

Sharpening up CPTED – towards an ontology based on crime science and ecology¹

Prepub version – may contain minor errors.

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Abstract

This chapter builds on previous work documenting the limitations of CPTED and suggesting ways to connect it more closely to crime science and architecture and recent computational approaches including simulated environments. While the earlier material sought to develop CPTED from the top down, starting with the familiar principles of surveillance, defensible space, territoriality etc., this time the aim is to start from the bottom up, identifying a range of conceptual ‘primitives’ from which the higher-level principles can be constructed and/or defined. This is the dimension of science known as ontology. Some of these primitives come from crime science – the applied field of causes and interventions active in the immediate situation leading to criminal events; but this is supplemented by a wider and more generic framework of ecology. Moreover, in order to understand the effects of the built environment, and crime preventive changes in its design and management, it is necessary also to understand the human agents who respond to, and modify, that environment whether as offenders or preventers of crime. Although centring the ontology on the immediate crime situation, the chapter therefore seeks to incorporate the more community-oriented aspects of Second-Generation CPTED and the contextual aspects of architecture and design.

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Introduction

In previous articles (Ekblom 2011a,b; 2013) and presentations (e.g. Ekblom 2015) I have noted various limitations of the field of Crime Prevention Through Environmental Design (CPTED). These range from lack of an adequate process model, to a failure to fully connect with situational crime prevention (SCP) and security on the one hand, and with architectural ideas on the other. Many of these shortcomings have also been identified by fellow researchers (cf. Kitchen and Schneider 2006; Armitage 2013; Cozens et al. 2005; Cozens 2014; Cozens and Love 2015) introductory chapter to this volume). In the present chapter, building on my previous thinking I will focus on the *conceptual* shortcomings – which have significant implications for research and practice – and explore an approach to fix them through *ontology*. This is a formal naming and definition of the types, properties, and interrelationships of the conceptual entities within a particular domain of discourse in

science, practice or in this case, both. It's not for the faint-hearted. The ultimate aim is to better articulate CPTED concepts for academics and practitioners alike; but in aspiring to that goal, this chapter unashamedly chips away at the intellectual, rather than the practical coalface. For the present, the ideas developed are more discursive than definitive. The right time to put them to practical use will be after sufficient progress has been made, and views exchanged on their validity.

The chapter necessarily takes a broad and in-depth approach. It begins by revisiting the theme of conceptual confusion in both CPTED and elsewhere in Situational Crime Prevention, and noting its significance for practice, theory, conventional research and computational approaches such as simulation. It then makes the case for an exercise in resolving the confusion through *ontology*, and argues that a suitable starting point for conceptual work on CPTED is in the more theoretically-developed, but equally applied, *crime science*. Part two then seeks to identify and develop elements of the ontology, starting with the concepts needed to characterise the human agents that inhabit, use and modify the environment and respond to it; and continuing with the environment itself. Various complicating issues in how we understand the environment and agent-environment interactions mean that the crime science approach (based on the integrating framework, the Conjunction of Criminal Opportunity, plus wider address to roles, scripts and script clashes) needs supplementing by a wider *ecological* approach. From these perspectives, it modifies and extends a suite of *environmental primitives* first introduced in 2011. After summarising both agent-oriented and environmental primitives, it demonstrates, through one of the traditional CPTED principles, surveillance, how bottom-up and top-down approaches to definition can be brought together. A final discussion addresses wider issues raised including the proper scope of CPTED and how it should relate to broader crime preventive interventions on the one hand and to architecture on the other.

Confusion in CPTED

The conceptual shortcomings of CPTED are substantial. There are overlaps between all the core concepts – for example, where does defensibility end, and territoriality begin? Likewise defensibility and access control? There is terminological laxity in clearly distinguishing between *environmentally-oriented instrumental tasks* to be undertaken by people occupying preventer roles, such as surveillance and defence, and *surveillability* and *defensibility*, which are *environmental attributes* that support or hinder the tasks (Eklom 2011b). Likewise there is insufficient distinction between tasks which are *preparatory*, such as target-hardening, and *operational*, such as using the hardened locks. Target-hardening itself is confusing – what is the exact nature of the target to be protected – is it the house to be protected against arson or the expensive TV inside it, against theft? And where does target *softening* fit in – for example, bolt shafts that swivel in their anchorages so cutting tools slip?

Some CPTED tasks are intended to have *direct* and straightforward effects on crime risk, such as access control and surveillance; others are *indirect* and subtle, such as activity support and image. Maintenance may keep the preparations in serviceable condition, or it may signal to malefactors that preventers are ready to take them on. This illustrates the need to address how practical preventive *methods* may reduce crime through multiple causal or functional *mechanisms* (Tilley 1993a; Eklom 2011c).

Territoriality is especially complex, additionally bringing in preventers' predisposition, motivational and emotional processes in generating the relevant behaviour. Updated from the 2011 paper this covers:

- 1) An agent's *territorial predisposition* (personal tendency to value/defend spatial property) interacting with their perception of
- 2) *Territory-related properties of the environment* and the presence or behaviour of other people in it
- 3) This precipitates (Wortley 2017) *territorial readiness* (i.e. motivational/emotional state in which territorial issues are salient) leading to
- 4) Territorial behaviour

Territorial behaviour in question can be *expressive* (an end in itself, usually involving emotion) or *instrumental* (a functional means serving some higher goal). However, this distinction is rarely clearcut: in confronting some stranger parked across my driveway I could genuinely be giving vent to anger, or I could be faking rage to boost the chances of them driving off.

All this makes for complex and potentially confusing relations between the traditional principles. Territoriality supplies motivation/emotion and sets goals relating to the (usually built) environment. Access control and defence are employed by the territoriality-minded agent to serve those goals. Target-hardening and surveillance are practical aspects of defence but can feed back to territorial emotion, motivation and behaviour. An example is where features intended for access control, such as pavement markings or crunchy gravel paths, may prompt and permit the spotting and challenging of an intruder, perhaps provoking territorial feelings.

Finally, there is a tendency, especially in the North American tradition, to blur the scope of CPTED by using the CPTED label synonymously with crime prevention in general.

Johnson et al. (2014) provide systematic empirical evidence of such confusion. Analysis of 64 CPTED documents identified significant terminological conflicts; free-for-all use of vernacular terms to characterise CPTED concepts, with little rationale – e.g. substitution of 'movement control' for 'access control'; and the organisation of CPTED under anything from three to seven headings with a total of 58 terms used. Twenty-five of the documents moreover offered a framework either of the author's own interpretation or unreferenced. Ekblom (2011b, 2013) also observes that terms and concepts have agglomerated from diverse sources (e.g. Newman, Jacobs, Jeffery) without formal consolidation.

Beyond terminology lies *theory*. It is fair to say that while CPTED has developed a range of practice principles any theoretical underpinnings for these have been borrowed and blended ad-hoc from sources such as SCP, and the Broken Windows approach (Wilson and Kelling 1982). And Armitage and Monchuk (2017) note the loose, even careless, way in which CPTED principles are articulated and applied by practitioners. Whether this is because the terms and concepts are unfit for purpose is arguable.

Confusion beyond CPTED

The conceptual and theoretical confusion within CPTED is unfortunately matched by that in SCP and security (Ekblom 2011, 2006). This derives from an arguably misplaced attempt to oversimplify a highly complex subject in order to make it readily available to practitioners.

They ultimately do not benefit (except from easier lessons and exams) and are quite capable of acquiring and applying more advanced approaches with the right training and guidance material, in the right working context, and when the approach makes sense in relation to the operational tasks they must undertake.

Among weaknesses of *SCP* are:

- Oversimplification of the central concept of *opportunity* (Bouhana 2013; Ekblom 2016 21c) – as something ‘out there in the *environment* enabling action’. Opportunity is also defined by the offender’s *resources* to exploit vulnerabilities and cope with hazards (an open upstairs window is only an opportunity for someone with agility, courage and perhaps a ladder); the offender’s *goals* (opportunity to do *what?*); and *presence/access* and *dynamics* (encountering, grasping, planning/creating opportunity)
- Sloppy usage – unlike in the original Routine Activities article (Cohen and Felson 1979) ‘likely offender’ (which includes resources) is often shrunk to ‘motivated offender’; similarly, ‘guardian’ is commonly used for all preventer roles including place manager, and handler of offender.
- Constrained view of crime-relevant roles – where are planners, designers, architects and developers?
- Poor integration between the theoretical perspectives underlying SCP – Rational Choice is psychological, Routine Activities ecological, Crime Pattern Theory spatial and temporal. Each uses slightly different terminology, or the same words with different nuances; jamming them crudely together left gaps and overlaps.
- The *decision* perspective of Rational Choice is important, but cannot handle the behaviour that precedes or follows those decisions, hence is insufficient to cover consequent interactions with the environment.
- Deliberate disinterest in offender-related factors – an issue because knowing about offender goals, resources and emotional precipitators can help design situational interventions.

The term ‘security’, too, has significant limitations. One encounters many meanings of:

- *Threat* – risk, hazard, intent, intent + capability
- *Vulnerability* – weak points, exposure to risk, manifest risk pattern
- *Hazard* – harmful event, something with potential to cause harm
- *Risk* – likelihood, likelihood x harm; *negative* uncertainty versus *all* uncertainty (ISO 31000 inclusively defines risk as the effect of uncertainty on objectives)

I cannot fairly judge architecture but my impression is of a field of practice where diverse ‘schools’ have come and gone, often led by passionate and charismatic figures like le Corbusier, and lacking any recognisable and cumulative theory in the scientific sense: in extreme cases only shifts in values, aesthetics or fashions, and hearty criticism of what came before. However, from Vitruvius onward, architecture does also have a theoretical dimension (e.g. Murphy 2016). And the approach known as *evidence-based design* is now emerging, initially in the healthcare field (e.g. Webster and Steinke 2009); one hopes this will extend to the whole domain (cf. Sailer et al. 2008) and be worth CPTED connecting to.

Why conceptual and terminological confusion needs straightening out

Conceptual and terminological confusion render our tools for thinking and communicating about CPTED principles and CPTED action blunt and inefficient. Operationally speaking, this

can limit the scope of the problems we can tackle and undermine focused problem-oriented analysis and action. More particularly it can:

- Allow objectives to drift – e.g. from inclusive community safety to exclusive gated security
- Reduce the quality of analysis of crime risks in built environments (Clancey et al. 2012), and muddy the waters where complex conjunctions of interacting risk factors are proposed, a state of affairs common in the built environment
- Reduce the quality and appropriateness of interventions suggested or designed to address those risks
- Constrain our ability to undertake the CPTED process professionally and rigorously (Armitage and Monchuk 2018)
- Disadvantage CPTED in influencing decisions in the wider planning/ development process
- Hinder practitioner collaboration within CPTED locally, nationally and internationally

Likewise, it constrains professional infrastructure and academic scholarship by:

- Hindering the capture, consolidation, retrieval and sharing of practice knowledge – efficient training and briefing is increasingly important with accelerating rates of staff turnover and loss of experienced practitioners (Hirschfield et al. 2013)
- Limiting the transfer of CPTED knowledge and principles to other cultures and contexts (cf. Ekblom et al. 2013)
- Jeopardising formal research, theory building and evaluation of what works – hampering our ability to design experiments (real or simulated) which might assess the validity of particular claims made by the field
- Constraining the systematic logging and auditing of practice decisions which may have significant human and financial consequences
- And as said, hindering collaboration and cross-fertilisation with wider disciplines and professions – especially links with criminology, security and architecture

A solution through ontology?

During the 19th Century, both medicine and engineering only took off as professional disciplines on combining *practice experience* with *practice-oriented science* – medical science and engineering science (e.g. Hapgood 1993). Neither discipline could have progressed so hugely without conceptual clarity and a ‘controlled vocabulary’ (see e.g. www.controlledvocabulary.com, and medical example <http://ihtsdo.org/snomed-ct/>). Crime Science aspires to the same combination of science applied to practice (e.g. Junger et al. 2012) but has yet to address conceptual clarity (Bouhana 2013; Ekblom and Hirschfield 2014; Ekblom and Sidebottom 2008; Ekblom 2014a). Conventional security has made some attempts to do this (e.g. the US Department of Homeland Security Risk Lexicon www.dhs.gov/dhs-risk-lexicon). CPTED has certainly not.

The issue of *computational requirements* adds weight to this argument. Computers play an increasingly significant part in the design of places. Most familiar is their role in BIM (Building Information Management) systems linked with computer-aided design at various scales. Less familiar is Agent-Based Modelling (ABM), described below. Computers currently cannot handle the degree of imprecision in thinking and communication, storage and retrieval of information that humans routinely cope with. Computer scientists have thus

made a big thing of conceptual and terminological consistency, and not simply due to allegedly nerdy tendencies (though this may help). The requirement for consistent and clear definitions comes about largely because problem decomposition is key to computer science – every entity, attribute or variable used in generating computer code has to have an explicit and unambiguous meaning and a consistent logical relationship with other terms – hence the emphasis on ontology. Originally a term in traditional philosophy, this is now used to refer to a formal naming and definition of the types, properties, and interrelationships of the entities that exist for a particular domain of discourse in science, practice or in this case, both.

But the analytic approach implied by ontological definition runs against architects' and designers' emphasis on *holism, patterns and configurations*. This tendency is exemplified by Alexander's 'pattern language' (Leitner 2015) for describing archetypal configurations of buildings and wider layouts. Influential within architecture in general, pattern language shaped the pathfinding 'designing out crime' works of Barry Poyner (1983, 2006) and the Dutch 'Police Labelled Secure Housing' programme (Armitage 2013).

Configurations of causes are important, too, in social science more generally. Addressing causal interactions has long been inadequate in criminology and crime prevention. In SCP, for example, it is not enough to know about separate offender factors, target factors or guardianship factors. It is crucial to know, too, how these come together in distinct patterns and interactions, whether this is brought about through routine activities (Cohen and Felson 1979), market forces or active shaping of environments by offenders (as in creating ambush sites). The configuration of built environments can facilitate such comings-together (e.g. Brantingham et al. 2017, as with commuter crowds funnelling into a station entrance), or can be designed to hold them apart (as with separated stadium seating for rival football supporters). For further coverage of configurations and conjunctions see Ekblom (2004, 2010, 2014b) and for a quantitative statistical methodology for 'conjunctive analysis' suited to the built environment see Hart and Miethe (2014).

We therefore face an apparent paradox. While ontological requirements suggest precise, analytic, well-bounded concepts and terms for CPTED, the importance of pattern and configuration, and wider requirements of design thinking (e.g. Dorst 2015) suggest a holistic approach. One avenue of resolution however may lie in ecology, discussed below; another, mentioned above, in computational agent-based modelling (ABM). This is where software-based agents endowed with a heterogeneous assortment of simplified human properties such as motives and action repertoires autonomously make decisions whilst moving about a virtual environment, generating patterns of interest to science and practice. Birks and Clare, in this volume, describe using ABM to test CPTED principles in ways impossible in the real world through expense, delay and disruption.

ABM simulation of built environments could more broadly contribute to research and the planning/design of developments, including crime impact assessment. Of especial interest is that ABM could explore the effects of entire *configurations* of physical layout, presence and movements of potential offenders, preventers and victims, and wider causal interactions, and then observe the emergent patterns of behaviour and misbehaviour. But this synthetic approach must be founded on an ontology suitable for rendering, in code, the underlying concepts of crime causation and intervention by humans in and on environments. Ontology does not just dissect ideas into individual defined pieces and leave them lying around like

Humpty-Dumpty after his great fall, it puts them together again by virtue of the *relationships* that are specified as clearly and systematically as the individual entities. Perhaps it is no coincidence that Alexander's Pattern Language has been highly influential in computer science! (Attempts to incorporate it within practical CPTED in the Dutch 'Police Labelled Secure Housing' programme however enjoyed only limited success.) The strength of computational models like ABM lies in their heuristic value because they force one to engage with such ontologies and the relationships amongst them. Often, at first in a simple fashion, but subsequently through increasing levels of complexity (see Townsley and Birks 2008)

So, we should aspire to represent patterns, configurations and emergent properties of built environments in some effective, consistent, communicable and replicable way that is suitable for sharpening up CPTED research and practice so it relates to and draws on an applied science of its own, and especially for supporting computability whether for purposes of simulation, training, BIM and wider knowledge management of practice. We therefore need the concepts and terms of CPTED both to be individually precise and to interlock with and relate to one another rather than overlapping, leaving gaps, conflicting with one another or introducing category errors (e.g. apples versus fruit). And we really should aim for tighter connections with SCP which, as discussed, has limitations of its own that need addressing.

I previously attempted (Ekblom 2011b) to start with the high-level concepts of CPTED (territoriality, defensibility etc.) and define these relative to the subject matter and to one another. This time I start from the bottom up, with a range of *primitives*, building the more complex concepts upon these. According to the IT site <http://whatis.techtarget.com>, a primitive is defined as 1) in computer programming, a basic interface or segment of code that can be used to build more sophisticated program elements or interfaces; and 2) In computer graphics, an image element, such as an arc, a square, or a cone, from which more complicated images can be constructed. Here, primitives refer to representations of the properties of real-world agents, objects and places and the relationships between them. Given the role of offender factors in defining opportunity stated above, the agent (people and organisations) side gets more prominence than is customary in environmental approaches to crime.

Where to begin the specification of primitives?

There are good arguments for starting with design and architecture as a whole and then incorporating crime and security as just one of many requirements (e.g. Thorpe and Gamman's (2013) 3rd Generation CPTED). The chapter by Willcocks et al. in this volume suggests one way forward, but a narrower perspective is required for present purposes. Following crime science (e.g. Junger et al. 2012), I opt to start with *proximal causes of criminal events* – the immediate precursors present in the crime situation. SCP typically represents these through the Routine Activities approach, as the likely offender encountering a suitable target in the absence of capable guardians (Cohen and Felson 1979). However, I favour the more detailed and supple equivalent of this triad, the Conjunction of Criminal Opportunity (CCO – see <https://Sisframework.wordpress.com/conjunction-of-criminal-opportunity/> and Ekblom 2010, 2011c). CCO integrates Rational Choice, Crime Pattern theory and Crime Precipitators (Wortley 2017) perspectives in a single framework of 11 proximal causes. Another advantage is its greater inclusion of offender factors. As stated

above, these are essential in defining opportunity and hence for the practical consideration of specific opportunities.

Developing CCO initiated my ontological efforts. It establishes a clearly-defined suite of interrelated 'causal primitive' concepts. These comprise 1) several types of *agents* (offenders, crime preventers, crime promoters – discussed below); and 2) *entities* or assets that are acted upon, or with, by the agents (e.g. the target of crime, and the environment). The agents and entities have various properties. Some of these are individual (e.g. readiness to offend, appetite for risk etc.); others are relational (for example, the vulnerability of targets to attack depends jointly on attributes of the offender and those of the target; as does their attractiveness). Some properties are more or less permanent, others reflect temporary states. Together these agents and entities interact in particular conjunctions and sequences to increase the risk of criminal events. If influenced by preventive action, they serve to reduce it.

Because we are talking about people perceiving, reasoning and acting in particular roles in particular environments, it seems appropriate to adopt a combined ecological and socio-psychological discourse. This moreover facilitates detachment from cultural assumptions, fixed traditional ways of thinking and practice. Ecology especially connects us with ideas from biological evolution and also cultural evolution, including design and innovation.

This ambitious exercise departs from the current, purely environmental, approach to CPTED. It can only be sketched out in this chapter. Developing an ontological suite of terms and concepts requires iterative design, with one eye on the requirements of computation, another on those of theory and research, and (reflecting the task's superhuman nature) a third on those of practitioners. But the science requirement comes first. Only after the advanced-level thinking is resolved to a sufficient and stable degree will it be appropriate to develop practitioner-friendly versions. (Albeit that practitioners' observations can sharpen the science in their turn.) The aim is to emulate medical science, where highly technical leading-edge discourse is subsequently converted to various levels 'good-enough' for use by people ranging from advanced surgeons to general practitioners to paramedics and readers of family healthcare guides. This is in contrast to the 'lowest-common-denominator' approach currently in vogue in SCP and CPTED.

Specification

The specification starts at the most fundamental level of all – human *agents* in an *environment*. It may seem strange to emphasise human agency in an obviously environmental field like CPTED. But as will be seen, knowing the users *and abusers* of built environments is fundamental to understanding and designing against crime. A CPTED, or indeed any architectural approach, that lacks such understanding would be seriously deficient. Unfortunately this realisation is not widely shared. A famous international architect once harangued my Design Against Crime colleague (Lorraine Gamman) that there was nothing wrong with his building designs, it was the *people* that were the problem.

Agents

Agents are primarily individual people, but could also be corporate. Apart from the pioneering writings of C Ray Jeffery (e.g. 1977) CPTED has paid little attention to the *nature* of the people who commit, prevent, promote or suffer crime in the built environment, or indeed use and enjoy its amenity in positive ways. The model is implicit and essentially

vernacular. SCP, too, deliberately downplays the importance of individual differences between offenders, or the motivation for committing crime, viewing these as a constant largely resistant to manipulation. Nevertheless, in the simplified agents envisaged in the SCP world, certain generic elements of human agency are assumed: perception, motivation, emotion, decision and capability. As for conventional security, to make a broad generalisation, it describes the malevolent agency side in terms of *threat*, defined in turn as intent, capability and presence.

Agents feature significantly too in computation. In the near future, we can anticipate artificial intelligence counterparts roaming and interacting with the environment including autonomous vehicles, drones or disembodied software interpreting, deciding and acting upon video images and sounds. Agent-based modelling draws on various software architectures that represent what it is to be an active, generic human agent, in a form that is simple enough to compute with, but nonetheless realistic in theoretically-significant ways. Example architectures include PECS (Schmidt 2000) – Physical, Emotional/motivational, Cognitive and Social; or BDI (Bratman 1999) – Belief, Desire, Intention. These architectures are currently rather elementary due to the novelty of the field.

Elsewhere (Ekblom 2007) I have argued that ‘making offenders richer’ actually serves to support subtler and more sophisticated SCP, and this applies equally to security and to CPTED. Whether we are talking about conventional social or crime science based models, or computational representations, the applied world of architecture and design needs *agents which are more realistically complex in their interactions with the built environment and each other*.

In line with this view, the CCO framework aspires to provide greater detail for offenders in particular. It distinguishes between the offender’s:

- *Predisposition* – potential to offend relating to emotional/motivational tendencies, accepted moral values and rules, ways of perceiving etc. which are often acquired during childhood or adolescence and remain stable across situations; territoriality may fit here
- *Resources to avoid offending* – ranging from anger-control in the ‘executive function’, to interpersonal skills to avoid de-escalating disputes, to the capacity to keep a well-paid legitimate job
- *Resources for offending* – ranging from control of fear, courage and agility at climbing, skills of breaking and entering or countering surveillance, and social contacts with supportive crime promoters such as fences or suppliers of tools or inside information; also tools and weapons which may be brought along or acquired at the crime situation (e.g. stray bricks for breaking windows); knowledge of areas, getaway routes, security devices and how to cope with them
- *Readiness to offend* – current emotional/motivational state, e.g. psyched-up to burgle a house or stressed-out by an unpleasant commute; active pursuit of particular goals
- *Perception and anticipation* – of opportunities, affordances, hazards etc, leading to decisions and actions

Equivalent attributes can be developed to characterise crime preventers/promoters.

Humans as ‘caused agents’

The elements of CCO actually reflect two perspectives on human agency, both of which CPTED needs to take on. Our goals, plans, decisions and actions do not come out of the blue: human behaviour is both *caused and causing*, and we can view ourselves as *caused agents* (Ekblom 2010):

- *Caused* reflects that in the here-and-now we are influenced by anything from current perceptions to recent experiences to emotional precipitators (Wortley 2017) and consequent internal mental or physiological states, to developmental and even evolutionary history. Causal mechanisms usually involve interactions between what is in the human agent (predisposition, emotional state) and what is in the immediate situation (attractive target, threatening gang).
- *Causing* reflects our nature as active, goal-directed planners, decision-makers, doers, makers as well as takers of opportunities, and exploiters of resources.²

Sensitivity to this duality of discourses enables us to define, and view, crime prevention from both angles – reducing the risk of criminal events by intervening in their causes, or equivalently, by frustrating criminals’ goals. CPTED can benefit by distinguishing between the causal and the functional viewpoints and applying the one or the other in appropriate circumstances.

More complex concepts such as fear and reassurance are composites of perception, emotion, motivation and behaviour, and may involve both caused and causing aspects.

Another important aspect of behaviour is its sequential nature. Cornish (1994: 175) introduced the concept of *crime scripts* as “... simply a way of highlighting the procedural aspects of crimes. In doing so, they emphasize the form of crime as a dynamic, sequential, contingent, improvised activity, and the content of specific crimes, considered as activities with particular requirements in terms of actions, casts, props and spatio-temporal locations.” An example is stealing a bicycle: obtain tools, seek bike park, see bike park, enter bike park, select bike, break lock with tools, remove bike, depart, sell bike’. At each stage, decisions are made, resources deployed and actions taken to complete the step, avoid hazards and threats, and move forward. Each step is influenced by the situation and each offers a possible ‘pinch-point’ for preventive action. Our use of the built environment, whether legitimately or illegitimately, follows such sequences, from approach to entry to exit, and CPTED should get to grips with procedural analysis.

Social primitives – crime roles and civil roles

CPTED should handle more than just individuals interacting with their environment. *Group-level* processes – peers, families, communities – are important and rightly emphasised e.g. within Second Generation CPTED (Saville and Cleveland 2003a,b). This chapter focuses only on the micro-level: one social dimension for CPTED to capture is the *roles* agents occupy. Roles shape and are shaped by individuals’ behaviour, perception and motivation. Roles are purposive and can be associated with tasks, duties and responsibilities. CPTED needs to consider both crime roles and civil roles.

Crime roles specified within CCO comprise *offender, preventer and promoter*, and the *victim* that emerges during and after the crime. Preventers are anyone who by virtue of presence or action make crime less likely or harmful. The role incorporates the guardians of targets, managers of places and handlers of offenders featured in the Problem Analysis Triangle of

SCP/Problem-Oriented Policing (Clarke and Eck 2003). However, the concept is more flexible and inclusive. Preventers can act before the crime event of interest (e.g. locking windows before departing), during (calming a neighbour dispute) or after (reducing the likelihood of the *next* criminal event by remedying vulnerabilities).

Promoters make crime more likely or harmful, and again can do this before an event (leaving doors unlocked, or installing an inadequate frame), during it (provoking a neighbour during a heated argument) or afterwards (buying stolen goods). They can act with various degrees of culpability (inadvertently blocking the view of a CCTV camera with their van; carelessly leaving a laptop in their car, or deliberately supplying inside knowledge for crime.) Influencing people not to be promoters, or to switch from promoter to preventer, is an important part of crime prevention.

The role of *victim* involves being a passive target of crime (e.g. of assault), the owner of a physical target such as a house; often, too, an active preventer (locking the house), or promoter (leaving the house unlocked, or provoking neighbours with loud music). People's perception of the risk of victimhood for themselves or loved ones raises the issue of *fear and reassurance* and their impact on behaviour, captured for example in Ekblom's (2011 5Is) definition of community safety.

Civil roles – e.g. landlord, tenant, architect, salespeople – overlap with crime roles. For example, a landlord can be an offender by stealing from tenants, a promoter who fits inadequate locks, a preventer who fits good ones, and a victim if an unruly tenant smashes the windows. From an architectural/design perspective the various *civil users* as potential preventers, promoters or victims should be a central consideration, alongside the many positive roles they could play. And of course planners, architects and designers themselves could either prevent or promote crime by producing criminocclusive or criminogenic buildings and landscapes in the first place.

Awareness of all these roles and their interrelationships is vital for understanding patterns of crime in the built environment, and in designing practical solutions that work and are adopted and accepted by individuals, households, organisations and communities. From a broader implementation perspective, roles can be viewed in terms of stakeholders and (where institutions are concerned with some official responsibility for security) as dutyholders.

Failure to appreciate and to address the complex, messy nature of the implementation of prevention (Ekblom 2011c) has caused many theoretically plausible projects to fail (e.g. Ekblom et al. 2012). 2-G CPTED rightly attends to participation and partnership dimensions of the preventive action but arguably risks confusing these concepts with the central action of CPTED, which is about making physical, procedural or informational changes to the built environment to reduce the risk of crime. A useful set of distinctions here is in the 5Is framework (Ekblom 2011c and <http://5isframework.wordpress.com>) where the preventive action is split into intervention (interrupting, weakening or diverting causes of criminal events or frustrating offenders' goals), implementation (the practical tasks of making the interventions happen) and involvement (partnering with or mobilising people or organisations to implement the interventions or to cease promoting crime; and climate-setting, i.e. establishing supportive and accepting attitudes to the action). CPTED action

needs to fully address all these tasks, but in a way that is simultaneously analytic as well as holistic.

Primitives of crime-related social interaction – tactical script clashes

Returning to the micro-social level, in many situations agents of course interact socially with one another. Purely *causal* interactions include things like accidental pedestrian collisions. Types of functional social interactions of interest (i.e. with an element of purpose, or ‘causing’) include *care, control, collaboration/cooperation, competition, conflict and conflict resolution* (Ekblom 2011c). These relationships are often associated with particular role pairs, e.g. concierge:resident, manager:customers.

Any of these functional interactions could be analysed for a fully-rounded, ‘more of, less of’ approach to environmental design (see chapter 11 in this volume by Willcocks et al.) (This would ideally also include potential negative consequences of CPTED such as social exclusion (Cozens 2014)). However, the most significant for mainstream CPTED are conflict- and control-related interactions; the *safeguarding* agenda could draw in care.

At the social interaction level, the concept of *script clashes* (Ekblom 2012a) takes the individualistic scripts approach further. Script clashes can be seen as *tactical primitives of conflict* – elementary and universal elements of interaction between roles such as offenders and preventers as they pursue their various more strategic goals. CPTED must address at least the following clashes:

- Surveill v conceal
- Exclude v gain entry
- Wield force v resist (Damage v protect, Injure v keep intact)
- Conceal criminal intent v detect
- Conceal traces and tracks v detect
- Challenge suspect v give plausible response
- Snoop v maintain privacy
- Act at will v control misbehaviour
- Take v keep property
- Confront v avoid
- Surprise/ambush v be alert
- Trap v elude
- Pursue v escape...

Some of these clashes are inherently face-to-face, others less direct and confrontational. Some can reflect interactions symmetrically, because either party, offender or preventer, could, say, equally be doing the pursuing or the escaping. (In fact, we can consider offenders and preventers in parallel, since an opportunity for one party relates to a problem to solve for the other – Ekblom 2017.) Scripts and script clashes can moreover *evolve* as offenders and preventers develop countermoves – imagine the first ‘takeaway’ bicycle thefts versus today’s equivalent where owners lock, and thieves must obtain the tools to break the locks and then apply them.

Environment: a challenging concept

Agents of course act, and interact, in the environment. Although environment is so central to both CPTED and SCP, neither has addressed its essential nature in any depth or breadth.

Admittedly environment is a slippery notion, as will be seen, but an aspiring applied science really should make the effort. Here I discuss the basics of the environment, arguing that we should root the concept in ecology. In the next section, I suggest some ecologically-oriented environmental primitives.

Mainstream understandings of ‘environment’

CPTED does at least differentiate the environment at different geographical *scales* – the micro-environment (e.g. the interior of a room), meso-environment (e.g. a street intersection) and the macro-environment (e.g. the street pattern of a neighbourhood). CPTED also identifies particular environmental *properties* such as permeability and defensibility. While important, these elements are piecemeal and little is written that explicitly and systematically reflects on the ontology of ‘environment’.

SCP is similarly circumspect on the nature of environment. Wortley (2012) identifies the situation as the immediate environment, and defines it as ‘a setting in which behaviour occurs’ (p186). By extension, then, an environment is just a bigger, hence less purely proximal, situation in terms of time and space. For the Rational Choice perspective in particular (e.g. Clarke 2012), the environment is a place wherein risks, effort and reward are encountered, perceived and, following some decision, acted upon. The Routine Activities perspective (Cohen and Felson 1979) has a more explicit spatial dimension. It explains (changing) patterns of crime in terms of (changing) patterns of day-to-day activity that happen to *bring offenders and victims or targets together* in the absence of capable guardians; the offenders then seize the opportunities presented. How spatial relationships and dynamics cause this coming together is not covered. By contrast, the Crime Pattern theory/Geometry of Crime approach (Brantingham et al. 2017) is the most spatially/environmentally explicit of all the SCP perspectives. It supplies a framework of nodes (destinations), paths between them, boundaries and the awareness space of agents as they move about and familiarise with the locality. Places where routine encounters between offenders and targets most often occur (e.g. transport interchanges) are termed *crime generators*; those whose favourable conditions motivate offenders to actively seek them out are *crime attractors*. Other such terms are in Cozens and Love (2015).

The *social* nature of the environment also differentiates the various approaches. SCP as a whole implicitly assumes that people will encounter and interact with one another and that the environment will allow for surveillance and social control. Crime Pattern theory explicitly refers to social networks. Situational Action Theory (SAT: Wikström 2014) further assumes the social/cultural environment includes the influences of moral rules and interpersonal responses to their transgression.-Emergent social processes beyond the micro-environment – such as intergroup conflict and cohesion – are not well-handled by SCP. First-generation CPTED addresses this dimension rather patchily e.g. in terms of the poorly-defined concept of ‘activity support’. Second-generation CPTED (e.g. Savile and Cleveland 2003a,b) takes it further with explicit reference to processes such as social/community cohesion (Cantle 2008) and collective efficacy. This is worthy in principle but the accompanying imprecision means Second-generation CPTED risks merging with all forms of ‘social crime prevention’ and losing its distinctive focus on the built environment. Social disorganisation approaches (e.g. Sampson 2011) do better but make little connection with design. A promising new approach to ‘contested space’ (e.g. <https://theconversation.com/au/topics/contested-spaces-36316>) does have connections to

environmental design and looks worth bringing together with CPTED but how conflict relates to contest needs teasing out.

CCO attempts to integrate the above environmental perspectives, albeit imperfectly and at the micro-scale only. It focuses on the proximal, covering both the immediate layout of the physical environment plus its contents such as cars to steal, bottles to use as weapons, and other agents. Environment is covered in terms of both causal, motivational influences (e.g. it contains lots of expensive houses, or is rival gang territory) and functional, especially tactical, ones (e.g. the permeability of a neighbourhood, availability of recesses for lurking). To avoid the confusion alluded to in the introduction, CCO also distinguishes between the wider environment in general, and the very particular kind of built environment element that is the 'target enclosure', which itself contains the ultimate target of crime. Enclosures range from handbag to locked safe, to secure room, building, compound or block.

On the social dimension of the environment, beside the roles already covered CCO allows for the incorporation of the social/cultural attributes of elements such as targets and enclosures alongside the purely physical.

Thus in sum, the situational side of CCO comprises these elements:

- Target object or person
- Target enclosure
- Wider environment
- Preventers and promoters

More generally in the crime prevention world, social terms like 'community' are often-used but poorly-defined (Ekblom 2011c) – is the community a collective target of crime, a level of causation of/intervention against crime, a source of nearby offenders, a context for implementation and involvement of preventive action? All these issues are important for understanding built environments and their manipulation in the service of safety and security, but we must develop a more tightly-defined set of concepts and levels. The same applies to 'community safety (Ekblom 2011), which CPTED often aspires to support.

The environment – complications

SAT distinguishes between the *setting* of criminal action – the immediate environment in time and space terms – and the *situation* as *interaction between agent and setting*. Ways of perceiving the setting (and consequently of responding to it) depend not just on what is out there to be perceived, but the *propensities of the agent to perceive things in particular ways*. Some of these propensities will be pan-human (e.g. a tendency to perceive rustling in the bushes as potentially threatening) but others will reflect individual differences. Thus for example, only individuals with certain attitudes to moral rule-breaking will tend to see opportunities for crime, and depending on circumstances, act on these 'affordances' (Gibson 1950; Ekblom 2012b).

CCO similarly articulates the *interactive* nature of concepts like *opportunity*, as already described: conducive environment *plus* offender's resources, active goals and presence or remote influence. As in SCP, perception shapes opportunity; and as in SAT, an agent's predisposition and readiness shape perception in turn. Wortley's (2017) situational precipitators approach also envisages environmental cues prompting or provoking

motivational states of readiness which then engage with opportunities – e.g. a provocative noticeboard triggering vandalism. But for the vandalism to be triggered, the offender must have the potential for certain signs – the officious statement of rules like ‘no ball games’ – to do the triggering. There is no escape from the person-environment interaction.

All this implies that we cannot treat ‘the environment’ as a kind of common Newtonian platform of space and time that is perceived, and interacted with, by all individuals in an identical way. What provokes me to vandalism may not provoke you. And I am part of your environment and vice-versa. Especially where we are in conflict, your opportunity or solution may be my problem (Ekblom 2017). This environmental relativism has both academic and practical implications, although it is often convenient to slip into the shorthand presumption of commonality. Whether Wikström’s use of ‘situation’ is the right term for this interaction is debatable, given the long-established CPTED and SCP usage in the environmental sense, but the underlying concept makes sense.

Related to environment is the important, but confusing, concept of *context*. Some advocates of CPTED risk blurred holism with the slogan ‘context is everything’, which appears prominently on the website www.doca.org.uk, the UK Designing Out Crime Association. By definition, contexts have to *surround* some core entity or relationship – so they can be extremely important, but never ‘the whole caboodle’. For describing interventions and their impact, crime science favours the ‘context-mechanism-outcome’ framework of the Scientific Realist approach (e.g. Pawson and Tilley 1997). The context-dependence of preventive interventions – the need for certain conditions to be present for the preventive mechanisms to be successfully triggered – was amply demonstrated by Tilley’s (1993) study of (failed) replications. But the scope of Scientific Realism’s ‘context’ needs further differentiation. CCO takes the *causal* context of a preventive intervention to refer to those of the 11 proximal causes which are present, but not directly manipulated by the intervention. Wider contexts can relate to practical issues of implementation, or the people/organisational factors of involvement, as described by the 5Is framework (Ekblom 2011c). As already stated, these distinctions are important for getting the best out of Second-generation CPTED.

Ecology – agents in environments

The previous sections lead to the conclusion that if CPTED and SCP are to advance their academic understanding and their development of practical knowledge, they require a better account of the environment and how agents perceive, decide act and interact in it; one which combines holism with detail and conceptual rigour. We should cast our conceptual net wider. And we should try to detach ourselves from too intimate a link with the *built* environment, whose many practical considerations obscure understanding of the environment’s essential nature.

A promising source discipline is *ecology*. This is the study of the interrelationships of agents with their environment and each other.³ Ecology brings from biology a rich and well-developed suite of relevant concepts with a strong spatial dimension. The *environment* has many definitions within ecology but the most appropriate here is ‘the external conditions, resources, stimuli etc. with which an agent interacts.’ *Ecosystems* emerge from interactions between individual agents, and populations, with their environment (which includes each other). Second-generation CPTED (e.g. Saville and Cleveland 1997) does already use the

term 'social ecology', but does not develop the concept in depth. I now consider how agents act in environments, attempting to merge ecological and crime science approaches in support of CPTED.

Again we must attend to temporal and spatial scale. In the longer term and over wider-ranging activity space than individual situations, the concept of the ecological *niche* offers a good way to understand the dynamics of human interactions with our environment and with each other (cf. Brantingham and Brantingham 1991). A range of definitions of niche exist⁴ but the functional one adopted by Colinviaux (1980) is most appropriate: the way an agent makes its living in its typical habitat – i.e. where it normally occurs. More formally put: 'a specific set of capabilities for extracting resources, for surviving hazard, and for competing; coupled with a corresponding set of needs.' (232). These capabilities underlie the agent's adaptedness to exploit or cope with particular environments. Thus in Colinviaux's example, a wolf spider with its long legs and rapid movement is adapted to the 'profession' of hunting insects on the leaf-strewn forest floor.

This perspective can be linked quite closely to that of crime science, especially as described using CCO. Colinviaux' 'biological professions' can be equated to social roles, albeit humans are far more flexible in adopting or switching between these. In human ecology (e.g. see Schutkowski 2006), where much of our own environment comprises fellow people, understanding roles and their interrelationships is extremely important, whether these are the crime-related roles of CCO or the complete set of 'civil' roles with which these overlap, as described above. Colinviaux' capabilities are the equivalent to CCO's 'resources for offending' (or the counterpart for the other crime roles). The interactional nature of niche relates to that of opportunity as characterised above: they are kindred concepts, both spanning agency and environment. The main difference is that opportunity is more tactical and proximal and confined to particular sets of situations. A crime niche, such as the 'profession' of house burglar, can comprise a career-long set of choices and opportunities occurring in a particular habitat, sufficient for suitably-resourced agents to make a living from, or at least to supplement an honest one. For CPTED, the concept of niche helps to think about the built environment as a whole, and the properties, features and configurations that influence how offenders, equipped with particular skills, tools and knowledge, can exploit it in ways extending over time and space.

Whether agents have merely encountered existing places or have actively modified them, how do they then dynamically interact with those environments? Continuing with the *caused agent* concept, we can distinguish between *causal* and *functional* interactions. Causal interactions are inherently simpler – for example, a crowded train may cause overheating and stress, which may in turn lead to aggressive encounters. Functional interactions relate to an agent's goals – how the environment features in their affordances, purposes and plans.

We have already discussed the relevance to CPTED of crime scripts – the practical procedures for offending. Purposive accounts of scripts (Ekblom and Gill 2016) might cover, for example, 'enter house without making noise; search house for desired loot without leaving traces; leave without being seen...'. Scripts have obvious affinity with *modus operandi* or perpetrator techniques. They connect to ecology through, for example, *foraging*.

Originally covering how animals obtain food in the wild, and extended to cover human hunting and gathering societies, the ecological concept of foraging has been imported to crime science and generalised to the pursuit of diverse goals, principally by Bernasco (e.g. 2009). Optimal Foraging Theory has close affinities to Rational Choice and awareness space in crime science and elsewhere, in terms of the balancing of risk, effort and reward as agents go about their environment in search, say, of things to steal or people to harm. Understanding how offenders and others forage enlightens our view of the misuse and use of the built environment. It supports a 'think thief' heuristic helpful to practitioners (Ekblom 1995). (It certainly adds to the standard Routine Activities view. This does not handle agents' active pursuit of purpose in seeking out targets located in crime-attractor situations whose configuration, say, makes place managers easy to outmanoeuvre.).

Beyond the foraging of offenders, script themes of *preventers* relevant to CPTED cover defence of portable property or territory. A suite of operational-level CPTED actions support such defence, e.g. surveillance, management and maintenance. Each could be characterised via tactical scripts.

Complementing the concept of scripts for foraging, defence etc. we can envisage 'opportunity paths' (Ekblom 2017) – a configuration of individual environmental opportunities which together enable whole script sequences to be undertaken.⁵ An example might be a deserted, poorly-lit street, an unlocked sideway and a weak back door.

The physical environment also influence the occurrence and outcome of *script clashes*. For example, lighting can support concealment, or detection, of criminal intent; marking of territory as private can permit and support a challenge to an intruder to explain their presence or behaviour. Understanding, then addressing, such script clashes is pivotal to CPTED – designing environments, products and procedures to tip the balance to favour the good guys, whilst not forgetting the range of other requirements such as low carbon, inclusivity and aesthetics. Place managers feature here too.

Unfortunately it's not only the good guys who modify the environment. Hideouts (Atlas' (1991) concept of 'offensible space') and ambush sites are examples of places constructed or altered by offenders to favour them in script clashes. Interestingly, the recent evolutionary/ecological concept of *niche construction* (e.g. Laland et al. 2014) (think of birds modifying trees by creating nests, which boosts breeding success) may generate useful connections with humans' own deliberately-constructed environment. It is certainly consistent with the view of the offender and other agents as not only passively adapting to the environment, but also active, causing adaptors of the environment.

In sum, the physical, social and informational environment that agents inhabit, encounter, modify or construct has certain properties that exert causal influences upon those agents. And from the functional perspective the environment's properties can provide or block opportunities, helping or hindering the pursuit of agents' goals, tactically favouring one or other side in a criminal conflict, and facilitating or constraining attempts at social control. These properties may act individually or, more likely, in combinations and configurations in space and time.

So, what are these properties of the environment? How do they relate to criminological, architectural and design perspectives?

Primitives of the environment – properties, features and contents

The primitives defined in the CCO framework to characterise the environment and its material contents (wider environment, enclosure and target of crime) specifically focus on crime. They are also rather generic. Here I delve deeper into the detailed attributes of environments, enclosures and their contents, drawing on the ecology of human perception and action as discussed in the previous section.

What follows develops my earlier attempt to deconstruct and reconstruct CPTED (Ekblom 2011b). The environment can be characterised by *properties* – causal and/or functional attributes however they are realised; *features* – designed physical and/or informational elements which confer the properties; and *contents* including the targets within the space.⁶ Recall that an offender's environment may also include 'human contents' acting e.g. as preventers or promoters; and likewise the preventer's (or victim's) environment may include offenders.

Properties

Here are listed candidate causal/functional properties for consideration as environmental 'primitives' which enable, constrain, shape or motivate human behaviour and interactions. They range from simple physical properties to more complex psychological and social ones, and include:

- **Containment** – space for containing people, objects and subsidiary places; or spatial constraints e.g. size which exclude them
- **Presence** – recording evidence of presence e.g. footprints, DNA; and traces of past actions e.g. movements or use of force
- **Movement** – enabling, shaping or constraining movement of people and objects, into, within or out from the space at various scales; in particular, of encounters and avoidances (Hanson and Hillier 1987); also vertical movement including climbability
- **Manipulation/force** – enabling, shaping or constraining application of physical force to people, objects, built, landscaped or natural structures; and conferred for example via space (room to swing a kick at a door, or to accelerate to ram a gate), or leverage points (e.g. for using a crowbar)
- **Perceivability** – allowing production, transmission and detection of sensory/perceptual information in sight, sound, and smell, or via artificial modalities such as infra-red; applies to both close and distant perspectives
- **Understandability** – the inherent ability of the environment to be 'read' and understood by culturally proficient users, in navigating and behaving in it (e.g. logical street patterns)
- **Informativeness** – containing information that refers usefully to other places, people and things inside the local environment (e.g. posters notifying of nearby public meetings) or beyond it (signs to distant destinations)
- **Normativeness** – respecting and/or conveying cultural norms of society in general or of some subgroup, e.g. a minority culture or a gang
- **Motivational/emotional/aesthetic influence** – e.g. generic comfort factors e.g. temperature or smoothness underfoot (cobblestones being uncomfortable); or more crime-specific ones, prompting defence behaviour, or engendering feelings of territoriality or fear

- **Interpersonal/intergroup** – engendering encounters and avoidances (see movement above), and relationships of, say, ownership, care, competition or conflict, e.g. thin apartment walls causing conflict over noise
- **Communications** – whether local (e.g. speaking to nearby people, waving or shouting across the road against traffic noise) or more remote (e.g. phone signal, wifi connection)
- **Privacy** – enabling individuals, families or wider groups to control availability of information about themselves, their actions and their assets

Each property can be subdivided further – for example, perceivability can be split into vision and sound, and vision in turn into sightlines, lighting level and quality, and background pattern (Ekblom 2011b). The properties each have physical, psychological and social dimensions to varying degrees.

The list remains a task in progress. As currently stated, they are not always neatly separable, e.g. unclear boundaries of public and private space can relate to perceivability, understandability, informativeness and interpersonal/intergroup influences. And as with Wikström's situations, the perceived, phenomenological dimension of the properties overshadows the objective one in influencing people's behaviour and feelings.

Note that none of the properties of the *environment* make complete sense without considering how they interact with the properties of the *agent*. This is obvious with properties such as understandability, which requires humans to have sophisticated perceptual analytics and also cultural knowledge of the meaning and purpose of particular spaces or configurations. But even at the simplest level, sightlines, say, are only meaningful when considered in relation to the height of the human body (can I see over that fence?), or the human capacity to make out shapes and movements at night. So whenever we are thinking about environmental properties, they are always defined in relation to ourselves.

Features

Some properties are inherent – the bulk of a home cinema TV renders it unlikely loot for a pedestrian burglar. Others are conferred by distinguishable features of design. This could be via materials (a wall coating resistant to graffiti), structure and form (a speed bump in the road) or operating action (the way a gate swings shut). The properties a feature confers may serve some crime or security function. Here, the feature may have been incorporated by deliberate design. Function may also emerge incidentally: a gravel path installed for aesthetic reasons happens to indicate the presence of prowlers; or an entrance porch incorporated for shelter may get repurposed as a burglars' climbing aid.

Security adaptations are features that have deliberately been designed-in to confer security, whether on the designed object itself (making it a secure product), or on something else (a securing product (Ekblom 2011b) such as a public bench seat with places to hitch one's bag).

Features which seem relevant as possible primitives for understanding environmental aspects of crime and its prevention include:

- Nodes (destinations)
- Paths (nodes and paths taken from 'crime pattern theory' – Brantingham et al. 2017)
- Barriers and gateways – physical
- Screens and windows – visual barrier or prospect

- Grades and elevations – physical, visual prospect or barrier
- Enclosures (containers, bags, vehicles, subordinate buildings e.g. shelters and kiosks, gated compounds) – each with surrounding walls or fences, entrances, exits, interiors and peripheries (protection, refuge or shelter is part of this and indeed the ‘prospect-refuge’ axis is a significant concept in environmental psychology (see Appleton, 1975; Fisher and Nasar, 1992, who also add ‘escape’, which here falls better under ‘movement’)
- Recesses
- Fixed furniture (bike stands, utility boxes, signboards, seating...) and installations (e.g. statues)
- Plants – trees, shrubs, flowerbeds
- Lighting
- Signage/markers
- Surfaces – colour, pattern, texture, reflectivity, resistance, hand/fooholds

One feature may confer several properties, e.g. a physical barrier may also serve as a visual screen. And a property may be conferred by a configuration of features, e.g. where speed-reducing cushions on the roadway to prevent use of force through ram-raiding are accompanied by barriers on their flanks so drivers can’t just maintain speed by steering round them.

Contents

It’s stating the obvious to say that environments *contain* things, and people. Diversity defeats a definitive listing for the present, at least, but content can include:

- People’s bodies (standing, seated or moving; crowded or sparse)
- Movable furniture (planters, rubbish skips)
- Vehicles (parked or moving)
- Other potentially mobile property (such as a mass of coats on hooks which can obscure the view of the entrance of a bar)

Holistic considerations

Holistic consideration of design requirements applies to properties, features and content alike. Movement properties, say, may clash with perceivability in interventions such as barriers to enhance defensibility (Armitage 2013); perceptual requirements for surveillance sightlines may conflict with privacy. Lighting features may clash with sustainability (e.g. Pease 2009; Armitage and Monchuk 2009); abolition of recesses for security purposes may remove shelter and perhaps the opportunity for people to meet casually on the street; and rubbish skips may block the view. More positively, sightlines over an elderly neighbour’s house may join with a configuration of paths that boost accidental encounters – which together prompt and facilitate caring for the neighbour and their home.

We can only understand the behavioural effects and possibilities offered by environmental properties, features and contents and their configurations, with reference to human capacities and motivations to use them. (This is, essentially, a restatement of the niche concept already discussed.) Thus for example, perceivability relates to the range of human senses (e.g. visible light, how we perceive shape and structure) and any artificial

enhancements (e.g. infrared cameras). Understandability relates to who is doing the understanding, equipped with what cognitive resources for reading physical and/or socio-cultural information.

Taking this further, practitioners applying CPTED to particular building designs must be able to ‘think thief’, i.e. play out in their minds (or on virtual reality facilities) the kinds of scripts offenders might perform in ‘foraging with criminal intent’ and in undertaking a particular kind of crime in a particular context. In the case of burglars, a simple version could be ‘seek enclosure, overcome external security, enter, seek target items, take, leave, all without being detected, confronted, caught or traced’. The burglars will likely further adapt their choice by selection of familiar script tracks (e.g. appropriate actions for night-time burglaries versus daytime ones), or improvise at the scene (Ekblom and Gill 2016). These selections and modifications will be influenced by the properties, features and material/human content of the environment and the burglars’ perception, readiness and resources for dealing with the problems and opportunities they pose.⁷ These will also modify with experience and changes in expertise (e.g. van Gelder et al. 2017). We can similarly ‘think preventer’, or even ‘think promoter’. This wider attention span fits with the *user-friendly/abuser-unfriendly* approach advocated by the Design Against Crime Research Centre (www.designagainstcrime.com).

A higher level of holism relates to groups, communities and societies, covering processes such as cohesion and collective efficacy (Sampson et al. 1997), and contextual factors such as culture. How far an understanding and an ontology of this emergent level can be built up from patterns of connection and interaction among psychological/ecological concepts to be of theoretical and practical use in beneficially manipulating the social environment through CPTED is unknown but computer simulation may eventually help here.

Finally, a holistic approach should be capable of addressing multiple drivers or requirements, beyond crime and security. The ‘troublesome tradeoffs’ concept (Ekblom 2004) takes this on board but only in a limited way: crime remaining the focal concern. Cozens (2016) highlights the ‘dark side’ consequences of maladroit CPTED practice (Cozens 2016) such as social exclusion of homeless people. Most radically, the need to fully address multiple requirements beyond security is expressed in ‘Third Generation’ CPTED (Thorpe and Gamman 2013) and in the ‘more-of, less-of’ approach in the chapter by Willcocks et al. in this volume.

Primitives summarised

We can now summarise the ontological primitives, their relationships and the perspectives or discourses by which we view and describe them, that seem most relevant to a sharpened-up CPTED and indeed to the overlapping domain of SCP. The primitives have a broadly ecological flavour that links with crime science and builds in particular on the CCO framework covering immediate causes of criminal events. They are intended to apply to theory, empirical research, practice and computational approaches. At present, they are confined to the micro/meso scale and hence immediate situations rather than covering wider community/societal levels for which a fully-rounded CPTED requires ontological sharpening too. I briefly return to this issue below.

Individual primitives should be analytic, but capable of supporting a holistic view of social agents acting individually, jointly and collectively in the built environment. For this, they

must fit together in consistent suites that reflect integrated models, ideally with no gaps or overlaps, representing relationships and interactions at multiple levels or scales. The discourse can be causal, or functional (relating to agents' goals or purposes). An understanding of environments must be based on an understanding of the agents that live and act within them, and how agent and environment interact in both senses – causal interdependence and social reciprocity (Wortley 2012).

Agents

On the agent side are individuals (and organisations) viewable as both *caused and causing*. They (we) have characteristics of *perception* (including affordance of opportunity), *motivation/emotion* (as propensity and current state), *anticipation, decision* (covering self-interest and moral rules), *planning* and *capability*. All this is tied up in our abilities to construct, maintain, update and utilise (i.e. simulate with) internal models of the external world (including environments, other agents, their internal models etc). Capability includes resources including tools, knowhow, agility, courage and social contacts. More complex concepts such as fear and reassurance are *composites* of perception, emotion, motivation and behaviour. Regularities of agents' sequential behaviour can be captured by *scripts* relating both to strategic themes such as foraging or defence, to operational-level actions such as patrolling or surveillance, and to tactical detail.

Roles, both crime-related (offender, preventer, promoter, victim) and civil (including stakeholders and dutyholders), reflect the social nature of agents. Preventer roles include (but not exhaustively) guardians of targets, managers of places and handlers of (potential) offenders. Reciprocal interactions between roles include elements of care, control, collaboration/cooperation, competition, conflict and conflict resolution. Control and conflict are central to CPTED, but a broader address to environmental design that covers all these interactions is desirable.

Environment

The environment should ideally be defined relative to particular agents or roles (e.g. offenders), because one agent, a group or a community, may constitute part of another's *social* environment. The primarily *physical* environment relates to physical targets of crime, enclosures such as buildings, wider environments such as housing estates and resources e.g. tools and weapons for offending. CPTED must increasingly develop a *cyber* environment of sensory, communication and control systems (and encompass artificial intelligence-based agents); indeed, the boundaries of social, physical and informational are dissolving.

In detail, the environment can be characterised through three kinds of attribute: causal or functional *properties; features* conferred incidentally or by deliberate planning, architecture, design and construction; and human and material *contents*. Higher-level properties emerge through *configurations* of subsidiary attributes on various scales in time and space.

However, the properties of environments can only be understood in relation to the perceptions, capabilities, goals and predispositions of the agents that use or misuse them. At the micro-level this interdependency-type interaction relates to *precipitators* such as provocations, and to *opportunities*. (Recall, importantly, that provocations depend on the agent's potential to be provoked; opportunities are not just environmental in nature but must be defined in terms of an agent's goals, capabilities, and presence and access.) At the meso level, the interaction relates to *opportunity paths* that facilitate agents' performance

of complete scripts; and at the macro and longer-term level, to *niches* for, say, pursuing particular criminal careers. In the interpersonal domain, too, the interaction relates to *script clashes* between the relevant roles; how the environment facilitates one or other side; and how it can be modified to favour preventers (e.g. making space defensible) or offenders (making space offensible).

It is arguable how far an ontology of CPTED can extend beyond individualistic and interpersonal aspects of the social environment to include *collective* processes. Can they cover the built environment's influence on social levels of groups, communities and society, which are the emergent outcomes of individualistic interconnected and interdependent processes? Likewise influences in the other direction, ie where collective processes impact on individual processes.⁸ And what about society's influence on the built environment? Attempts to address these higher levels should be cautiously encouraged provided they do not dilute the focus.

CPTED needs concepts and approaches to handle *change* in the built environment, ranging from local refurbishment to major developments to emergence of 'hyperconnected' (McGuire 2007) buildings, streets and their human and material contents. Computer simulation may help anticipate and plan new developments, and on the wider changes, existing ontological frameworks e.g. CCO can be modified to help CPTED evolve in step.

Connecting the primitives to CPTED principles

The ontological primitives identified above are intended to help sharpen thinking and communication in CPTED. They will need to be packaged up in two ways: 1) that practitioners can make sense of and apply at the 'coalface'; and 2) that academics, in their turn, can exploit, and extend, at the 'leading edge' of applied research and development. For both applications a necessary early step will be to map them onto the traditional CPTED principles (or other variations e.g. the seven attributes of sustainable communities in *Safer Places*, DCLG 2004), and to come to a judgement on whether these principles are still useful in their present form. In the introduction to this chapter and elsewhere (Ekblom 2011b and 2013) I have argued that they require significant modification. Other steps from ontology to practice are sketched out in the conclusion.

In this section, therefore, I try to connect the bottom-up primitives just set out, with the top-down definitions of CPTED principles that I developed in a previous article (Ekblom 2011b⁹). There, as here, I distinguished between environmentally-oriented instrumental *tasks* to be undertaken by people occupying preventer roles, such as surveillance and defence, and *surveillability* and *defensibility*, which are *environmental attributes* that support or hinder the tasks. I also differentiated tasks which are *preparatory*, such as clearing sightlines, versus *operational*, such as doing surveillance using those sightlines. Some actions are not strictly tasks at all, but *expressive* of emotions and motivation e.g. relating to territoriality.

Below, space confines me to an illustrative example, surveillance. The earlier version of connecting each of the CPTED principles to primitives, top-down, is in Ekblom (2011b).

Surveillance – an illustration

Abridged and slightly modified from Ekblom (2011b), surveillance from the preventer's perspective is an *operational task* which can be subdivided into a generic *script* of watching,

patrolling or remotely monitoring some building, interior or landscape, for the *presence* of some *suspicious person* or occurrence of *suspicious behaviour*; *detecting* possible suspicious behaviour; provisionally *attributing innocent or criminal intent*; *investigating further*; and/or making some escalatory *response*, whether to confront or arrest the person directly, take protective action such as locking down a building, report or summon assistance. The suspicious person could be unknown to the surveiller, a member of a category or group of interest, or a pre-specified individual. Note that surveillance could be undertaken either by someone acting in a *crime preventer role*, or by an *offender* (e.g. a stalker) or deliberate *crime promoter* (e.g. letting a burglar friend know when a neighbour is out shopping). The original definition goes on to differentiate active versus passive surveillance, and to relate it to other CPTED principles such as being undertaken in support of defence, and being motivated by territorial emotional states and goals.

Surveillability is a functional property of the *environment*. This builds up from an array of more specific causal properties, principally under *perceivability*, covering the senses of sight and sound; these properties are conferred by particular environmental features and contents, individually or in configuration. Visual properties, for example, can be split into sightlines, lighting levels and quality, and background pattern. On *sightlines*, features affecting this include dog-leg bends, screens, barriers, recesses and enclosures by way of geometric structure; transparency and reflectivity of materials; and regarding content, human/vehicular presence (e.g. crowds or traffic jams) and fixed furniture such as planters.

It would be possible to go on, to tease out how these environmental attributes relate to the goals, emotions, goals and capabilities of the agents playing the various crime roles; the scripts each often uses in particular environments; and the script clashes between them. Obviously the last is about surveillance versus stealth, and counter-surveillance. The pattern of relationships and interactions would differ by crime-type.

Similar exercises can be completed for each of the other primitive environmental attributes that underlie surveillability; likewise for the other CPTED principles and how they support or interfere. This wider picture is taken further, but at an earlier stage of development, in Ekblom (2011b). Attempting to merge the present thinking on, say, activity support with that by Willcocks et al. (this volume) would be interesting.

Discussion

The above exercise raises wider issues meriting brief discussion. These include a fresh look at the suite of CPTED principles, the issue of how the ontology might be used in practice, and the scope of CPTED.

Different, or additional, CPTED principles?

There is no particular reason for sticking rigidly to traditional CPTED principles. It may be that we want to recombine the underlying primitives in different, more user-friendly and use-appropriate ways. Perhaps we merge defence and access control; or add new principles. One likely candidate here is *resilience* of built environments – the property of being able to sustain wear or damage, whilst maintaining or rapidly recovering function and adapting to changed conditions. Another is *reconnaissance*, the task of actively acquiring information about an environment and the people within it, to plan future actions, usually of a hostile nature. (This applies equally to criminals planning a robbery, and police planning a raid on a terrorist hideout.) A third, relating to permeability, is (for want of a better word)

escapability – which is significant in preparing for immediate responses to terror attacks (RIBA 2010).

Ontology in practice

However well it eventually maps onto the full range of CPTED practice, there is no point in developing an ontology unless it is used. Although this chapter targets the academic end of the scale, some points are noteworthy. First, any ontology must pass a *sense-making* test with practitioners, although practitioners in turn should be prepared to move out of their conceptual comfort zone, trading (initial) difficulty for greater utility. Educational material, well-designed graphics and interactive graphical applications may help. Second, there is a need to organise the ontology. Third, the ontology must combine a necessary minimum of *constraint* with a predominant support for *design freedom*. (Lavoisier’s terminology of chemistry both revised and confined the chaotic and vague vocabulary of alchemy, and helped unleash the vast and innovative array of modern industrial and medical chemistry.)

The traditional way of achieving these aims is to develop a glossary, but this can be complemented by more structured approaches. One such example is the Security Function Framework (SFF: Ekblom 2012c). Although developed for product design this equally applies to the built environment (Meyer et al. 2015). It aims to describe in retrospect, and to help specify in advance, a product’s design in terms of *purpose* (what and who is it for?): *niche* (how does it fit in with the security environment – is it e.g. an inherently secure product, a security product dedicated to protecting something else, e.g. a car, or a securing product, i.e. one which supplies security whilst its main purpose is something else, like a bicycle stand); *mechanism* (how does it work in cause-effect terms?); and *technicality* (how is it constructed, how does it operate in practice?). SFF could be presented both in advanced form for leading edge research and development of environmental design, and in elementary, plainer-language form for immediate use by CPTED practitioners, giving them a way of articulating, communicating and reflecting on some universal dimensions of anti-crime designs. In the CPTED context, the chapter by Willcocks et al. in this volume in fact extends SFF as the ‘vibrant secure function framework’ to cover a ‘more-of, less-of’ address to the redesign of a neighbourhood attending to multiple drivers beyond crime. But however practitioner-friendly we aspire to make the operational version of the ontology, there are limits, and besides there is really no avoiding the need for practitioners to sharpen their language and thinking.

Revisiting the scope of CPTED

Previously (e.g. 2011a,b, 2013 and above) I have expressed concern about diluting CPTED by merging it with general crime prevention and especially community-oriented kinds relating to boosting social cohesion and collective efficacy as envisaged e.g. in Second-generation CPTED. However, dilution becomes less of an issue if, as advocated here, we have developed definitions of core first-generation CPTED concepts and processes that are systematic, mutually consistent and integrated and clearly-expressed, ideally in the form of a controlled vocabulary; and accorded the concepts and processes sufficient attention during research, education of practitioners and operations. We would also need a corresponding articulation of the ontology of the collective, social, processes to match, at a range of ecological levels from individual persons and places to community to society. The primitives of care, control, conflict and conflict-handling already mentioned, might contribute here.

We can further envisage a joining-up between CPTED and planning/architecture/design: again, with CPTED (and the rest of crime prevention) better-articulated, it is in a stronger position to engage with, yet preserve its distinctive approach within, these wider fields. Thus a decent ontology for CPTED can be both constraining and liberating in all the right places. None of this means that we should wave goodbye to CPTED specialists – there is still a distinctive body of knowledge and experience that is peculiar to the field. Rather, that the CPTED concepts and knowledge they apply are properly joined up with these wider disciplines and practice areas, and that the specialists are sufficiently adept to communicate and collaborate with colleagues across the disciplinary boundaries. Ontological rigour would enable CPTED to take on the ‘multiple drivers’ approach of 3rd-generation CPTED (Thorpe and Gamman 2013, and see Willcocks et al. Chapter 11 in this volume for an account of the ‘more-of, less-of’ approach) without loss of clarity. Indeed, the properties, features and contents primitives have been expressed in as neutral a way as possible so they can apply to both security and amenity requirements. This seems a prerequisite for properly embedding CPTED within architecture and design. Tradeoffs and conflicting requirements are best considered together at all stages of the planning and design process rather than security being bolted on at the end, where attempts to do so are disruptive and options severely limited.

A more radical thought is that some aspects of the ontological framework developed here for crime and safety might actually be of wider use in architecture as a whole. Concepts of agency, causal and functional properties, features, content, roles, scripts and script clashes etc. are entirely generic and could equally apply to people going about their legitimate business in the built environment. Architecture does, it seems, have its own explicit approach to ontology (see <https://plato.stanford.edu/entries/architecture/#Ont>) but it is highly abstract and there are several ontologies to choose from (e.g. concretist, abstractist, performative or social constructivist) so attempting to connect it with CPTED and crime science is definitely work for another occasion! What may be more profitable and doable in the shorter term is to explore the links with evidence-based architecture and architectural theory briefly alluded to above.

Conclusion

It is doubtful that CPTED or even crime science could ever reach such conceptual heights as hard science or medical science, and we should note with caution that practitioners in all fields have a tendency to misuse jargon as a kind of ‘professional defensible space’. But I firmly believe that for CPTED to advance we must significantly develop its ontology. While this chapter has focused on the ontology of micro-level social processes it has shown a possible route to connecting up with community processes and concepts and indeed with those of planning, architecture and design. I previously argued (2013) that CPTED was languishing in a ‘No Man’s Land’ between architecture, crime science and wider social science. Perhaps we have now identified a way to reclaim, reconnect and reseed the territory in a way that is holistic yet analytic, and rigorous yet practical, bringing together theory, research and experience. In short, sharpened-up.

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2 'Causing' behaviour can also be laboriously described in purely causal terms, but the feedback loops which diminish the difference between 'actual state of affairs' and 'desired state of affairs' are most economically and meaningfully described teleologically.

3 This and subsequent definitions are adapted from www.biology-online.org/dictionary unless otherwise stated. For consistency, I have substituted 'agent' for the original 'organism'. Ecology does have a history of use in the crime field, for example Barker's (1968) 'ecological psychology', with its focus on 'behaviour settings' – regularities of place and activity. The 'ecological zones' approach of the Chicago School (Bulmer 1984) is also relevant but arguably too impoverished and macro-scale for present utility.

4 E.g. see <http://environment-ecology.com/what-is-ecology/205-what-is-ecology.html>

5 This resembles the 'Swiss cheese' model of accident causation (Reason 1990), where vulnerabilities line up (as in the holes in adjacent slices of Emmental) establishing a causal pathway through the entire stack of scenes. Opportunist offenders may simply follow through the pre-existing paths, but more active ones may engineer the environment to deliberately line a path up.

6 Features and contents of an environment may have properties, features and contents of their own which, independently of the environment in which they are incorporated, relate to crime or security. For example, officious 'park regulations' notices may both influence the social ambience of the park; and provoke defacement against themselves.

7 A detailed focus on the generic mechanisms by which security interventions can influence the offender, the 11Ds, is in Ekblom and Hirschfield (2014).

8 'Coleman's Boat' describes the complex interrelationship between macro and micro processes in society – e.g. see <https://understandingsociety.blogspot.com/2012/02/causal-pathways-through-colemans-boat.html>.

9 Available at

https://reconstructcpted.files.wordpress.com/2012/07/ekblom_deconstructing_cpted.docx