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European Journal on Criminal Policy and Research

ISSN 0928-1371

Eur J Crim Policy Res
DOI 10.1007/s10610-015-9291-9

Springer

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Rewriting the Script: Cross-Disciplinary Exploration and Conceptual Consolidation of the Procedural Analysis of Crime

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Abstract The use of Cornish's crime-scripts approach in situational crime prevention grows apace. However, we believe the conceptual foundation of cognitive scripts imported from Abelson and colleagues was rather unclear and is too narrow to support current script research. We therefore review the notion of scripts to both promote clarity and better connect it to mainstream situational prevention and criminology more generally. We also seek to broaden the approach by exploring additional cross-disciplinary links. We believe all this will support the progressively more demanding uses to which the procedural analysis of crime may be put in research and practice and—more broadly—challenge how human behaviour in crime is analysed.

Keywords Crime scripts · Situational crime prevention · Crime science · Adaptability

Introduction

Even the opportunistic theft of belongings from unattended cars is a dynamic process in time. Yet criminological research and situational crime prevention (SCP) practice often still treat such events as minimalist "billiard-ball collisions". The Problem Analysis Triangle (Victim/Target, Location, Offender—e.g. Clarke and Eck 2003) is static like its more comprehensive

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Published online: 14 August 2015

counterpart, the Conjunction of Criminal Opportunity (CCO: Ekblom 2010). However, Cornish (1994a, b) introduced what still seems a remarkably sophisticated application of the concept of crime scripts. Cornish (1994b: 175) describes 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." There were modest precedents: as Tompson and Chainey (2011) indicate, Brantingham and Brantingham discussed crime procedure in 1984; and Cornish also drew on the then-emerging interest in interviewing offenders for preventive intelligence (e.g. Ekblom 1991).

The importance for research and practice of the script approach were obvious to Cornish. Procedural analysis of crime can identify many "pinch points" for SCP to address, both upstream of the criminal event (e.g. in obtaining fake ID), during the event and afterwards (e.g. in selling the loot). But scripts inspired only limited research compared with the "mainstream" rational choice perspective (RCP: Cornish and Clarke 1986) and routine activities theory (RAT: Cohen and Felson 1979) perspectives. And few script studies were designed to support practical prevention. However, lately, we have seen exciting developments covering the application of scripts to complex crimes and blends of criminal and noncriminal actions. The diversity of studies using scripts is illustrated as follows (fuller reviews are in Tompson and Chainey 2011, and Leclerc and Wortley 2013):

- To tackle illegal disposal of waste and anticipate the impact of legislation (Tompson and Chainey 2011)
- To appraise potential effectiveness of different approaches to regulation in a complex system linking illicit and legal markets (Bichler et al. 2015; Morselli and Roy 2008)
- To identify vulnerable victims (Deslauriers-Varin and Beauregard 2010; Soudijn and Zegers 2012)
- To determine effective intervention points (Clarke and Newman 2006; Leclerc et al. 2011; Savona 2010; Leclerc and Wortley 2013)
- To assess how offenders choose targets and attack victims (Beauregard et al. 2007)
- To understand displacement of offending (Ekblom and Tilley 2000)
- To develop hypotheses about how offenders might exploit other opportunities (Tompson and Chainey 2011)
- To assess the versatility of career criminals (Gavin and Hockey 2010)
- To design situational anticorruption measures (Zanella 2013)
- To understand interactions between different roles (e.g. offender versus victim or preventer) (Ekblom 2012; Leclerc et al. 2013)

We contend that the exploration of further dimensions of procedural analysis—many identified in Cornish's original but subsequently neglected—will significantly benefit researchers and practitioners alike. Our current interest lies less in furthering application by practitioners (whose importance we readily acknowledge) than in scrutinising the concepts underlying scripts. Our contention is that the conceptual foundation imported from the "cognitive script" approach of Abelson and colleagues (Abelson 1981; Schank and Abelson 1977) was, in important ways, unclear, and too narrow a platform to support the current scope of script research, let alone any extensions. We intend our search for conceptual clarity to better connect the scripts concept to mainstream SCP and criminology more generally and to explore

additional cross-disciplinary links. We believe all this will support the progressively more demanding uses to which the procedural analysis of crime will hopefully be put, both in research and in practice.

We proceed by first identifying current issues with scripts, with special emphasis on conceptual considerations. We next attempt to rewrite the script concept from basics, whilst preserving as much as possible of insights and language from previous research. We do this taking account of Cornish's original work, the scientific realist approach (Pawson and Tilley 1997) and a diversity of sources beyond crime science, conventional criminology and traditional social research.

We distinguish between "empirical" and "explanatory" scripts, in the latter drawing on ethology/behavioural ecology—the study of animal behaviour in natural environments. This guides us to differentiate functional, causal, developmental and evolutionary perspectives on behaviour—and procedural competence versus performance. From this base we endeavour to connect script concepts more thoroughly to mainstream SCP. We next explore what is special about crime scripts as opposed to those generating "honest" behaviour, and address the interaction of scripts performed by different agents (including offenders and preventers) in competition, collaboration or conflict. We then discuss the need for script analysis to draw on a wider field of discourses. Our conclusion discusses potential benefits of our reformulation.

Issues with Current Formulations of Scripts

Reading both the 1994b Cornish article and reports on more recent developments, we were impressed by the depth of thinking and variety of contexts and uses of the script literature. But we also identified some limitations.

- The "universal script" devised by Abelson and defining some highly abstract and universal stages of crime commission (preparation, preactivity etc.) appears difficult to apply; in our own experience, more work seems required to assign actions to particular universal stages than to actually analyse script content and may not repay the effort. Tompson and Chainey (2011) for their part compressed the original 11 stages to four. The downside is that this potentially reduces the number of intervention points indicated.
- A practical issue was raised by Wortley (personal communication 31 May 2014), who considers that the essential dilemma of scripts is how they can support meaningful generalisation while accommodating variation. Cornish (1994a) identified a similar trade-off between abstraction versus crime-specific detail. A script involving ten decision points, with three behavioural options at each, generates nearly 60,000 variations. It is debatable, moreover, whether this equates to a script or a field of improvisations (which Cornish reflected with his "swivelling-dice" permutator).
- There was inadequate linkage between the static/snapshot causal models in SCP e.g. RAT, rational choice theory (RCT) and conjunction of criminal opportunity (CCO), and the dynamics of scripts.
- There was confusion between describing knowledge and perception of action, which is declaratory, versus know-how-type potential for action, which is procedural. This may stem from Abelson's initial application of scripts in computer simulation of cognitive processes in understanding text (cf. Abelson 1981; Schank and Abelson 1977).

- According to Wortley (personal communication 31 May 2014), Abelson had an almost opposing goal in describing scripts than do crime scientists. He was interested in "mindless" molar behaviour–event schemas allowing individuals to perform complex action sequences without making "controlled" decisions. Crime scientists pursue an applied approach focussing on the proximal causes of criminal events, and their purpose is generally the opposite—to deconstruct the script into molecular stages to identify actionable offender decision points. The issue of automatic versus controlled cognition muddies the script concept in particular and rational choice more generally. We wonder whether Cornish's importation of Abelson's concept to support the notion of crime scripts in SCP contained some inappropriate baggage.
- We were concerned, nonetheless, that the RCT emphasis on decisions, whilst pivotal, limited coverage of the actions taken on the basis of those decisions (and sometimes, given human impulsivity, despite them). A fuller account requires wider address to the executive function as a whole, to different kinds of causal mechanisms mediating scripts (from reflexes to reflection), greater emphasis on goals and perhaps a control-system approach. Although script literature referred to both causes and goals or purposes, the relationship between causal and functional discourses was implicit, needing clarification.
- Distinctions between regularities, processes, procedures and scripts were unclear. Moreover, the script concept seemed to veer between everyday perception of elements of behaviour and academics' description of empirical behaviour and their explanation of that behaviour. It also seemed to confuse stored sequences or competences with those actually called up and performed.
- It was unclear/inconsistent whether scripts described behaviour or events.
- We uncovered many other ways of describing behaviour, including the dramaturgic concept of "performativity", "attack trees" and ethology, which held promise for research and practice.
- While Tompson and Chainey's (2011) reformulation of the script glossary impressed us, we felt they had prioritised practitioner needs for simplicity over research needs for precision and exploration of constructs. We believe translation into practice guidance should follow the leading edge rather than hold it back. Here, we therefore unashamedly focus on academic considerations. In this, we follow Lewin's dictum (Marrow 1969) that there is nothing so practical as a good theory; but we also sympathise with Bouhana (2013) and Ekblom and Hirschfield (2014) in their critique of the "good enough theory" approach in crime science.

We reiterate that few of these limitations stem from Cornish himself. While he delivered a penetrating exploration and application of the script concept, the original Abelson model was constraining and arguably confusing. And some of Cornish's successors (ourselves included) have employed scripts in oversimplified ways. With use of scripts at last growing, we judged that, rather than tinkering with the concept, a fundamental rewrite was indicated.

Leclerc (personal communication 17 June 2014) argues compellingly that a script is far more than a methodology; it is, rather, a journey into the head of the offender during the commission of a crime. It can reveal the offender's motives and other previously unseen situational aspects, some of which may inhibit the script's execution. It can help identify why the offender decides to do this rather than that and at what point in the script. It can reveal subscripts that could involve committing other crimes. We heartily agree, with two extensions. First, we would take the scope of scripts beyond decision making alone. Second, following

Ekblom (2012), we note the existence of twin perspectives, valid for different purposes: the "view *from* the offender" (how they view and deal with the world), and the "view *of* the offender" (an outsider's detached analysis centring on causal mechanisms).

In what follows, we hope to help restore much of the richness of the original conception and, ideally, improve upon it.

Starting Over

Although terminology is not our focus, some conventions are necessary. We distinguish between the twin perspectives of behaviour and events: the former focusing on the agent; the latter focusing on the agent's ecological interactions with other people and entities. When referring throughout to agents, we mean people in general, with offenders being a subset. We refer to units of behaviour as actions to avoid confusion with the theatrical usage of "acts" ("Macbeth, Act 3, Scene 4"), common parlance in discussion of scripts (e.g. Tompson and Chainey 2011). We use environment as being relative to the agent of interest and to include both physical/informational entities and other agents. The environment immediately preceding/containing a criminal event is the crime situation, and an occasion is a particular situation at a particular time.

Defining Scripts

We view scripts as abstracted descriptions of a particular kind of behavioural process, namely, structured sequences of behaviour extended over time and perhaps space, which could be considered functionally self-contained units or subunits of longer sequences. Scripts refer to both actions of agents and what the agents act on (other agents, material entities or information) and in (totality of the relevant environment, situation or setting). The behaviour, when performed on a particular occasion, generates an event (as distinguished above). Depending on content and context, the event may be classed as criminal. The behaviour sequence can be produced by an individual agent, a set of independently acting agents or a group in concert.

Scripts cover regularities of sequential behaviour:

These may emerge when the sequence of behaviour is performed by many agents (e.g. everybody behaves similarly in restaurants), across multiple situations/occasions (e.g. the same individual eats in a distinctive way irrespective of where) or across particular combinations of agents and occasions (e.g. students eat one way in restaurants, another in refectories). Schank and Abelson (1977) call these situational, personal and configurational, respectively; the latter could also be called conditional regularities, where the regularity amounts to a statistical interaction. Sometimes, regularity is actually observed; on other occasions, it is only assumed as a potential—as with a behaviour sequence that exists only as a plan—or a first execution, which might subsequently be repeated by the same or other agents. Both observed and assumed regularities enable inductive prediction, i.e. targeting situations, offenders and offences for preventive or enforcement action. They are also grist for theorisation about the causal processes that generate them, thereby facilitating deductive prediction, which is more robust and versatile. In turn, the outcome of such predictions tests the theories that generate them.

Irregularities: These are important, too. Operationally, irregularities may often stem from measurement too limited to establish a reliable pattern. Otherwise, irregularities can challenge

theories, illuminate causes or indicate unresolved agent-situation interactions. They may also signal change—when offenders develop new modus operandi (MO). We can describe and/or explain sequential behavioural regularities in various ways, but relevant to all is the relation of the behaviour to the occasion in which it occurs or the event it produces.

Empirical Scripts

Empirical scripts are simple descriptions of recurrent sequences of behaviour in situ. The descriptions may be aggregated across individual agents, situations or both, averaging out subtler interactions or (if enough events are sampled) differentiated into frequent variants [e.g. Cornish's (1994a) "tracks" concept]. Empirical scripts may at minimum be described as bare abstracted sequences of actions or associated events. Schank and Abelson (1977), for example, study variation in behaviour across agents and/or situations. This may suffice for guiding criminal investigation (e.g. linking serial offences through MO) but is of limited preventive use. Empirical scripts may be of limited academic interest, too, if descriptions lack interpretation and relation to occasion and wider context and if individual sequences are described in isolation from one other. But even the most determinedly empirical descriptions of behavioural regularities will adopt the "intentional stance" (Dennett 1987) or "theory of mind" (Goldman 2012). This helps economically summarise and interpret the events: otherwise, "person A hit person B as a warning", say, becomes "Person A first flexed his arm…". Tedeschi and Felson (1994) roundly reject the latter alternative, using an example description of the assassination of Abraham Lincoln. However, intentionality may introduce subjective and/or cultural assumptions, which may not always be supported by evidence. The descriptions of animal behaviour under natural conditions undertaken in ethology or its successor, behavioural ecology (e.g. Davies et al. 2012), offer an alternative: units of behaviour are more objectively identified, and goals must be evidenced, not assumed by "putting oneself in the agent's place" ("thinking anteater" is harder than "thinking thief").

Explanatory Scripts

Ethology can also illuminate explanatory scripts. Tinbergen (1963; cf. Davies et al. 2012) identified four levels of explanation for any observed pattern of animal behaviour, and we adapt these to humans:

- Function: how the behaviour affects the animal's chances of survival and reproduction, and why the animal responds that way rather than otherwise. For humans, we take this to include behavioural goals, whether strategic—as in wealth acquisition, or tactical—as in "steal that money without being caught". [Note this is individual-level function, not societal-level functionalism (Merton 1968).]
- Causation: we take this to mean the causal mechanisms mediating the behaviour, and generating ensuing events.
- Development: how the behaviour changes with age, and any early experiences necessary for its emergence. This can also cover lifetime learning and continuous professional (criminal) development. We also distinguish the development of an individual through acquiring a whole repertoire of procedural competences—from the inauguration and improvement of a given procedure by a given individual. With the latter, our interest covers both the mastering of a sequence and its origins for that individual. Origins could

come via spontaneous improvisation based on freshly combining prior subcompetences—that is, rewarded by positive outcomes—and subsequently become a new, well-integrated, functional unit; or, at the other extreme, be deliberately conceived, planned, rehearsed and modified by an individual or group.

- Evolutionary history: how the behaviour compares with similar behaviour in related species, and how it may have emerged during phylogeny (evolution of new species). In evolutionary psychological terms, we can, for example, consider the origins of our human decision-making capacity (Ekblom in press); our capacity to string together complex action sequences (e.g. Sterelny 2012); or the evolved preferences that are our ultimate rewards for action. Cultural evolution plays a significant role alongside the biological, with scripts viewable as "memes", i.e. units of cultural replication and transmission that compete with alternative units for getting adopted, used and further copied. But variation, selection and inheritance processes operate in both cases (e.g. Aunger 2000; Ekblom 2015).

Abelson's use of "schema" (1981) relates to perception, knowledge and communication of actions. To Tinbergen's levels we can therefore add phenomenology. Agents perceive and experience their own action sequences in a subjective view-of-the world sort of way, as the flow of situated actions with some kind of background sense of purpose and sometimes culminating in a satisfying consummatory act, like eating or injecting a drug. Less often, agents experience detached reflection on their own actions. The reflection may relate variously to the quality of experience (e.g. analysing the pleasure of an exercise routine), quality of performance ("Did I improve?" "Did I meet appropriate standards?") and achievement of goals ("Did I score?" "What went wrong?"). Approaches to self-awareness during performance (Duval et al. 2001) are relevant here.

We now focus mainly on the functional and the causal and how they interrelate.

Functional Explanation—Procedural Scripts

With animals, functions are latent: an animal does not know, say, that licking salt from rocks serves to restore a biochemical balance; it just tastes good (and is thus repeated). With humans, we can (sometimes) consciously articulate, reason with and combine our goals in extended ways; exercise voluntary control over their execution and prioritisation; and communicate and collaborate on them.

Functional explanation of human behaviour centres on identifying the agent's goals, or plans—however these are mediated—from reflex to reasoning; and across the range from pursuit of fundamental reward in the service of strategic survival and reproductive gain to more tactical ends. In SCP, where the focus has traditionally been on decisions, the perspective of frustrating offenders' goals and disrupting their plans has been overshadowed. The fact is that goals, plans, decisions and scripts are functionally interwoven. Tedeschi and Felson (1994) describe how people, in using aggression to coerce victims (e.g. to surrender their wallet), decide to switch to ever-more escalated scripts, as less-persuasive scripts fail to achieve the desired goal; those authors draw on a repertoire Schank and Abelson (1977) call a "persuade package".

Plans and goals and how to thwart them feature more in organised crime control and commercial security management and in the military's "effects-based approach" to operations (Batschelet 2002). Interestingly, they also feature in the phenomenology of Schutz (Wagner 1983),

whose account of action views agents envisaging and "projecting" behavioural alternatives into the near future. Recent research on imagination's role in planning and choosing actions confirms this (Markman et al. 2009).

Procedural scripts, then, describe sequential actions in the service of some goal. At a minimum, understanding the goal, or hierarchy of goals, provides sufficient explanation for the actions (Tedeschi and Felson 1994). Another way of putting this is that procedures relate to actions intended to lead towards those events, experiences of events or states that the agent desires to happen or exist—or away from those they wish to avoid.

The events/experiences/states usually exist in the real world, with the procedures equating to the ecological concept of foraging applied to property crime, e.g. by Bernasco (2009). But sometimes they are internal (e.g. when someone resists tempting biscuits by focusing thoughts elsewhere). Instrumentality, the practical connection of means and ends, is clearly a defining functional feature of procedure. However, the end in question may be an emotional rather than always a material one. It may even be functionally autonomous: consider a religious ritual, performed "for its own sake". (This may apply to personal pre-crime rituals used by superstitious offenders to allay anxiety: such idiosyncratic regularities may aid detection.) The emphasis of SCP on criminal events and their proximal circumstances focuses attention on the tactical/logistical side of procedures, but even the most immediate tactical choices may be selected to support higher strategies, so they need viewing in this wider frame. This is relevant to anticipation of any displacement or development of countermoves.

Rituals apart, another defining feature of procedures is their generative adaptability to the environment. Even automatic procedures like walking involve shortening stride to accommodate slopes, dodging obstacles etc., and where anticipation fails, applying feedback to maintain balance and direction. No single act of walking is identical to any other, but the underlying procedure is universal. This rather tests the limits of Schank and Abelson's (1977) original notion of "script as automation". More complex procedures, and variable environments of performance, will obviously generate highly variable behaviour patterns. Tactical/logistical procedures usually contain conditional branching points enabling the means to handle "Plan B" contingencies either in the environment ("What if the door is locked?") or in the agent ("What if I freeze with fear?): hence the importance of Cornish's permutations concept.

From an applied perspective, simple scripts with limited choice points and behavioural branches are easier for practitioners to address, and Cornish sought to balance simplicity of use against permutational complexity. But not all offenders oblige, and in information technology (IT) security especially, articulating a whole hierarchy of branches may be a necessary prerequisite for anticipating and reducing vulnerabilities in complex systems under sophisticated attack. "Attack trees" offer a synoptic, hierarchical view of the range of alternative means and choice points in achieving some criminal goal (e.g. to access a financial operating system, offenders can either steal the password or trick administrators to leave their workstation unlocked; to trick administrators they can either…). Certain formulations (Kordy et al. 2013) include sequential information thereby serving as "script maps". A practical consideration in all these more complex analyses is simply that of obtaining the detailed information to flesh out the scripts/trees. Ideally, this is an empirical research task, but if, as often happens, the detailed evidence is lacking, the choice is between accepting a less finely grained picture or filling in by imagining oneself in the perpetrator's shoes (Ekblom 2014).

"Pure" procedures can be abstracted as tactical/logistical steps to progress through in order to achieve the goal. One might expect to see these as instructions in a military or surgical

manual, recipe book or computer algorithm. However, they usually draw heavily on building blocks of procedural/declaratory knowledge already in the agent's head; otherwise, the manual for the simplest task would be encyclopaedia-sized.

In a learning or self-improvement context, a good rationale can help agents perform intelligently and adaptively ("Wrap the brick in cloth, so you can break the window quietly."). This obviously helps in coping with contingencies, including through varieties of displacement (Hakim and Rengert 1981) and exploiting new crime opportunities. Lesser rationales of the "don't think about it, do exactly as I tell you" kind are less adaptable to new situations. This renders the agent more like a technician with a limited repertoire than a consultant (Ekblom 2011). On the other hand, Fielding (personal communication 11 June 2014) notes that certain technologies require action that is both formulaic and highly skilled, e.g. bomb disposal, which requires profound knowledge of types of devices and models; or, indeed, the construction/operation of bombs by terrorists. Interestingly, military manuals (e.g. US Army 1992) distinguish between drills, which are rigidly adhered to, versus tactics, which require flexible interpretation of orders, thereby providing both "mindless" and "mindful" scripts and resolving Wortley's above-mentioned dilemma. The mindful approach reaches a pinnacle in recent military thinking that favours "mission command": centralised, clear intent with decentralised execution; a style that describes the "what," without necessarily prescribing the "how" (UK Army 2011).

Cornish (1994b) noted the importance of procedural rationale for prevention. By efficiently and clearly describing perpetrator techniques/MOs procedural rationale can help practitioners (or potential victims) customise preventive responses and find critical points where countermoves are difficult to develop (e.g. where conflicting requirements such as speed versus stealth constrain offenders). Regarding investigation and enforcement, enhancing procedural analysis with hypothesised rationales could facilitate prediction of where serial offenders might strike next or where to find them. We can also better describe the cultural evolution of procedures, thereby facilitating rapid reaction to emerging crimes/ MOs or even anticipating them (Ekblom 1997, 2005).

Causal Explanation in Scripts

The case is well made (Pawson and Tilley 1997; Wikström 2014; Ekblom 2011) that a scientific realist approach using conjectured causal mechanisms is the best way of developing a theoretical understanding of individual behaviour and events in individual situations, designing interventions and evaluating these. Practically speaking, it supports intelligent, context-customised replication and innovation and facilitates accumulation and transfer of practice knowledge. Descriptions of causal mechanisms range from the physics of assault or explosions, to detailed neurological processes, to different levels of cognitive functioning (Bouhana 2013) ranging from planned, goal-directed voluntary, and reason-governed behaviour to habitual, skilled or even reflex actions. However, Tedeschi and Felson (1994) rule out reflexes as actions because they are neither under the control of motives nor decision-making processes. Whatever the case, an understanding of scripts can be far richer than the traditional crime science focus on decisions. In this connection, cognitive sciences now accept the idea of dual-process thinking (and thus behaviour)—a frequent, unconscious, habitual process and a rarer, narrow-capacity, deliberative process [e.g. Kahneman's (2011) "system 1 and system 2"]. So should criminology.

Combining Functional and Causal Perspectives in Scripts

But how do causal and functional discourses relate? Ekblom (2012) states the importance of using both according to circumstance, depicting humans as caused agents: caus*ing* (through planning, deciding, pursuing goals) and caus*ed* (by psychological and/or ecological influences). Tedeschi and Felson (1994) draw on Schutz (1967) to make a related distinction between an actor's intent and motive ("in order to" versus "because" explanations). Ekblom accordingly defines crime prevention in alternative discourses (reducing the risk of criminal events, by intervening in their causes, or …by frustrating criminal goals) (Ekblom 2011). However, this is mere juxtaposition. Here, we attempt a deeper articulation that also involves developmental, evolutionary and experiential perspectives, and note the following:

- Despite subjective experience of free will, we take it as axiomatic that our planning, goals etc. are themselves caused. But their causation and execution are mediated through diverse pathways, often complicated, including psychological, cognitive/computational and ecological mechanisms. These include motor skills, procedural memory, involvement of emotional, "gut-feeling" processes in "rational" decision making (Van Gelder et al. 2013) and interpersonal processes; and simply the determination of subordinate goals by the succession of environmental obstacles and opportunities to negotiate in order to achieve the superordinate goals.
- Procedures always involve control-system (cybernetics) concepts, i.e. the pursuit of a goal is not a linear "stimulus-response" process but inherently includes feedback loops. Perceptual control theory (Powers 2009) links functional, causal and experiential perspectives. It sees behaviour as the control of perceptions: desired events/experiences are compared with perceived ones, and action upon the real world is initiated to bring the latter closer to the former, in a negative feedback process involving many levels of control. (Thus, for example, the burglar keeps kicking the door until the lock yields whilst simultaneously keeping noise down and expenditure of effort to acceptable levels.)
- In a recursive twist, some offender rationales explicitly represent the causes and effects of the agents, events and states that the procedures are intended to influence—e.g "At this moment Tim and Ken will start a fight to distract the guard."

Linking functional and causal perspectives helps us choose how to represent explanatory scripts. At one extreme is the pure, abstract explanatory script, essentially describing behaviour as a distilled tactical/logistical rationale; at the other extreme is the enriched explanatory script, linking the rationale to the causal mechanisms within the offender and in the proximal situation that mediate and generate the behavioural sequence and ensuing events. Enrichment can go quite a long way: Tedeschi and Felson (1994) propose a social interactionist approach emphasising the actors' perspective and how values and expectations feature in their evaluation of decision alternatives. For example, actors often view their own coercive actions as legitimate and even moralistic. Wikström's (2014) situational action theory takes a related line.

Two aspects of procedures merit greater scrutiny. These are (1) the distinction between competence and performance, and (2) the role of ecological/situational and psychological factors in performance. The latter is the key to tying procedures (and the scripts that describe them) to the core approaches in SCP.

Competence and Performance The distinction between competence and performance, originating in psycholinguistics with Chomsky (1965), firmly connects function to mechanism. Competence is a static potential by which to generate certain actions in certain ways in certain classes of situation. Performance is a process of generating actual sequences of behaviour in specific real-world situations; these are the product. Competences can only be hypothesised from empirical observations of performances.

In computing, competence resides in the instructions of stored programmes; performance resides in the programmes as called up and executed. Psychologically speaking, competence is a resource people bring to situations, which may or may not get deployed. (To flag a subtlety, individuals' self-knowledge that they possess this resource may shape their decisions, including whether to treat a particular situation as an exploitable crime opportunity.) The competence–performance distinction meshes with the generative nature of procedures discussed above: a competence is rarely about producing some fixed sequence (as with the "instinctual" swallowing reflex; a habitual act such as scrawling a graffiti tag on a wall; a reassurance ritual). Rather, it is about generating a range of possible behaviours adapted to coping with or exploiting a particular set of situational contingencies, perhaps aided by possession of particular tools. [This connects with Mills (1959) on artisanship and the relationship of craftsman to tool; and more recently, to Sennett (2007) on a similar theme; its application to criminal craft might be fruitful.]

Functionally speaking, from the agents' perspective, competence is beneficial, providing the means to fulfil their goals. A competence can be characterised by its scope. Thus, it could be fit for serving particular goals in a multipurpose, versatile way; and be adaptable to likely variations in situations, or perhaps explicitly anticipating them. (In computing terms, this may involve various preprogrammed conditional instructions so the same programme produces different responses to different situations.) At the other extreme, it could be single purpose and/or highly adapted, serving only specific environments. Performance can be either good or bad; delivering or failing to deliver the intended goal(s): e.g. respectively adroit versus clumsy movements when foraging, or stealthy versus noisy break-ins.

Causally speaking, how does competence generate performance? Competences are incomplete instructions for behaviour; the process of generating performance from competence always involves taking in information from the current or anticipated situation (even if only where to point the gun). And, as Cornish (1994b) noted, it requires improvisation, especially where existing competences fail to meet agents' goals. The nature, extent and quality of improvisation depends on the generative quality of the mechanisms mediating the competence: reflexes, "instincts" and habits will supply least variability of response; perceptual–motor skills will provide more variability; voluntary planned behaviour will provide the most variability. (To these sources of variability or constraint, we can add those stemming from the regularities and irregularities in the environment where the performance is initiated and executed, e.g. how far the noise of drilling travels.) Generative capacity also resides in the ability to open-endedly combine multiple competences, using several skills in an organised, perhaps planned, sequence, as well as responding to events that unfold unexpectedly by rearranging the sequence or drawing on additional subroutines. These may involve "meta-competences".

No behaviour is totally impromptu. This leads us from causal consideration of how competence can generate performance to developmental consideration of how competences are originally acquired. They can be:

- Inherited as "hard-wired" reflexes (like swallowing) or "fixed-action patterns" (ethological term for "instinctual" behaviour, e.g. courtship sequences in birds, albeit rare in humans); these, of course, add an evolutionary dimension to their origin
- Learned and improved through performance:

– Repetition as habits, perceptual–motor skills (cycling) or language skills (which may build on inherited "readiness to learn")
– Operant (trial-and-error) or insightful ("aha!") processes
– Social learning by instruction or imitation
– Reflective practice (Schön 1983)

- Planned, combining the above with mental or real-world envisaging of innovative combinations, trial-and-improvement, and then repetition
- Communicated, covering strategy, tactics or skills, where/how to obtain them, and deliberate instruction
- Channelled by tools, which designers refer to as "persuasive technology" (Lockton et al. 2008), and the idea that a device (e.g. a vending machine) has a script "expected" of its users (Latour 1992), though adaptive offenders can develop procedures to "hack" these to their own ends
- Supplied, through development and diffusion of productivity tools, e.g. "script kiddies," enabling criminals unskilled at programming to generate customised computer viruses

The procedures topping the list are usually tacit and only transmissible through imitation. In practice, this requires "reverse engineering" rehearsal and adjustment by imitators to turn the observed movements into an organised, goal-directed and skilled decision-and-action sequence.

Hopefully we have demonstrated the centrality of the competence–performance distinction in linking functional and causal perspectives on behaviour sequences. Flagged by Cornish (1994b), but subsequently neglected, it should be revived. The practical significance resides first in understanding and influencing how offenders acquire, develop and evolve procedural competences as resources for committing crime. Second, it resides in how competence is converted into performance on specific occasions. The versatility of competences and the capacity for improvisation where these reach the limits of their scope during performance both determine the adaptability of offenders. Adaptability underlies both tactical displacement and longer-term, strategic co-evolution of offensive/defensive measures (Ekblom 1997, 2015; Ekblom and Pease 2014). Preventers must find ways of slowing acquisition, improvement and dissemination of criminal competence and of anticipating criminal adaptation, ideally out-innovating the offenders. Influencing performance offers further avenues of intervention: e.g. by disconcerting offenders about to commit a crime (Ekblom and Hirschfield 2014).

Ecological/situational and psychological factors in performance Preventive intervention against offender performance requires detailed consideration of underlying causation. What mechanisms are involved in selecting and initiating an agent's performance of particular procedures? How do they shape, facilitate or impede ongoing performances? Considering performance connects scripts more closely with mainstream SCP concepts:

- Real-world objective opportunity factors—centring on risk to offender, effort and reward, as in the RCP (Cornish and Clarke 1986)—may directly influence which performances are

possible. A wall may be too high to climb; the presence of ladders could remove that constraint. Such material resources, the offender's own procedural ones, including agility, and their goals, help construe the opportunity itself (Ekblom in press).

- *Perception* of opportunities, however, mediates most interactions between offender and situation. Perception can involve complex situational/dispositional interrelationships (e.g. Bouhana 2013). For example, offenders may be differentially predisposed to see criminal possibilities in certain situations (Wikström 2014). Certain procedures may be called out by situational prompts (Wortley 2008). More generally, offenders—through affordance (Taylor and Currie 2012)—are primed to spot particular items in the environment usable as tools or weapons in their scripts.
- RAT (Cohen and Felson 1979) describes the ecological conjunction of likely offender, absent/incapable guardian and suitable target of crime, which is necessary for a criminal event to occur. This conjunction may set the scene for a particular opportunity to be realisable, to be perceived as realisable and to require performance of a particular procedure to safely and successfully exploit it. Part of being a "likely offender" is having such procedures and being capable of performing them in appropriate circumstances. [The later-adopted phrase "motivated offender" fails to include capacity factors (Ekblom and Tilley 2000; Gill 2005) and, by implication, scripts.]
- The CCO framework (Ekblom 2010, 2011) is more detailed than RAT. It explicitly covers resources for offending, including procedural know-how and facilitative tools/weapons. CCO has been used (e.g. Ekblom 2003) to describe the causal preconditions enabling each of a linked sequence of events to be realised in committing more complex crimes (e.g. "obtain forged passport; steal car; commit assassination; escape; cross border…"). We can envisage CCO as a notation for scripts, a way of systematically and generically describing all agents and entities in the crime situation (or precrime scene) that offenders can exploit and/or need to cope with.
- Crime generators (Brantingham and Brantingham 2008) describe regularities of crime deriving from properties of the environment and everyday legitimate routines: e.g. offenders and victims happening to come together at stations. Exploitation of such encounters may be supported by procedural knowledge: e.g. if a thief happens to be standing behind a distracted commuter, does he/she have the skills to exploit the pickpocketing opportunity? Crime attractors, from the same authors, involve offenders actively anticipating opportunities at particular locations and following them through using procedural knowledge in reaching the location and then exploiting the opportunity; and "knowledge of their knowledge" to decide whether the journey could be worthwhile.
- Awareness space (Brantingham and Brantingham 2008), comprising familiar paths and nodes and their mental representation, produces regularities of events: e.g. by channelling and facilitating successful foraging procedures. This may mean less reliance on improvisation, less risk of looking out of place, failing to recall escape routes etc. Procedural knowledge may assume the territory is familiar; alternatively, offenders may develop procedures for operating in unfamiliar territory, or even for hostile reconnaissance to render the unfamiliar familiar.
- Precipitators (Wortley 2008) may prompt, provoke, pressure or permit initiation of action to seek and/or exploit an opportunity, and this might then include deploying particular procedures. Sometimes, precipitation involves triggering an emotional/motivational state: e.g. someone provokes anger in the offender who then takes action such as breaking the provocateur's window; or seeing a tempting target may awaken a dormant goal and set

procedures in motion to realise it. Berkowitz (1984) describes the related priming process whereby environmental cues can activate a script, although as Tedeschi and Felson (1994) note, activation as a possibility has to be followed by a decision to execute that script or some alternative.

Situational prevention tends to focus on the reasoning side (Cornish and Clarke 1986) and on decisions. But the wider operation of the executive function (e.g. Wikström 2014) is important not only in making the decision but also in following it. This could involve, e.g., walking away from a "very tempting but too risky" opportunity; or sticking determinedly with the choice to inhibit a violent impulse during a performance of a distraction burglary procedure that goes awry. One might call this extension of scope "rational action" to correspond to the "rational choice" that may initiate it.

Cognitive factors seldom considered within traditional SCP include emotional, perceptual and motivational processes that shape acquisition, imagining, initiation and performance of procedures. Besides precipitation (above) and influences on decision making (van Gelder et al. 2013 distinguish "hot and cool" decisions), emotional processes may facilitate performance. For a convincing threat the offender may have to *feel* aggressive. They may also interfere with that performance: fear, besides deterring offenders, may jeopardise stealth ("My hands shook so much I dropped the silverware with a crash."). Cornish (1994b: 163–164), again ahead of the game, described various "crime commission failures". Connecting procedural analysis of crime with the wider "human factors" literature on performance errors (HSE 1999; Sasse et al. 2007) may extend the scope of SCP. Errors in performance due to incompetence rather than bad luck may stem, variously, from failure to select the script best able to meet the agent's goals in that situation; failure to understand that improvisation, not stereotyped response, is necessary in particular circumstances (a shortcoming also in "cookbook" replication of preventive action (Ekblom 2011); failure to combine script elements in appropriate sequence; failure in execution. For research, errors can indicate underlying mechanisms. For practice: well, we may sometimes want to encourage errors so attempts fail and offenders get caught, but we would rather an armed robber's gun, intended as just a threat, did not discharge accidentally.

One important issue in the study of procedural scripts relates to how far these should exclusively focus on the instrumental/tactical/logistical aspects of action or additionally include "enriched" processes. The emphasis should depend on how researchers or practitioners intend to use the information in the script. But the choice may not always be clearcut: for some scripts, emotionally significant goals may be inherent (e.g. stalking an ex-partner), or certain emotional states may be necessary to perform them properly (e.g. being psyched up to attack an enemy gang). Pragmatically, the choice may also turn on availability of data, which could range from brief incident reports or traces from, say, crime scenes, to interviews with offenders, to filmed observations of behaviour.

Crime Scripts Specifically

One major issue remains. We take as axiomatic that criminal behaviour is a subset of all behaviour. So what, exactly, distinguishes scripts describing crime, antisocial behaviour and terrorism (hereafter, crime)? Crime scripts describe behavioural procedures that in their intent and/or execution serve criminal goals and/or inflict criminal harm on some recipient person(s)

or target(s). Crime-related procedural characteristics are rarely unique to crime; nor is a single set common to all criminal behaviour. They include:

- Foraging, which combines active pursuit, in the environment, of some positive goal(s), with simultaneous avoidance of negative goals, e.g. getting the rewards without being arrested (but this could equally apply to harvesting apples without falling from the tree)
- Conflict between agents as individuals, or between one agent and societal norms and institutions, especially the law (not all conflicts are crimes)
- Violent or threatening behaviour (not all such behaviour is criminal; not all criminal behaviour has these features)
- Stealth/surprise relating to presence, movement or actions (many crimes are stealthy, but so, too, are surprise parties)
- Deceit relating to intention, information on value of goods etc. (many legal actions involve deceit)
- Co-evolution of tactics and strategies of conflict (co-evolution occurs in business competition, too)
- Collaborative behaviour and trust (widespread in both co-offending, gangs, organised crime and legitimate community life; see below)

Returning to Cornish (1994b): The reason crime scripts become so elaborate, full of contingency branches and receptive of innovation stems from the conflictual nature of crime. Conflict renders it likely that during many performances, plans must be adapted and revised, and new scripts invented or recruited through improvisation, on each occasion. Enduring conflict between adaptable agents drives arms races (Ekblom 1997, 2015).

Scripts Conjoined

Scripts may be performed jointly, perhaps enjoying strength in numbers, division of labour and explicit coordination. Criminal collaboration may also involve networks. In all cases, collaboration and trust play significant roles; indeed, scripts may be available—some unpleasant—for enforcing that trust. Scripts may be co-developed and shared or kept private—whether to hinder law enforcers, to keep preventers/potential victims in ignorance or to maintain competitive edge amongst rival offenders. Understanding these issues guides prevention: e.g. locating pinch points in a network where mission-critical procedures can be disrupted (Bichler et al. 2015); or actively sowing distrust.

When agents are in competition or conflict, Ekblom (2012) extends the script concept to cover script clashes, where the offender's script engages with the preventer's or rival offender's script in such issues as:

- Surveill vs conceal
- Exclude vs permit entry
- Wield force vs resist
- Conceal criminal intent vs detect
- Challenge suspect vs give plausible response
- Surprise/ambush vs warning
- Trap vs elude
- Pursue vs escape

Understanding clashes is pivotal to SCP, which must design environments, products, procedures etc. to favour the good guys whilst respecting all legitimate requirements—and perhaps running arms races. Leclerc and Reynald (2015) pursue a related line.

For analysing script collaborations and clashes alike, we must understand roles and role relationships, in particular, in order to see how the crime roles (as described in the problem analysis triangle or the CCO) overlap with "civil" roles referring to "real-world" actions. So, a security guard, say, could be a preventer (ex officio), promoter (asleep on duty) or offender (taking bribes). Shoppers could be preventers who alert staff to someone pocketing items on display, or they could be offenders if they themselves steal. We could further sharpen the picture through the designer's technique of developing various criminal "personas" (Hilton and Irons 2006)—archetypes with different motives, abilities or resources—commonly encountered in the situation of interest. Combining analysis of roles and scripts reveals subtleties normally glossed over in practitioner-oriented heuristics like CRAVED (concealable, removable, available, valuable, enjoyable, and disposable) (Clarke 1999), which identifies products' risk factors for theft. Here, easily "concealable, hot products," such as smartphones, are criminogenic if this helps offenders escape undetected but actually criminocclusive if—in the earlier search stage of the theft script—they hide the items from offenders in the owner's pocket.

A final issue here is where one person's script "encapsulates" another's—usually involving deceit or other manipulation. This often happens in fraud, but a terrorist example (Gill et al. 2013) is where perpetrators anticipate/exploit the actions of victims, as when a bomb disposal team is lured into the execution of a particular—fatal—script by cleverly disguised antitamper devices.

Script Language and Discourses

As noted, diverse terms are employed to describe scripts. These terms are in flux while researchers address existing limitations and extend the scope of the analysis. Cornish originally chose a cognitive psychological discourse. But to fully exploit the connections the scripts approach could make with the rest of scientific thinking and research, we should acknowledge the additional discourses available. We therefore list various ways of describing behavioural regularities and procedures and encourage colleagues to explore their application and report back. There is considerable overlap and correspondence between discourses, but navigation requires care, because each comes with its own domain of associated terminology, theory, practice and background assumptions.

- Empirical, whether qualitative or quantitative—but note this assumes the "intentional stance" described above
- Ethological (now merged with behavioural ecology)—the zoological study of animal behaviour under natural conditions, where intentions are empirically verified, not assumed
- Cognitive/psychological/neurological causal mechanisms that generate the empirical patterns and mediate the mental representation and performance of the rational/control-system aspects
- Ecological—the causal mechanisms whereby agents variously react to, cope with, adapt to, exploit or actively create the combination of ecological circumstances (i.e. offenders in their environment) that causally enable the events to occur and goals to be achieved

- Functional or teleological—concerning agents' goals, plans and decisions, relating to RCT and "executive function" approaches (e.g. Banich 2009; Gottfredson and Hirschi 1990)
- Ideal, rational, "platonic" strategies/tactics—as with tactical/logistical doctrines of military combat, effects-based approaches etc. (US Army 1992; Batschelet 2002)
- Simulation of criminal events and wider crime patterns (e.g. through agent-based models: Birks et al. 2012); interestingly, this is where Abelson (1981) began
- Workflow modelling (Borrion 2013)—understanding activity (usually business-related but could cover criminal action) in a sequence of connected steps
- Cybernetic/control system/computer science/robotics terms—logical/algorithmic description of goal-directed behaviour, tackling obstacles etc. (Alrajeh et al. 2012)
- Design—acknowledging perpetrator techniques in making products, places, systems and procedures crime resistant (Ekblom 2012; Gamman et al. 2012)
- Evolutionary or "ultimate" causes—how the capacity to generate behaviour sequences, to improvise, improve and share them is an evolved adaptation for surviving and prospering in the foraging environment
- Phenomenological/experiential—what agents see and feel as performance unfolds
- Performance and performativity—in the theatrical sense (e.g. Goffman 1969)

Multilevel combinations of these are possible, e.g. psychological mechanisms systematically embedded in ecological ones. This array of discourse offers nuance, connection to diverse disciplines, sources of theory, research findings and potentially a huge headache for thought, communication and collaboration. At the present stage of research on crime procedures, we suspect it would be premature to foreclose options. More broadly speaking, we believe that in the short term, researchers must awaken to the possibilities and limitations of the various discourses; but in the medium term, the SCP community at least must develop a consensus suite of terms, otherwise it will remain an unstable multidisciplinary admixture rather than evolving into a "true-breeding" interdiscipline of its own. However, this consensus should be no dull compromise but the product of a deliberate exercise of collective design.

Discussion

We believe this conceptual strengthens the links between the procedural approach to criminal behaviour and mainstream SCP, with criminology more generally and with wider disciplines. It provides what we hope is a better definition of a script and its multiple features.

We emphasise the importance of differentiating between behaviour and events. We draw on behavioural ecology/ethology to distinguish the levels of explanation needed to handle sequences of purposive behaviour (functional, causal, developmental, evolutionary), enabling us to clarify some limitations and confusion in how scripts have been used and to map out additional conceptual axes. The competence–performance distinction in particular plays a central part in linking functional and causal perspectives.

We identify the use of different types of scripts and their utility, e.g. empirical scripts in criminal investigation; procedural scripts to anticipate crime and help preventers. Moreover, we attempt to systematically relate script analysis to other theories and approaches that focus on criminal events and are much discussed within crime science and criminology.

We present scripts as vital for understanding the broader dynamics of offending rather than as a detached and narrow decision-making model. In particular, we introduce goal/control-

system ideas and incorporate concepts like emotion, planning, learning, performance and errors. We note the full range of processes mediating behavioural procedures—from reflex to reflection. We consider how scripts handle the environment—both in anticipating, responding and adapting to it and in seeking to modify the environment in their turn—in the service of particular goals. We drawn on terms and concepts from other scientific disciplines, and we contribute to the understanding of diverse script discourses, enabling a nuanced understanding of regularities (and irregularities) of behaviour. We further highlight the importance of script clashes and collaborative scripts.

Many of these considerations may not immediately be helpful in generating and executing preventive proposals, but the history of science is full of "pure" ideas that eventually yield significant practical benefit. Nonetheless, we do offer avenues for practitioners to exploit that—building on the aspirations of crime script researchers from Cornish onwards—provide support for a systematic and disciplined approach to identifying and addressing crime opportunities and precipitators. Describing procedures as tactical abstractions such as goal structures may help design elementary preventive interventions. Taking account of underlying cognitive mechanisms of initiation and performance of procedures, as these relate to the physical and social environment, may demand more of practitioners. But it should extend the scope and increase the (cost-)effectiveness of interventions, and moreover facilitate the design of more subtle trade-offs with wider requirements (e.g. security versus aesthetics or convenience). It perhaps enables more realistic and imaginative anticipation of crime risks and preventive opportunities. And "making offenders richer" (as Ekblom's 2007 title puts it) can greatly broaden the scope of research and theory too.

In closing, we note that much of the understanding of crime scripts could equally apply to the acquisition and performance of procedures of crime prevention—whether by "native" preventers or professional practitioners. (A related angle occurred to Leclerc 2013a, b.) Boosting factors like adaptability and versatility, and rationale-guided action rather than cookbook copying, can use essentially the same framework. In rewriting the script, the bad guys need not always get the best lines!

Acknowledgments We are grateful to our reviewers and to Benoit Leclerc (Griffith University), Nigel Fielding (Surrey University) and Richard Wortley (UCL) for helpful comments.

Funding This work is partly based on research funded by the UK Technology Strategy Board and the Engineering and Physical Sciences Research Council (Project TP/400206) to MG

Conflict of Interest The authors declare that they have no conflict of interest.

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