sample of German jihadist terrorists when compared to other nonviolent jihadists (Bockler et al., 2021). One governmental agency, the Scottish Risk Management Authority (2020), has found it to be a validated instrument for the assessment of terrorism risk. There is anecdotal evidence of its use by counterterrorism agencies in both North America and various countries in Europe, and other studies have demonstrated its usefulness in deeply understanding individual cases of lone actor terrorism (Erlandsson & Meloy, 2018; Meloy & Genzman, 2017; Bockler Hoffmann & Meloy, 2017; Cotti & Meloy, 2019).

Time Sequence Analyses

We use proximity coefficients to perform quantitative behavioral sequencing (Beune, Giebels, & Taylor, 2010; Giebels & Taylor, 2009; Taylor, 2006). Proximity coefficients help identify how risk factors impact upon each other and unfold along trajectories towards a terrorist attack. Hence it may be possible to identify risk pathways which better specify relations among patterns of risk factors, rather than relying on static profiles of single factors. We use ProxCalc 2010 version 1.1 to perform all calculations (retrieved from https://paultaylor.com/notes/proximity-coefficient-software/).

The proximity coefficient helps identify the collocation of behaviors across a sample of interactions. The proximity coefficient offers a more complex understanding of chains of behaviors than so called 'lag one sequence analyses' which are more typically used in the literature (Ellis et al., 2017). Lag-one analyses take an antecedent behavior ('a') and a sequitur behavior ('b') and tests whether the latter occurs directly after the

former more frequently than expected by chance (Ellis et al., 2017). This is carried out

repeatedly across each possible behavior pair. Whereas lag-one analyses can only look at

the interdependence between relationship pairs (e.g. A->B, B->C, and C->D), proximity

coefficients can look at interconnectedness across a full chain (e.g. A->B->C->D)

(Taylor, 2006).

Proximity coefficients are calculated from chains of indicators ordered

temporally. Each indicator is assigned a code and these are then arranged in

chronological order. Below we provide a simple worked example of a behavioral

sequence for one hypothesized offender:

Grievance/Moral
Identification
Leakage
Virtual Community
Pathway
Leakage
Attack

The proximity coefficient quantifies how indicators within a behavior chain occur

temporally in relation to one another. In other words, the proximity coefficient describes

the 'closeness' of two indicators in a sequence.

Table 2 provides the computed matrix for the above worked example sequence.

< Insert Table 2 here >

For example, *Identification* (e.g., "Identif") only occurs once in the sequence and is

directly preceded by *Grievance/Moral*. Therefore, the proximity coefficient here is 1.

Identification is not preceded by any other indicator, and so the rest of the *Identification*

column is empty. However, *Identification* precedes five other indicators, the coefficients

for which can be seen in the *Identification* row. In another example, *Leakage* directly

precedes the *Attack*, which would result in a proximity coefficient of 1. However,

Leakage also occurs earlier in the sequence and so the proximity coefficient between

Leakage and Attack is reduced to account for the combined proximity coefficients of

Leakage in relation to the time of *Attack*. Each offender sequence (*n*=125) was analyzed

and a proximity coefficient matrix computed based on the aggregation of all offenders in

the database.

State transition diagrams can be a useful way to visually represent matrices of

proximity coefficients. In these diagrams, the nodes representing indicators are connected

by arrows. The arrows represent contingencies between experiences. An arrow is drawn

between two nodes when they occur next to each other in the behavioral sequence. The

direction of the arrow highlights the temporal ordering of the indicators. These diagrams

resemble flow chart diagrams, which allow for an efficient interpretation of the complex

coefficient matrices.

To further aid interpretability, ProxCalc allows users to apply and adjust the

parameters of two separate filters: a *contingency filter* and a *coefficient filter*. All

diagrams have the same filter applied, that is, contingency ≥ 3, coefficient $> .5$. The

contingency filter sets a lower bound limit for how many times a code needs to

immediately precede another code, for an arrow to be drawn. In the present case, an

arrow is drawn between two nodes when the corresponding indicator is preceded by the

adjoining node (across all sequences) at least 3 times (i.e., contingency ≥ 3).

The coefficient filter sets a similar lower bound but with respect to the proximity coefficient. Again, in the present instance, an arrow is drawn between two nodes when the proximity coefficient is > 0.5. The reason for setting the filters as described above is to: (a) aid interpretability of the resultant diagram; and (b) suppress connections with small proximity coefficients and/or contingencies in order to highlight the most prominent pathways. Table 3 (below) provides the full matrix of proximity coefficients. It is important to note that Table 3 describes the data in its entirety. We employ the state transition diagram to highlight significant 'routes.' Setting the coefficient and contingency filters as we have done means we only draw an edge between two nodes when 1) the corresponding indicator is preceded by the adjoining node at least 3 times, and 2) the indicators occur relatively 'close' to one another in a sequence, i.e., set at 0.5 they are closer together than they are further apart.

The resulting state transition diagram (figure 1) produced by the contingency and proximity coefficient filters utilized can be interpreted by investigating the contingency and proximity coefficients between each node (i.e., TRAP-18 indicator variables). Each arrow in the state diagram indicates the contingency (i.e., the number of times the one indicator directly preceded the next indicator in the sequence) and the proximity coefficient (i.e., an indication of how close within the overall sequence of indicators that the one indicator preceded the other). However, it is important to note that the proximities and contingencies indicated are based on only the bivariate relationship between the two indicators, yet the values are derived in context of the entire sequence. Therefore, the reader should interpret the proximities and contingencies information listed for each bivariate relationship in the state transition diagram as 'stand-alone' or

'unique' bivariate relationships and not as a sequence or chain of indicators. In effect, state transition diagrams illustrate multiple bivariate relationships in a chain or sequence based on an aggregation of data and general temporal order, with some exceptions. However, state transition diagrams do not provide information on the temporal *length* of each indicator, and the time when it starts or ends in the sequence—an important limitation of time sequence analysis.

Results

Table 3 displays the matrix of all proximity coefficients obtained via ProxCalc for TRAP-18 sequences across our dataset of 125 lone-actor terrorists.

< insert Table 3 here >

Figure 1 is a state transition diagram visualizing the results presented in Table 3, with the previously described filters applied[1].

< insert Figure 1 here >

The diagram provides an overall aggregated conceptual account of a person of concern's movement in attack sequence from left to right. The TRAP-18 indicators on the far left (Figure 1: *failure to affiliate with an extremist or other group* and *criminal violence*) occur first in the sequence with no noted indicators preceding

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[1] Contingency (coefficient)

them, and the indicators on the far right (Figure 1: *pathway*, *leakage*, *direct threat*, *last resort*, *identification*) occur last in the sequence—with *attack* being the final outcome.

It is notable that there are three arrows which move right to left against the overall sequence in Figure 1: *failure of sexually intimate pair bonding* to *mental disorder*; *personal grievance and moral outrage* to *mental disorder*; and *fixation* to *framed by an ideology*. One can conceptualize these as potential "feedback loops" or backward links. Three of the TRAP-18 indicators (*energy burst*, *creative and innovative*, and *novel aggression*) fell below the contingency threshold (≥ 3) and/or proximity coefficient (>0.5) filter rules adopted in this study, and are therefore not included in the state transition diagram—but still may be quite relevant in an individual case. The coefficients and contingencies for these can be gleaned in Table 3.

The state transition diagram (Figure 1) aids the reader in visualizing and understanding temporal relationships (i.e., from earlier to later in time, corresponding to interpretation of the left to the right of the diagram, respectively) between the indicators, based on their ordered frequency (i.e., contingency filter applied is ≥ 3) and proximity (i.e., proximity coefficient >.5). This has the potential to allow for closer tracking of individuals as they move toward a potential act of terrorism, and once again, appears to quantitatively support the metaphor of clouds on the horizon (i.e., left side of diagram) versus a storm in the backyard (i.e., right side of diagram) (Monahan & Steadman, 1996).—although the frequency cutoffs and proximity coefficients must be kept in mind when applying this model to individual

cases of concern, and the reader is referred to Table 3 for comprehensive data on the temporal relationships of all the indicators across all the subjects.

Although the actual construction of a state transition diagram is linked directly to the proximity and ordered frequency of the indicators, the configuration of the diagram (i.e., which node is placed where) is malleable and determined by the researchers. In the present study, nodes were configured to best elucidate a temporal sequence of indicators (i.e., nodes) from left to right (i.e., preceding indicators to the left, subsequent to the right) with the fewest number of nodes running right to left. However, there are instances where important and valid nodes or temporal relationships that ran counter to the configuration overall and may be related to "backward" movement (e.g., right to left). Nodes that indicate backward movement (see the blue-colored arrows in Figure 1) may result from sequences that simply found the opposite to other sequences, but may also be indications of a "feedback" mechanism in which the offender is cycling through the same indicators more than once in their entire attack sequence. For example, *framed by an ideology* tends to precede *fixation,* yet *fixation* may also precede *framed by an ideology* in some circumstances (i.e., sequences). In fact, a sequence may have both cases, where an offender develops changes in *ideology* followed by *fixation*, only to return to further changes in *ideology*, bringing about greater *fixation*, as an a example of an inherently destructive, downward-spiraling, feedback loop.

In general, the sequencing within the state transition diagram supports the theoretical model of the TRAP-18, which proposes that distal characteristics precede proximal warning behaviors, and proximal warning behaviors would

precede an attack (Meloy et al., 2015; Meloy & Gill, 2016; Meloy, 2017). As evident

in Figure 1, almost all the distal characteristics, based upon the directionality of the

sequencing and the proximity coefficients, are antecedent to proximal warning

behaviors. The one exception is the proximal warning behavior of *fixation* which

precedes the distal characteristic of *changes in thinking and emotion.* This temporal

reversal may be explained by the nature of the two indicators, as both reveal

cognitive changes in thinking that may appear to coincide or, in the least, prove

difficult to discern a valid temporal sequence. In fact, a person of concern's changes

in thinking and fixation may develop in tandem oscillating back and forth, making

temporal judgments between the two pragmatically moot.

Likewise, the current analysis revealed both a relatively equal number of

instances of *fixation* preceding *ideology* and *ideology* preceding *fixation*, suggesting

that ideological framing may both cause a pathological fixation, as well as result

from such a fixation. Recent theoretical and clinical work has also suggested that

fixation typically has one of three cognitive-affective drivers: obsession, delusion, or

extreme overvalued belief (Meloy & Rahman, 2020), underscoring the importance of

differential mental health treatment for each of these states of mind in the context of

threat management.

Overall, the state transition diagram reveals a generalized sequence of

indicators moving from distal characteristics (on the left) to proximal indicators (on

the right) in line with the conceptualization of the TRAP-18 as an individualized

threat management tool.   For example, in the overall sample (Figure 1*), failure to

affiliate with an extremist or other group* and *criminal violence* do not have any

antecedent indicators, but do precede *mental disorder* and *framed by an ideology*, which in turn precede *thwarting of occupational goals* and a *failure of sexually intimate pair bonding* (failures in work and love), which precede *personal grievance and moral outrage,* and *changes in thinking and emotion*. It is at this point in the temporal sequence where the proximal warning behaviors of *fixation,* and then *identification* are evident, followed by *last resort, pathway, leakage*, and in a few cases, *direct threat* prior to an attack. Note, however, that *last resort* appears to not have any sequitur in Figure 1. In Table 3 it has a proximity coefficient of 0.461 in relation to attack, just below the cutoff for the diagram. *Last resort*, moreover, has been shown to discriminate between attackers and nonattackers in several studies (Meloy et al., 2019; Challacombe & Lucas, 2018; Bockler et al., 2021). This suggests the importance of utilizing Table 3 in individual case analyses.

The importance of the linear nature of this temporal sequence is that threat management of a case can forecast which indicator will likely occur next if the subject of concern continues to move toward an attack, and can plan an interdiction commensurate with the imminency of the threat. For example, deciding to criminally charge a subject who demonstrates a *failure to affiliate with an extremist or other group, a history of criminal violence,* and a *mental disorder* with an act of terrorism could be precipitous without further evidence according to the temporal sequence; however, strong interdiction at the point of *identification, last resort, pathway,* and *leakage* behavior is fully warranted—along with care to not discount a directly communicated threat as an imminent antecedent to an attack, despite the

very low frequency (<20%) of such direct threats by lone actor terrorists (Meloy & Gill, 2016; Meloy et al., 2019).

It is particularly important for the reader to understand that the visualization of the relationships between the TRAP indicators, depicted in Figure 1, is a useful but non-rigid depiction of these relationships. As noted, the employment of cut-off criterions [e.g., frequency filters (>3) and coefficient filters (>.50)] to enable a simplistic, narrative-based and fluid depiction of the indicators comes at the cost of some loss in fidelity. For example, although the visualization depicts *Failure to affiliate with an extremist or other group* as having no preceding indicators, a look at Table 3's contingency coefficients reveals that F*ailure to affiliate* may be preceded by numerous other indicators (e.g., *Changes in thinking and emotion, Criminal violence, Energy burst, Failure to form sexual pair bond, Fixation, Identification, Framed by an ideology, Leakage, Mental disorder, Pathway, Personal grievance and moral outrage, Thwarting of occupational goals,* and *Dependence on the virtual community)*. However, these associations are sub-criterion based on the visualization cutoffs employed and have thus been omitted for increased interpretability, albeit at the cost of greater fidelity. In this respect it is important to note that each individual terrorist may have a different sequence among the various indicators and did not necessarily "begin" their sequence at an indicator that is not visually preceded by any other indicators. In this respect, one may think of the visualization depicted in Figure 1 as a framework capturing only the most robust relationships (i.e, exceeding the cut-off criterions employed) across all individual sequences as an aggregate.

Discussion

Temporal sequencing underscores the finding by others that pathways to targeted violence, including terrorist violence, are complex, and single motivational explanations are insufficient (Clemmow, Bouhana & Gill, 2019; Corner, Bouhana & Gill, 2019; Corner & Gill, 2019). The temporal sequence in Figure 1 quantitatively illustrates the concept of *equifinality*: there are a number of pathways that can lead to one particular outcome. The time sequence also illustrates the concept of *multifinality* in the sense that any one indicator could lead to a variety of outcomes *not* shown in our diagram; for example, subjects who have a history of only criminal violence could move in temporal sequence toward a variety of outcomes, such as successful rehabilitation, job procurement, and affiliation with a prosocial community group. The absence of nonviolent pathways and nodes must be kept in mind to contextualize the attack pathways this time sequence is mapping, and operationally recognize that this can manifest in high numbers of false positive cases – a problem inherent to threat assessment *prediction*, but arguably, not for threat *management* (Meloy & Hoffmann, 2021).

The advanced utility of visualizing the behavioral sequences of lone-actor terrorists under the current state transition diagram framework can be seen in the identification of what may be considered "gatekeeper" indicators and "turning point events:" "a particularly critical point at which to intervene to influence the way a person moves through the process" (Taylor et al., 2008, p. 49). Based on the visualization of indicators in Figure 1, it is posited that *pathway*, *leakage*, and on

occasion, *directly communicated threat* may indeed be these critical points for intervention. In fact, if not for these "gatekeeper" indicators, an attack may not be generally foreseeable. The "turning point event," and central to the overall state transition diagram, is *changes in thinking and emotion*, which precedes the gatekeepers, but is a consequence of the accumulation of many distal characteristics, especially *personal grievance and moral outrage*, and is antecedent to the *dependence on the virtual community*, *identification*, and the gatekeeper indicators (e.g., *pathway*, *leakage*, and *direct threat*). *Changes in thinking and emotion* is an admittedly complex distal characteristic of the TRAP-18 focusing on changes in interpersonal behaviors, internal fantasies, and emotions felt toward an outgroup (Berger, 2018; Matsumoto et al., 2016; Meloy, 2017; Meloy & Yakeley, 2014). This may also be the indicator wherein attitudes become behaviors (Braddock, 2020; Khalil et al., 2019), and radicalization becomes fanaticism (Schuurman & Taylor, 2018; Taylor, 1991), and failures in social and occupational life, incubated in fantasies of revenge, glorification, and purification (Meloy, 2018), herald violent actions.

The notion of gatekeepers and turning point events also suggests that interventions at these points in time will likely prevent an attack. For example, a tactical law enforcement response to any evidence of *pathway* behaviors, *leakage,* and *direct threats* will mitigate risk. On the other hand, the turning point event of *changes in thinking and emotion* would likely necessitate a more strategic and long-term effort to disengage an individual of concern from proceeding further along a pathway to violence. Research indicates that involvement and disengagement from

terrorism is complex and multifaceted at an individual, social, and group level, and there are multiple risk factors which impact the "lived experience" of being a terrorist (Corner & Gill, 2019).   However, temporal sequence analysis is beginning to unpack and disaggregate these factors over the course of time (Corner & Gill, 2019; Corner, Bouhana & Gill, 2019).

Further complicating the risk assessment of an act of targeted terrorist violence is the presence of some direct routes from distal characteristics to pathway, a "fast track of particular concern to prevention efforts" (Taylor et al., 2008, p. 49), but occurrence of these direct routes is low. Figure 1 represents how a *failure to affiliate with an extremist or other group, personal grievance and moral outrage, mental disorder, framed by an ideology* and/or *thwarting of occupational goals* are all distal characteristics that may directly precede the *pathway* warning behavior--and could bypass other proximal warning behaviors. Such findings underscore the importance of monitoring and managing cases that may not indicate any specific proximal warning behaviors but do indicate distal characteristics, particularly when there are several. Again, the emergence of any *one* proximal warning behavior in such a case warrants a shift from monitoring to active management (Meloy, 2017). All the distal characteristics in Figure 1 are antecedent to at least one proximal warning behavior.

The close associations of routes among the proximal warning behaviors in Figure 1 also validates the finding in another study (Goodwill & Meloy, 2019); using a substantially different sample of North American terrorists and a different analysis—multidimensional scaling—proximal warning behaviors clustered among

attackers and did not cluster among non-attackers. The latter methodology is not

locating proximal warning behaviors in time, but rather a visual representation of

the relationship between proximal and distal indicators based on their co-

occurrence within a particular lone-attacker event.

Some distal characteristics occur without any antecedents in Figure 1,

namely *criminal violence* and a *failure to affiliate with an extremist or other group*.

For most persons of concern, these distal characteristics will be substantially

upstream, or "left of bang" (Van Horne & Riley, 2014), from the emergence of

proximal warning behaviors and an eventual attack. However, such findings in a

case provide evidence that the subject has already demonstrated a capability for

intentional violence and is socially unmoored, which could indicate drift toward an

antisocial group, or at least a virtual community of like-minded believers. Note that

mental disorder (0.69) is a *sequitur* of criminal violence, and *framed by an ideology*

follows (Corner & Gill, 2019), but with less proximity coefficient dominance (0.64).

The backward linking of both *personal grievance and moral outrage* and a *failure of*

sexually intimate pair bonding to *mental disorder* accentuates the degree to which

mental disorder is central to both the progression of the lone actor terrorist, and

perhaps regression, as well as the backward linking witches' brew of *fixation* and

framed by an ideology (Corner & Gill, 2019; Cotti & Meloy, 2019).

Some proximal warning behaviors fell below the threshold for inclusion in

the time sequence analysis, i.e., *novel aggression* and *energy burst*, and are not

represented in Figure 1. We think this is likely due to the relative absence of

questions in the original codebook (Gill, 2014) that would account for these

proximal warning behaviors. Both proximal warning behaviors in this study

occurred at a frequency of 2%, which is significantly lower than the same proximal

warning behaviors in Meloy et al. (2019) which appeared in 12% (*novel aggression*)

and 76% (*energy burst*) of the attack sample. In the translation from the codebook

to the TRAP-18 in this study, *novel aggression* was coded if there was "violence close

to the attack with no prior violence in sequence," and *energy burst* was coded if

there was "physical activity."

 Threat Management

Time sequencing is not measuring cause and effect, but can be useful in

forecasting—to return to the weather metaphor—what behavior(s) are likely to

either precede or follow a particular behavior, event, or indicator; thus enhancing

threat management of a case. For example, referring to Figure 1, since *pathway*

(research, planning, preparation and implementation), *leakage, and directly*

communicated threat warning behavior are robust indicators which precede an

attack, any evidence of one of these proximal warning behaviors in a case

necessitates urgency in responding, and the assumption of an mobilization for

attack mindset in the person of concern. When our findings are considered in the

context of FBI data on pre-offense behavior of active shooters, the actual length of

the time frame for research and planning was greater than one month for 62% of

the subjects, and for preparation was 24 hours to a week for 52% of the subjects

(Silver, Simons & Craun, 2018). On the other hand, the proximal warning behavior

of *identification* does not immediately precede an attack, but is followed in close

temporal proximity by either *leakage or pathway behavior*, or both. It is a

mobilization indicator, likely immediately preceded by a *failure of sexually intimate*

pair bonding, mental disorder, changes in thinking and emotion, personal grievance

and moral outrage, and/or framed by an ideology. In earlier work, we have theorized

that *personal grievance and moral outrage* (a distal characteristic) contains within it

the vicarious identification as a *victim* of a suffering group; when identification as a

proximal warning behavior emerges, the vicarious identity is now as a *soldier or*

warrior for the suffering group (Meloy et al., 2019)—impotence to omnipotence,

passive suffering to righteous violence. The time sequencing generally supports this

theoretical assertion, which has been independently validated (Challacombe &

Lucas, 2018) in discriminating between violent and nonviolent Sovereign Citizens in

the US, an extreme right-wing group. Nidal Malik Hasan, the US Army Major who

carried out a massacre at Ft. Hood, Texas, illustrates this well. He identified himself

as both a Muslim being persecuted by the US war against the Taliban in Afghanistan,

whom he considered his brothers; and then over the course of time as he

radicalized, felt compelled to be a warrior to defend his Taliban brothers and attack

those soldiers who were about to be deployed to Afghanistan (Meloy & Genzman,

2017; Poppe, 2018). The evolution from *fixation* to *identification*, supported by this

study, has also differentiated terrorist attackers from other persons of national

security concern (Meloy et al., 2019): it is movement from what one thinks about all

the time, to whom one becomes.

Looking further back on the temporal sequence, *changes in thinking and*

emotion may be immediately preceded by a number of distal characteristics:

personal grievance and moral outrage, *failure to form sexually intimate pair bonds*, *framed by an ideology*, *criminal violence*, *thwarting of occupational goals*, and *mental disorder*; however, only one proximal warning behavior, *fixation*, may immediately precede *changes in thinking and emotion*. Although fixation alone appears to not directly precede an attack, aggregated studies have confirmed that fixation occurs on average in 82% of targeted attackers, whether ideologically motivated or not (Meloy & Rahman, 2020). Fixation may be the temporally earliest proximal warning behavior, and was first noted as an important warning behavior in threatening communications toward public figures (Mullen et al., 2009), one of many studies which led to the founding of the Fixated Threat Assessment Centre (FTAC) in the UK and QFTAC in Australia (Pathe et al., 2018).

Our study is one of several published studies using the current sample of 125 lone actor terrorists (Bouhana, Corner, Gill & Schuurman, 2018; Corner, Bouhana & Gill, 2019; Clemmow, Bouhana & Gill, 2019; Clemmow, Schumann, Salman & Gill, 2020). The other studies, which we recommend be read along with this study, provide a deep analysis of the life course events and vulnerabilities, pre-offense behaviors, and different propensity-situation clustering of lone actor terrorists, and add to the risk assessment value of the TRAP-18 for use by counterterrorism operators given its parsimony, reliability, and continued demonstrated validity (Bockler et al., 2021; Meloy, 2018; Meloy & Holzer, 2020).

Clemmow et al. (2019) devised a typology of person-exposure patterns, (PEPs) and used cluster analysis to identify the relationships among propensity, situation, and exposure indicators; they identified four person-exposure patterns:

the solitary, susceptible, situational, and selection. This cluster analysis nicely pairs

with the TRAP-18, highlighting both its strengths and weaknesses. For example, the

solitary PEP displays low leakage and low stress with an absence of most TRAP-18

warning behaviors, the exceptions being pathway and novel aggression. A

prototype example of this style would be extreme right-wing terrorist Timothy

McVeigh who carried out the Oklahoma City bombing in 1995 (Meloy & Holzer, in

press). On the other hand, the *susceptible* PEP was characterized by high incidents

of diagnosed mental disorder (70%), with high frequencies of leakage, and a likely

co-morbidity of impulsivity, violence, and psychiatric disorder. Our case example is

Tamerlan Tsarnaev, the older brother who orchestrated the Boston Marathon

bombing in April 2013 (Cotti & Meloy, 2019). The *situational* PEP characterizes

offenders who appear relatively stable (comparative to the other PEPs) but

demonstrate high frequencies of leakage and other dynamic stressors, culminating

in last resort warning behavior, which may indicate acceleration toward a targeted

attack. Our prototype is Rev. Paul Hill, an anti-abortion terrorist, who murdered

two clinic staff in Pensacola, Florida in 1994 (Gill, 2015). The *selection* PEP suggests

a psychopathic offender with a history of criminal violence. Our prototype case is

Omar Mateen, a jihadist inspired lone actor who attacked the Pulse Nightclub in

Orlando, Florida in 2016. Different analyses of the same data set using advanced

statistical methods improves our ability to simultaneously and accurately answer

the questions: Where is the person of concern on a individually constructed

timeline, What can be forecasted, and What is the person-exposure pattern of this

individual? Such data provide an opportunity to have a more granulated and

analytical response to each case, enhancing efficiency of use of personnel and resources.

In an important extension of the Clemmow et al. (2019) study, the first base rate study of purported risk factors for terrorist violence in the general population was conducted (Clemmow et al, 2020). In terms of *propensity*, or predisposition to offend, the lone actor terrorists were significantly more likely than the general population to have previous criminal convictions, previously been in prison (*criminal violence* in the TRAP), a history of substance abuse, previous military experience or in the military at the time, were unemployed *(thwarting of occupational goals)*, with traits of thrill-seeking, low self-control, and diagnosed mental disorder (*mental disorder* in the TRAP).   Some, but not all, of these findings are captured in the TRAP-18 distal characteristics, and their temporal relationship to one another and the attack are seen in Figure 1.   Several counterintuitive findings were that the general population (n=2108) was *more likely* to have experienced bullying or other violence, and chronic stress than the terrorists.   Such findings illustrate, once again, the risks of using remote historical data to assess current risk of targeted violence without such base rate data in the general population. In terms of *situation,* the lone actors were more likely than the general population to have been made unemployed (*thwarting of occupational goals*), experienced prejudice or injustice, reported escalated anger (*personal grievance and moral outrage*) and dropped out of school. However, the general population had more frequent experiences with situational stressors across the family and occupational spectrum, but were mitigated by attitudes disapproving violence in their immediate family or

community. The absence of measurement of protective factors in the TRAP-18 is a weakness of the instrument and needs to be offset by other measures of protection, such as those included in the Violent Extremist Risk Assessment Version 2 (VERA; Pressman & Flockton, 2012). In terms of *exposure* items, the lone actor terrorists experienced significantly more of the following: joined a wider group, close associates involved in violent extremist action, face to face interactions with extremists, virtual interactions with extremists, attempts to recruit others, rejected from a political group, engage with propaganda from the wider group, and spouse involved in the wider movement. Such findings negate once again (Schuurman et al., 2018) the notion that these individuals are truly alone, or loners, and most interestingly, did not do significantly greater engagement with propaganda by other lone actor terrorists (26.4%) or their materials (16.8%) than the general population; such behavior also emphasizes the importance of (virtual) social networks among lone actor terrorists, and underscores the importance of *failure to affiliate with an extremist or other group* and *dependence on the virtual community* as distal indicators on the TRAP.

Limitations

The present study is not without limitations. First, the data are open source. It is necessary to acknowledge the potential limitations of relying on secondary source data, over primary sources, such as direct assessments. Open-source data have been criticized for having the potential to be unreliable, subject to bias, and incomplete (Spaaij & Hamm, 2015). Yet the nature of terrorists as a subject of study

has required researchers to rely on secondary data collection methodologies to progress. As such, open source data have been the source of a range of important findings (Corner & Gill, 2015; Gill & Corner, 2016; Gill et al., 2014; Gruenewald et al., 2013). Robust data collection methodologies and provisions to ensure intercoder reliability can mediate many of these concerns, as in the present study.

Second, much of the data in this space are characterized by missing data and biases with regard to the nature of what is missing (the availability bias). Safer-Lichtenstein et al. (2017) summarized much of this debate and concluded that researchers and policy makers should be transparent about the assumptions made about missing data and the effects of missing values on policy recommendations. Given the nature of the data, there is likely to be some underreporting of certain types of indicators. In the present research, however, we did not rely on single indicators to make causal statements. Rather, we articulated assumptions, grounded in theory, based on patterns of multiple indicators. Although certainly not exempt from the availability bias, this approach may be somewhat more resilient to its effects. Third, it is important to consider the treatment of missing data. When relying on open-source reporting, it is sometimes difficult to decipher between missing data and data that should be coded as "no" or as "not present." The authors of these sources, such as journalists, are unlikely to report at great length the absence of potentially infinite indicators that may be of interest to researchers (Gill et al., 2017). For instance, in the present data set, it was rare to encounter a definitive "no" answer. This occurred most often in instances when corrections were printed in response to previous reporting errors. Hence, each

variable in the analysis was treated dichotomously, where the response is either a "yes" or not enough information to suggest a "yes" and, therefore, a "no." In previous research on attempted assassinations of public figures, fatal school shootings, and targeted violence affecting higher education institutions and terrorism, scholars have employed similar strategies (Fein & Vossekuil, 1999; Gill et al., 2014; Gruenewald et al., 2013; Vossekuil, 2002).

Finally, the sequence analysis does not account for mediating variables that could be in the sequence but have not been measured. Time sequencing is not measuring cause and effect, only temporal relationship; and, as noted earlier, it is not measuring the length of time the indicator is apparent, nor the time at which the indicator begins or ends. Time sequencing is a "before and after" method to quantify data and understand their meaning. The reader is also reminded that the comprehensive relationship between all the indicators is found in Table 3, and the indicators in Figure 1 are subject to both the frequency and coefficient edges to enhance visualization of the major findings.

There is also evidence in the research on terrorist violence that the vast majority of attacks are acts of targeted (ie, instrumental, predatory) violence (Gill, 2015). However, there is some limited evidence that terrorist violence can also be spontaneous, fueled by intense rage, if not hatred, at the sighting of a member or members of the outgroup believed to be persecuting the "true believers." Spontaneous violence seems to be most apparent among extreme right-wing terrorists who are young and less educated than their counterparts who carry out planned attacks; and the context appears to be communities which are undergoing

more racial diversification than others (Sweeney & Perliger, 2018). The distinction between spontaneous and planned violence among terrorists has received little attention, but is buttressed by a century of research which substantiates two biologically distinctive modes of violence perpetrated by humans, affective and predatory, the former fueled by intense emotion and high states of autonomic arousal, and the latter characterized by minimal emotion and autonomic arousal (Meloy, 2006).

Conclusions

The TRAP-18 theoretical model for assessment of risk of a lone actor terrorist attack was premised on the progression of distal characteristics to proximal warning behaviors. The time sequence analysis of a large sample of lone actor terrorists in North America and Europe appears to further validate this model. The parsimonious nature of the TRAP-18 allows for practical application in the investigation of cases, and interdiction when warranted, to prevent such an attack. A granulated look at progression, which the time sequence allows, also enhances the threat assessor's ability to calibrate both the nature and speed of the intervention by using the time sequence as a behavioral map. Caution is necessary, however, as we are reminded of the words of the scientist and philosopher, Alfred Korzybsky (1933), "the map is not the territory." Each case will have unique characteristics known and unknown to the threat assessor, and each map will have strengths and vulnerabilities to be carefully weighed.

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Figure 1. Time sequence analysis of TRAP-18 indicators applied to lone actor terrorists (N=125).