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S.I. : ENVIRONMENTAL CRIMINOLOGY IN CRIME PREVENTION: THEORIES FOR PRACTICE

A general problem-solving matrix (GPSM): combining crime prevention and public health tools

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Abstract

Crime involves different individuals interacting in complex social and physical settings. Often, crime problem solvers reach for a common generic response, when they need to consider a number of possible solutions. Thinking tools can help. In this article, we show how uniting an injury prevention tool—the Haddon Matrix used widely in public health—and a crime prevention tool—the crime problem triangle used widely in policing—can provide guidance to crime problem solvers. We call our hybrid the General Problem-Solving Matrix (GPSM). We apply GPSM to rape and burglary to illustrates its features. We conclude the article by examining the alternative versions of GPSM in crime prevention.

Keywords Offenses · Injury · Crime triangle · Haddon Matrix · Crime prevention

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Introduction

Thinking tools for preventing crime

Police have used problem-solving methods to prevent crime since the late 1980s (Scott et al. 2020; Hinkle et al. 2020). For even longer, owners of businesses have sought ways to sell their goods and services without being victimized by their employees, external thieves, fraudsters, and violent people (Vellani 2010). More recently, the medical profession has adopted problem-solving methods to reduce violence (Runyon et al. 2000). And government agencies, other than the police, apply problem-solving methods to prevent crime (Plant and Scott 2009).

For all these institutions, preventing crime is hard. Crime problem solvers need to collect facts showing how victims, offenders, and others interact in complex social and physical settings to create crime. Though difficult, fact collecting is not the concern of our paper, so we will not say more about it. We will focus on another difficulty, the difficulty of making sense of the facts in order to forge effective crime solutions (Clarke and Eck 2003). To surmount this difficulty, problem solvers sometimes turn to thinking tools. Thinking tools are the subject of our paper.

Problem solvers use a number of thinking tools. These include: flowcharts, like the SARA process for problem-solving (Eck and Spelman 1987); acronyms, like CRAVED for identifying hot products (Clarke 1999), VOLTAGE for analyzing crime (Ratcliffe 2019), and EMMIE for evidence-based policy (Johnson et al. 2015); tables, like the 25 techniques for situational prevention (Eck and Clarke 2019); and diagrams, like the conjunctions of opportunity (Ekblom 1997), and the crime triangle (Eck 2003).

Why do problem solvers need these tools? One of the greatest impediments to preventing crime is the impulse to reach for generic solutions. The reflexive acceptance of known, off-the-shelf, remedies sometimes works, but usually it doesn't. This is why problem-oriented policing (Goldstein 1990) and situational crime prevention (Clarke 1995) emphasize the need to examine a broad range of possible options before selecting a crime prevention strategy. Thinking tools aid this wide search. Good thinking tools push problem solvers to consider more than the first idea that pops into their heads. At the start, problem solvers seldom know what type of problem they are dealing with. So, a thinking tool should capture the complexities of a wide range of problems. It should be a general thinking tool. Rather than learning many tools, each applicable to a narrow range of problems, problem solvers can learn one that helps them solve many different problems. But, a useful thinking tool needs to be simple. Problem solvers should be able to learn, remember, and apply it quickly. General application and simplicity are in tension. A thinking tool that is generally useful may be too complex for problem solvers to learn and apply. And a tool simple enough for easy recall and application may

not be complex enough for general use. In this paper, we introduce the General Problem-Solving Matrix (GPSM), a thinking tool we developed by combining two widely used thinking tools, from different professions. In developing GPSM, we tried to balance the need for generalizability with the need for simplicity.

We organize our paper as follows. The next section describes the crime triangle, a tool widely used in policing. It is based on a well-established theory of crime: routine activity theory (Felson et al. 1995; Clarke and Eck 2003). We then turn to the Haddon Matrix. Its origins are in public health and injury prevention (Haddon and Jr 1968, 1980). Our fourth section combines these two tools into a General Problem-Solving Matrix (GPSM, pronounced like the mineral, 'gypsum'). In the concluding section, we discuss possible limitations to GPSM and how the tension between general use and simplicity can be managed.

Two thinking tools

The crime triangle and the Haddon Matrix were designed to address a wide variety of problems. Both tools are simple; the crime triangle contains six elements and the Haddon Matrix contains seven. We illustrate each tool using the problem of outdoor rape and other crimes.

The crime triangle

The crime triangle—sometimes called the problem analysis triangle—evolved over 15 years as a training aid for police learning to solve persistent crime problems (Eck 1994; 2003). A problem is a recurring set of similar harmful events, often at or near a common location (Clarke and Eck 2003). The triangle directs the problem solver's attention to the range of people and settings that have a role, often indirect, in the problem. As police have reflexively focused on offenders, the triangle shows how offender's actions interact with the actions of others. Thus, police may prevent a great deal of crime by looking beyond offenders.

In reality, the crime triangle (Fig. 1) is a pair of nested triangles. The inner triangle identifies the three necessary elements for any crime problem. All three elements must be present repeatedly for a crime problem to occur; if any one of them is missing a crime problem cannot occur.

Offenders are the most obvious element. They create the crimes. Imagine an apartment building experiencing a series of break-ins to units. The people who enter apartments, uninvited, and take things (e.g. laptops or cash) that do not belong to them, are the offenders. The second element is the target. A target can be a person, an animal, a thing, or a structure. Laptop computers are a type of target in the burglary example. Outside of cyberspace, most crimes require the offender to be close to the target: at the same place (the third element in the triangle). In the burglary example, the apartment is the place. With consensual crimes—the sale of illicit drugs, for example—the distinction between offender and target becomes irrelevant. Nevertheless, we still have two human elements who must interact at a place.

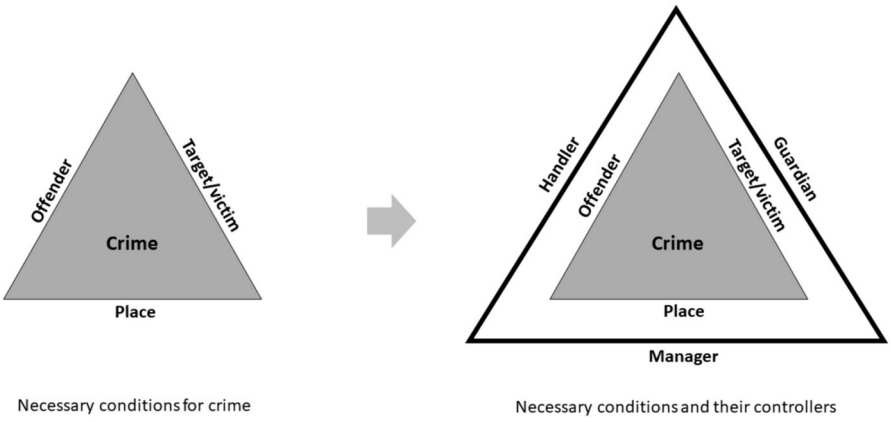

Fig. 1 The crime triangle

The outer triangle shows people who could control the inner elements. We call them controllers. If they are attentive and active, they may be sufficient to prevent crimes. Handlers are people emotionally engaged with potential offenders (Felson et al. 2003). The principal interest of handlers is the well-being of those they handle. Offenders often avoid misbehaving in the presence of handlers, for fear of losing emotional support. For young offenders, parents and older siblings can be handlers. Guardians are people who protect targets (Cohen and Felson 1979). Common guardians include friends who protect each other, security personnel, and residents who watch the street. The principal interest of guardians is to keep targets safe. To be effective, they need to be present, observe the situation, and be willing to intervene (Reynalds 2009). Managers are people who own or operate proprietary places: they include homeowners, bartenders, shopkeepers, and many other individuals. Their principal interest is in the operation of the place (Eck et al. 2023). In the burglary example, a key place manager is the landlord of the apartment building.

Crime is unlikely when one or more controller engages offenders or targets at a place. Keep in mind that these three elements define roles people play, so a single person can be a combination of handler, guardian, and manager (e.g. a mother of a teenage boy, for example).

The strength of the crime triangle is that it identifies a set of crime problem elements that could be part of a solution. Consider outdoor rape. Without the triangle, a problem solver might reflexively assume that the only solution is to catch the offenders, or that the sole solution is for potential targets to take precautionary measures. These may be useful tactics, but there may be others. The triangle prompts the problem solver to ask a series of questions—such as those in Table 1—whose answers reveal overlooked solutions.

In Table 1, we paired controllers with their elements. The first question asked of each element identifies the actors or places. If this question cannot be answered, then creating a solution centering on that element is doubtful (the problem solver knows too little about that element). The next questions probe for

Table 1 Questions the crime triangle can prompt for reducing outdoor rapes

Offenders	Who are they? How can they be removed? Who can help stop them?
Handlers	Who are potential handlers? Why aren't they effective? Can effective handlers be recruited?
Targets	Who are they? Why are they in vulnerable locations? What self-protection is feasible? How can they be protected?
Guardians	Who are potential guardians? Why aren't they effective? Can effective guardians be recruited?
Places	Where do the rapes occur? What characteristics of these locations make them likely crime sites? Can these characteristics be altered?
Managers	Who owns and controls these locations? Are their actions, or non-actions, making targets vulnerable? What can managers do to protect targets? What can managers do to make their locations safe?

interventions. We pose general questions in Table 1 because we do not have facts about a specific problem. A problem solver with specific facts can use the triangle to ask sharper questions.

Depending on the information in the hands of the problem solver, answers to some questions will lead to solutions, other answers may lead to dead ends. The fruitful questions will vary from problem to problem. Some solutions might be rivals (particularly if they compete for scarce resources). Other solutions may work well together (for example, combining place changes by managers with recruitment of guardians at high-risk locations).

We gave two predatory crime examples—burglary and rape—but the triangle has been used to prevent unintended events that have no clear offender or target. Heinonen and Eck (2007) show how it can be adapted to address vehicle–pedestrian crashes, for example.

The crime triangle illustrates the tension between general utility and simplicity. It can be applied to a wide variety of crime problems (Clarke and Eck 2003), and it is simple. But is not as simple as picking a well-known generic solution (e.g. arresting offenders, warning women to be careful). The gain of the added complexity is that it can reveal a wider range of prevention options. But is the triangle too simple?

The primary limitation of the crime triangle is that it is static; it fixates on the event. It provides no sense of the sequence of actions leading to crime and that follow from crime. Continuing with the rape example, the offender was engaged in actions that lead up to his encountering his target, but the triangle does not address

these. After the rape, the triangle is silent about what the offender does to escape. The Haddon Matrix is not silent about the sequence of events.

The Haddon matrix

William Haddon, an injury epidemiologist, created the Haddon Matrix in the 1970s and 1980s (Haddon 1972, 1999; Lett et al. 2002). The purpose of his matrix was to provide a systematic method for reducing car crash injuries. But Haddon (1983) argued analysts could use the matrix to find solutions to any complex injury problem. The three rows of his matrix (Table 2) show the passage of time relative to the harmful event: pre-event, during the event, and post-event. Before Haddon's creation, prevention models did not include a temporal dimension (Lett et al. 2002).

The four columns list contributing factors: a host (usually the person injured), an agent (typically equipment, such as a vehicle), a physical environment (describing the area around the harmful events), and a social environment (community attitudes, rules, and policies) (Runyon 2003). The cells of the matrix are for listing possible actions that will help avoid the events or make the events less harmful if they occur. Table 2 illustrates this with the example of vehicle crashes.

Besides car crashes, injury specialists have applied the Haddon Matrix to a variety of health problems: including sports injuries (Vriend et al. 2017); burns (Deljavan et al. 2012); drownings (Davoudi-Kiakalayeha et al. 2023); and COVID-19 in nursing homes (Fritch et al. 2021). Some researchers have modified the matrix to fit their problems. For example, Guerette (2004, 2007) adapted the Haddon Matrix to the deaths of migrants crossing the US-Mexican border. He used three rows (before, during, and after), as in the original matrix, but only three columns (migrants, coyote/guides, and environment). He found 12 discrete interventions using the matrix, arrayed in 9 of the 9 cells.

Researchers also have used the Haddon Matrix to prevent crime: for example, domestic violence related intentional burns (Natarajan 2014); workplace violence (Runyan et al. 2000); violence in hospital psychiatric settings (Hansen 1996); and terrorist bombings (Arnold 2005).

An example of the Haddon matrix applied to outdoor rape

In Stockholm, most rapes occur during evenings and nights. Rapes occur often at places that are close to vegetation (hedges, bushes, and trees), often poorly maintained; that are hard to see from the surroundings (low pedestrian flow, close to a big road, cut off by a railway); and offer an easy escape from the crime scene (close to a bus stop, subway or commuting train station). The analysis of rape case files, where the victims were on foot, suggests that suspects depend on public transportation (Ceccato 2014) but rape risks vary, temporally and spatially, across the city (Ceccato et al. 2019). Information about rapes in vehicles—illegal taxies, private cars, or boats—is not common in police statistics but researchers found it in hospital records (Ceccato et al. 2017).

Table 2 Haddon matrix of phases and factors involved in car crashes

	Host (individual)	Agent (equipment)	Physical environment	Social environment
Pre-event	Create education and licensing	Control vehicle design and load, collision avoidance	Avoid road distractions, plan for weather conditions, road hazards	Create social norms against drinking and driving, insurance incentives
Event	Use airbags, sit properly in restraint using seat belts	Ensure functioning of safety equipment	Plan roadside features, guardrails, type and size of object struck	Plan the distance to emergency services
Post-event	Provide first aid to the injured	Build cars that have crash protection	Build safer streets, good illumination, good maintenance	Impose regulations for use of seat belts

Based on table structure by Haddon (1980), page 47

Table 3 A hypothetical Haddon matrix for stranger rape prevention

	Individual	Equipment	Physical environment	Social environment
Before	• Learn the facts (avoid stereotypes of rapists & rape places) • Be careful with drinks from strangers Be observant when you come home at night • Check ride share company's passage safety efforts	• Use technologies to ensure safe trips • Train public operators • Eliminate illegal taxis • Promote development of safety devices	• Build safer environments (illumination, natural surveillance), schools, parks • Identify high risk locations: public and commercial • Train personal and place managers (bars, guards)	• Campaign against sexual violence (short term) • Develop educational programs to change cultural and social norms (long term) • Consider the patterns of occurrence & women's mobility
During event	• Know when to get help • Fight back if offender is empty-handed (self-defense) • Look for escape routes • Run away from the place	• Eliminate illegal taxis • Put cameras in public & transportation spaces	• Install alarm systems to call security guards/police as soon as soon there is a suspicion of sexual violence • Mark escape routes	• Have police on duty regardless time • Create helplines to promote immediate reporting
After	• Report rape • Keep evidence (do not clean yourself up) • Speak with family members • Have emergency services police standing by • Teach first aid skills	• Expand forensic analysis of rape places • Implement digital identification techniques (cards, tracking systems) • Implement programs targeting aggression on potential offenders	• Build safer streets, well illuminated, well maintained • Make public space readily accessible to ambulances	• Provide long term support for rape victims • Build cooperation between key-actors to create safety schemes to avoid that rape do not happen again

Table 3 illustrates the diversity of possible prevention measures for outdoor rapes in Stockholm revealed by the Haddon Matrix (see also, Mahoney et al. 2011). Rather than a single tactic centered on a single actor or setting, the matrix provides an array of options from which to choose.

The strength of the Haddon Matrix is its time dimension. This forces problem solvers to examine the crime as a process with a past and a future. Instead of restricting a search for solutions to the period immediately around the event, problem solvers look for precursors that, if addressed, may prevent the events. By calling attention to post-event results, problem solvers also look for harm-reduction opportunities. It can reveal the time-course of interventions (Linning et al. 2019). When trying to prevent intentional injuries (e.g. stemming from assaults), attending to post-events can help reduce injury or death, and may curtail offenders' motivation or ability to strike again. Using footage from CCTV cameras, for example, can aid in identifying rape suspects who may frequent the same area.

Like the crime triangle, the Haddon Matrix strikes a balance between general applicability and simplicity. Its seven elements, arrayed in a 3 by 4 grid, are easy to remember and, as its track record shows, it tackles a wide range of problems.

Still, the Haddon Matrix possess several weaknesses. First, its column headings are ambiguous. The concept of physical environment is vague. What should the crime preventer attend to: a building, set of buildings, streetscape, or larger areas? The concept of social environment is even vaguer. Ambiguity is the enemy of simplicity: the problem solver is unclear about what to do.

Advances in crime science can reduce this ambiguity. Research has established that crime concentrates on street segments and addresses (Lee et al. 2017). Further, we can pinpoint participants who have critical roles in the crime process. The crime triangle captures that knowledge.

Second, the Haddon matrix is explicit about only one type of person, the host. Haddon imagined injury problems as people versus physical objects—not as people versus people—and as accidental—not as intentional. Most crime problems are people versus people and intentional, however.

Third, the role of equipment in crime varies depending on the people: for example, offenders may use firearms to perpetrate the crimes, but potential victims, guardians, and place managers may use firearms to prevent crime. Locks can keep offenders out, or they can prevent victims from seeking safety. Thus, the role of equipment is far more complex when dealing with crime than when addressing unintentional injury problems.

The general problem-solving matrix (GPSM)

The two tools we just described complement each other. The strengths of the crime triangle—providing a detailed description of the elements of the problem—address the weaknesses of the Haddon Matrix (vagueness, a single human actor, and emphasis on equipment). At the same time, the strengths of the Haddon Matrix—accounting for the process that leads to and away from the harmful event—address the principal weakness of the crime triangle (being temporally static).

Table 4 The general problem-solving matrix (GPSM) applied to rape and other sexual crimes in public places

	Offender	Handler	Target/Victim	Guardian	Place	Manager
Before	• Detect individuals showing inappropriate unwanted sexual behavior • Create a list of known sex offenders in the area • Extend camera monitoring systems to include face recognition	• Educate friends of potential offenders as to how to keep offenders from attacking women/LGBQTI and other vulnerable groups	• Inform potential victims about: –Self-protection tactics –Risky situations –Situational awareness tactics –Availability of smartphone safety apps	• Signage encouraging people to look out for each other • Better designs of vehicles with more focus on the riders' safety needs • Encourage buddy systems for high-risk areas and places	• Increase lighting at transit places • Improve maintenance of transit places following "a whole journey perspective" • Make wait times visible at bus stops, reducing the time people wait at bus stops and platforms • Define different ranges of waiting time in areas with high rates of sexual harassment and crime • Stop selling alcoholic drinks in bars nearby • Have information for the public in multiple languages on how to report • Assure driver verification for ride-share vehicles	• Train transport staff on how to detect risky situations and how to intervene • Create reward practices for personnel who protect members of the public • Focus on preventing assault and harassment instead of enforcing fare evasion • Require ride share companies to protect passengers

Table 4 (continued)

	Offender	Handler	Target/Victim	Guardian	Place	Manager
During	• Disseminate information on high-risk offenders to police patrolling high-risk places	• Remind peers to intervene to protect women/ LGBTQI and other vulnerable groups	• Provide rapid help –Make help obvious –Use coded signals to request help	• Police patrols of high-risk areas at high-risk times • Employ non-police security patrols at high-risk times and places • Encourage the public to intervene if they detect trouble	• Call for help button/ helplines • Place CCTV at hotspot thoroughfares • Make maps of the stations and surroundings available at all parts of the stations	• Make it easy for staff to call for assistance and to intervene • Use signage to signal staff is watching • Have stations managers check at risky stations/ times
After	• Improve investigations of rape reports	• Encourage reporting of rape by non-victim witnesses and friends of offenders	• Provide easy-to-access medical help • Make reporting easy, safe, and untraumatizing • Provide early trauma assistance • Obtain riders' opinions about their safety needs	• Continuously assess high-risk places and times (women// LGBQTI and other vulnerable groups)	• Shift the placement of transit places from where serious sexual crimes happened • Increase women's and other vulnerable groups' participation in the planning of public transport services and the design of public spaces (also increase employment in the sector)	• Instigate a clear and easy protocol for reporting harassment incidents • Include riders' safety needs in policy-making processes, and develop measures accordingly

We suggest combining them. The hybrid framework, shown in Table 4 (for now, concentrate on the row and column headings), we call the General Problem-Solving Matrix (GPSM). Its rows are the same as in the Haddon matrix. They show the temporal sequence leading up to the problem events, during the events, and after the events. GPSM has three pairs of columns. The first column in each pair describes the three inner elements of the crime triangle: offender, victim/target, and place. The repeated convergence of these elements gives rise to a problem. The second element in each column describes the outer elements of the crime triangle. These people could prevent crime by controlling their inner element.

By combining the Haddon matrix with the crime triangle, we unite the time specificity of the first with the social specificity of the second. The offender is the instigator of the harmful events. The target/victim is the recipient of the harm. This is obvious in a street or commercial robbery, but may not be clear when trying to prevent bar fights. Therefore, for some problems this distinction may not be useful: recognizing that there are two people in conflict is sufficient.

The place is a physical context. For almost all crimes of violence, and most property crimes, this context will be a street segment (both sides of a block from corner to corner) or a specific address. Even high crime areas are mostly crime free, and it is on a very few segments or addresses where crime occurs (Lee et al. 2017). Much time and effort can be saved by focusing on precise spots rather than general areas such as neighborhoods. The controllers—handler, guardian, and manager—substitute for the vague "social context." This too adds focus to problem solving.

Place managers deserve special consideration, as they are often overlooked. They are the owners and operators of residences, businesses, and other properties. They also operate taxis, buses, and other modes of public transit. Only they have the legal authority to alter places; they create the physical context and only they can modify it. They have a great deal of influence on the social context of places, too (Eck et al. 2023). Further, networks of place managers in a small area can sometimes influence safety along street segments (Linning and Eck 2021).

Distinguishing between implementation and biting

Often, tactics bite problems after they have been implemented. So, we need to distinguish between putting a tactic in place and the actions of the tactic on the problem. For example, the opioid overdose treatment Naloxone may be distributed before an incident, but it prevents injury during the overdose episode. Rapid medical responses to overdose calls take place after the events to prevent the worsening of injuries, though planning and implementation of rapid emergency response occur long before the event. Drug user education is implemented before the event so that users can make choices before overdose situations. In all three examples, implementation occurs before the events, though the intervention bites the problem at three different points (before for education, during for the Naloxone, and after for the rapid response).

Problem solvers sometimes implement tactics after an event knowing that the tactic will bite before the next event. Specific deterrent threats to offenders are an

example. Follow-up advice to victims about how to take better precautions are another example. And providing guidance to place managers to avoid further crimes is a third example. In each of these examples, the first crime serves as a flag that the offender, victim, or place is at an elevated risk of further harmful events. Thus, actions after an event may thwart future crimes.

Comprehensiveness of solutions

There is another practical consideration. Comprehensive problem-solving initiatives address each time category within GPSM and have tactics in as many columns as feasible (i.e. each cell contains at least one tactic). The greater the diversity of tactics (as indicated by the number of cells filled) the more likely a solution package will reduce crime. Diversity creates layers of defense (Larourzee and Coze 2020; Reason 2000) if one solution fails, the success of others can make the initiative successful.

Diversity, however, increases the cost of solutions. Some of the cost is direct expenditures, and some are administrative burdens needed to manage the multiple organizations involved. Like the general versus simplicity tension, there is a tension between diversity and costs. So, there are limits to being comprehensive.

Using the general problem-solving matrix

To illustrate how solutions to a problem-solving initiative would be arranged within GPSM we use two examples. We picked these examples because one is a violent crime and the other is a property crime, and because we had ample documentation from which to draw. Following these two examples, we describe three ways problem solvers can use GPSM.

Example of GPSM applied to rape in transit environments

The contents of the cells in Table 4 illustrate the use of GPSM to prevent rapes in transit environments. When listing these contents, we were informed by study in Stockholm of victims' activities before, during, and after a rape (Ceccato et al. 2017). We also drew on a survey of transit environments in 18 cities across the globe. The survey gathered data at transport nodes (bus stops and/or train stations) and on the routes to them. It contained information about victimization, fear of crime and its impact on their mobility (Ceccato and Loukaitou-Sideris 2020).

There are 18 cells in Table 4, and all contain at least one tactic. Several cells have two or more tactics. We make no claim that all these tactics will work if applied. Table 4 purpose is to show that GPSM reveals a wide array of tactics. For any specific tactic, problem solvers will have to determine where, when, and how to carry it out, and who will do so. Problem solvers also need to consider evidence for and against the tactic, and the costs of the tactic.

GPSM applied to burglary near a university

Our second example of how GPSM can be used comes from a burglary reduction effort. It illustrates the use of GPSM for property crime. We took this example from a winner of the annual International Herman Goldstein Award entitled, "Strategic Investigation: Off-Campus Burglary Reduction Project" (University of Cincinnati Police Division Police 2021). Following an analysis of the problem, the project team identified and implemented a variety of burglary prevention tactics. The result was a 30% to 50% reduction of burglaries, depending on the baseline years used (UC Police 2021).

GPSM was not available to the team, so Table 5 is a retrospective demonstration how GPSM could have been used. Items with "+" and in bold were solutions the team applied. Notice that the initiative did not implement tactics in every cell of the matrix, but it did apply tactics in three columns and two rows, making it reasonably comprehensive.

To illustrate the use of GPSM during the selection of tactics, when the prevention team discusses possible solutions, we added to Table 5 the items marked with "o". We make no claim that our suggestions fit the specifics of this problem, or that they were feasible solutions. We do not know if these were considered, but they are possible solutions that were not used. We list them to illustrate the range of possibilities. Inevitably, there will be more solutions discussed than selected. We left two cells empty because we could not imagine solutions involving handlers during and after the events. This illustrates that not all cells will contain potential solutions.

Three ways to use GPSM

There are three ways problem solvers can apply GPSM, depending when it is used: before selecting interventions, when selecting interventions, or after selecting interventions. Before problem solvers can create a wide-ranging list of prevention options, they need to collect information. At this early stage, problem solvers can populate the cells of the matrix with questions, and with methods for answering the questions. Table 1 illustrated the use of the crime triangle to ask questions to drive information collection. But rather than six sets of questions, GPSM produces 18 sets of questions.

Once problem solvers have answers, they can use GPSM to array all imaginable solutions. They can populate the cells with possible interventions suggested by the facts they have gathered. Table 4 illustrates this mid-stage application. The purpose of the mid-stage application assure that a wide range of options are discussed and compared. Problem solvers then use other criteria—community acceptance, cost, evidence of effectiveness, compliance with law, and capabilities of implementing institutions—to choose a set of tactics for implementation.

Once problem solvers have adopted a set of tactics, they can array them in a new matrix describing the adopted solutions. They may also list who is responsible for carrying out each tactic. This last stage application serves as part of the

Table 5 General problem-solving matrix (GPSM) applied to an off-campus burglary reduction project

	Offender	Handler	Target/victim	Guardian	Place	Manager
Before	O create watchlist of known burglary offenders o focused deterrence messaging	O talk to parents of juvenile offenders	**+ Knock & talk awareness** **+ Social media awareness** O distribution of alarm systems for high risk properties	**+ Notifying parents** **+ Consult with university resource center**	O predict highest risk places for police visits with residents	**+ Landlord education**
During	O monitor offenders during peak times		O real-time reporting to social media platforms/ hotlines	O create student patrols of high-risk streets	**+ Directed patrols** **+ Visibility improvements** O place CCTV and license plate readers at hotspot thoroughfares	O have landlords check building security at high risk times
After	O knock & talk with known offenders		O community social media notifications of burglary incidents	O create cocoon neighborhood watch	O post temporary signs about recent burglaries for residents	O monitor social media sites for offenders selling stolen goods

O—possible interventions not used, +—**Interventions used**

implementation plan and may be useful for a process evaluation. Table 5 contains an illustration of this use (the tactics marked with +).

We have emphasized listing tactics in the cells, but problem solvers can list other things, too. Problem solvers can list possible stakeholders who need to be consulted, resources necessary to implement tactics, the timing of tactics' implementation, and the costs of tactics. No single GPSM should contain all of this information; it would be too crowded to be useful. But problem solvers might find it useful to create separate matrices, each addressing different aspects of project management.

Limitations and extensions of GPSM

We have introduced the General Problem-Solving Matrix. This thinking tool unites the strengths of two well-known and widely used thinking tools – the crime triangle and the Haddon Matrix—while overcoming their principal deficiencies. Just as no physical tool is perfect (Petroski 1994), no thinking tool will be either (Dennett 2013). With that in mind, we will close this paper by discussing the limitations of GPSM, and methods for improving it.

Is GPSM sufficiently general?

The first potential limitation is that GPSM leaves out important elements of crime problems, elements that are useful for finding solutions to common crime problems. Here are five examples of omitted elements.

- *Super controllers* (Sampson et al. 2010)—Super controllers provide incentives to controllers to thwart crime. They could be included within GPSM by adding three columns. The matrix would then contain 27 cells (compared to its current 18 cells).
- *Tools and materials* (Clark 2014; Ekblom and Tilley 2000)—In creating GPSM, we downplayed the role of equipment emphasized in the Haddon Matrix. Our rational is that most crime involves intentional conflicts among people, rather than accidental conflicts between people and things (or nature), as is the case with car crash injuries. Nevertheless, offenders and other actors use tools (e.g. guns, locks, barriers) and materials (e.g. precursor chemicals, spray paint, paint remover). Adding columns adjacent to offenders, targets, and places (to indicate who is using the tool or material) could prompt problem solvers to consider how to remove tools from offenders or provide them to others. This addition would give the matrix 27 cells (assuming no other additions).
- *Crime Scripts* (Dehghanniri and Borrion 2021)—We could have expanded the time slices within GPSM to describe crime scripts. Scripts can be short or long: for example, van Doormaal et al. (2018) draw a seven-step script for rhino poaching; Borrion et al. 2017 estimate a median script length of 8 steps for commercial robbery; and Leclerc and Reynald (2017) describe a 12-step guardian script. So, even a short seven-step script creates a matrix of 42 cells.

Including these three elements requires extending existing dimensions. But addressing other types of omissions requires adding new dimensions. Consider these two examples.

- *Goals* (Runyon 1998)—Problem-solving efforts often have multiple goals. Runyon (1998) suggested eight different goals and proposed a 3D Haddon Matrix. To assist problem solvers with multi-goal projects, we could apply Runyon's suggestion to GPSM. We would then have a 144-cell cuboid (3 by 6 by 8).
- *EMMIE* (Johnson et al. 2015)—EMMIE summarizes evidence for and against an intervention. It stands for Effects, Mechanisms, Moderators, Implementation, and Economics. One could connect EMMIE's five elements to GPSM by creating a third dimension. The result would be a 90-cell cuboid.

Each of the five augmentations of GPSM has value, and so would many other additions we do not list. But improvements come with costs. The costs are proportional to the size of the thinking tool. GPSM has 18 cells (3 by 6). Each of the efforts to overcome its limitations is far larger, and therefore more difficult for problem solvers to learn, recall, and apply.

Is GPSM too complex?

The second potential limitation is that GPSM is too complicated for practical use. It might have value to academics with time on their hands and conducting research with no immediate consequence, but for the practitioner—in governments, businesses, or communities—it maybe too hard to use. The Haddon matrix is simpler (12 cells) and the crime triangle simpler yet (6 categories).

However, the simplest thinking tool has one cell. Faced with a crime problem, the practitioner reflexively selects the first tactic that pops into her head: arrest people, for example, or provide them with treatment services, or organize the community. On occasion, reflexive solution selection works. But the many failures of reflexive solution selection are why practitioners and researchers have turned to problem-oriented policing, situational crime prevention, and evidence-based policies (Lum and Koper 2017).

How simple should a thinking tool be? How general should it be? These two questions pull in opposite directions. Too general and the tool becomes unusable. Too simple and it fails to reveal hidden useful solutions. We want a highly efficient tool: the simplest that provides the widest array of potential solutions. What we must settle for is a reasonably simple tool that provides more ideas than alternative tools, or no tool at all.

We suggest two ways to work with this tension. First, academics should treat crime prevention thinking tools as useful research subjects. Much can be learned about the tension between simplicity and generality from observing how tools are used in practice, and from experiments comparing alternative tools.

Second, problem solvers should consider adapting GPSM to their needs: add and subtract from it. If a revised matrix yields a wider array of potentially useful solutions, use it. Otherwise, stick with the original GPSM. Different problems may require different versions of GPSM because, even with good tools, preventing crime is hard.

Preventing crime is hard, but it is easier and more likely to succeed when problem solvers use thinking tools. We have melded two thinking tools—both with long successful track records of improving safety—to create the General Problem-Solving Matrix. Our hybrid tool addresses deficiencies in its parent tools, but retains their simplicity and general applicability. We encourage readers to test it on crime and safety problems and to report their results.

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Declarations

Conflict of interest The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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