Happy returns: ideas brought back from situational crime prevention's exploration of design against crime

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When lecturing on Design Against Crime (DAC) in design schools, I often introduce myself as a 'crime scientist fallen among designers'. But I didn't fall, I was pushed – by Ron Clarke himself. In 1978, when a novice researcher in the then Home Office Research Unit, Ron, my boss, suggested I write a kite-flying paper on the 'Crime-free car' to anticipate the possibilities design and technology might offer for preventing theft of/from vehicles, then a pressing policy problem. The article was duly written (Ekblom 1979)... and promptly sank without trace amongst policy colleagues,[1] like certain advanced vehicles, ahead of its time.

But designing products against crime inched up the research agenda, driven by vehicle theft. (The architectural design of environments against crime progressed more steadily but isn't covered here.) Roughly when Ron left the Home Office the original Crime Prevention Unit, another of his legacies, ran a study (Southall and Ekblom, 1985) on the feasibility of improving car security during manufacture, as opposed to after-sale. Again, little consistent action followed until Gloria Laycock and Home Office colleagues commissioned the first Car Theft Index (Houghton 1992), awakening purchasers' interest in car security as a choice dimension. Combined with pressure from insurers and consumer organizations, the security of this one class of products has never looked back, with a European Directive of 1995 mandating the designing-in of electronic immobilizers on all new vehicles.

Research on the wider field of secure products came and went, but was significantly boosted by publication of 'Hot Products' (Clarke 1999), whereby Ron introduced the world not only to *situational risk factors* as an adjunct to the opportunity approach to prevention, but also to the practice of eye-catching but tortuous acronyms. CRAVED (Concealable, Removable, Available, Valuable, Enjoyable, Disposable) was emulated for example by IN SAFE HANDS (mobile phone design security features – Whitehead et al. 2008) and EVIL DONE (Clarke and Newman 2006). Hot Products in turn influenced the design-oriented aspects of the UK Foresight Programme (DTI 2000), to which Ron contributed ever-practical views on, for example, a coding scheme for fostering product security (Clarke and Newman 2005a). That in turn inspired and informed a European-funded, international study (Project MARC – Armitage and Pease 2007) exploring practicalities of 'crime proofing' domestic electronic products at the design stage (testing whether their level of security was commensurate with the risks they were likely to encounter).

Other Home Office-funded research on Design Against Crime involved a widespread review of the field (Design Council 2000; Learmont 2005), guidance for designers issued by the UK Design Council (2003) and various student competitions. Ron gave useful encouragement and feedback on these behind the scenes; and stepped in when fickle Home Office interest diminished again (I was threatened with the sack if I continued to write in this area) to publish material from that programme as Crime Prevention Studies 18 (Clarke and Newman 2005b).

When I eventually escaped the Home Office to the design world (2005), it became apparent that as a lone criminologist I, and my designer colleagues, needed a body of crime science collaborators to undertake joint research, development and evaluation. Twenty minutes' walk away from Central Saint Martins College was the Jill Dando Institute of Crime Science, brimming with just the right people. Of course, Ron Clarke had been a leading light in establishing JDI, and we now have a strong track record of collaborations both formal (e.g. www.bikeoff.org, www.grippaclip.com) and informal.

But Ron's contribution to DAC continues to play out in the policy domain too. 'Modifying criminogenic products: what role for government' (Clarke and Newman 2005c), directly influenced the instigation (2007) of the Design and Technology Alliance against Crime,[2] chaired by a Home Office minister, led by designers and with work commissioned by the UK Design Council. Products so far have included safer beer glasses and kitchen knives.

Historical twists and turns apart, though, the principal legacy from Ron Clarke has been, and will ever remain, that of Situational Crime Prevention (SCP) in its entirety as *the* main theoretical underpinning of DAC.

Penetrating new ground has always affected the explorers themselves. As a member of a small scouting-party sent out, originally by Ron himself, to explore the enormous and diverse territory of design, what have we brought back to SCP, and how will it challenge and change things in the home discipline? I address this henceforward. I draw largely on my own experience in working in DAC with colleagues in a real art and design college, with real practitioners designing, making and testing things that work, are workable, have aesthetic appeal and are manufactured and deployed in the real world; but who are equally keen on theory, research and evaluation. Issues covered centre on the design process itself; visualization; discourses, co-evolution and innovation; and dynamics, scripts and script clashes.

From *think thief* to *draw on design*

Early forays into DAC centred on conveying the theory of SCP to designers, and the message 'think thief' (e.g. Ekblom 1995, 1997). Since designers are accustomed to 'user-centred' approaches (Norman 1998) this requirement to add the abuser perspective was challenging and to some, distasteful. Arguably, the message is slowly sinking in, though pockets of resistance remain, centred as much on 'police state' fears[3] as on erroneous assumptions that criminocclusive design will inevitably be ugly and awkward.

To the extent that designers have now taken the point, crime prevention practitioners can increasingly deploy, or recommend to their customer/user communities, an array of products occupying many *niches* in the preventive ecosystem:

- *Secure* products (like the Vexed/Puma bike[4] with diagonal down-tube replaced by a lockable tensioned steel cable which both doubles as bike lock and acts as a value-reducer – cut the cable to steal the bike, and the bike becomes unusable);
- Dedicated *security* products (eg locks, or ink-tags for spoiling the loot from shoplifting);
- *Securing* products (with some other primary purpose, like the Stop Thief chair,[5] primarily for sitting on, obviously, but with notches to hang one's bag behind the knees); and
- *Security communications* conveying preventive messages in an attempt, say, to mobilize users to self-protect, to mobilize designers themselves (as with posters encouraging architects to design against terrorism,[6]) or to deter offenders.

Hopefully, we're seeing the emergence of a market of preventive ideas and products, beyond the narrow domain of security products, where designers and practitioners negotiate supply and demand and each anticipates and exploits what the other needs or can offer. (This has its *market failures*, which governments have still not fully addressed – see Clarke and Newman 2005c.) Arguably, though, the *gold* brought home for crime prevention practice is not the *products*, but the *process*. Getting practitioners to *draw on design* is about transferring a design approach to the core problem-solving process that underlies SCP and Problem-Oriented Policing. Practice-oriented researchers in this domain are accustomed to addressing the design of surveys, say, or of evaluations, but far less so the design of the intervention itself whether a product, procedure, service or system (although the architectural side is an exception in name at least). Here, the amorphous 'Response' stage of the Problem-Oriented Policing process SARA (Clarke and Eck 2003) both epitomizes and exacerbates the shortcoming. Even the attempt to adapt the problem-oriented approach to CPTED (Zahm 2007) gives most emphasis to treatment of the 'Analysis' stage – necessary, but not sufficient.

One exception is the 5Is framework (Ekblom 2011),[7] in many ways a more detailed and inclusive equivalent of SARA. This was itself developed through a deliberate process of design.[8] Here, the Response stage is divided into three task streams – Intervention (planning the principles and methods with which to interrupt the causes of criminal events or frustrate offenders' plans), Implementation (converting plans into practical detail and making them happen) and Involvement (getting appropriate people and organizations to take responsibility, individually or in partnership, for implementing the intervention). Design enters in several additional ways:

- Capturing user *demand* under Intelligence – and (like all good designers) *questioning* it before taking action;
- Putting together Intervention principles in *workable and plausible combinations* fit for *problem and context*;
- Realizing, testing and adjusting practical preventive methods in Implementation and Involvement – *further customization to context, innovation and iteration.*

Iteration – trial, improvement, new trial – is central to design, and ranges from generation and assessment of initial sketchy ideas to mock-ups, lab tests, field trials and formal impact evaluations. Such a process isn't a luxury extra for crime prevention; it's a fundamental necessity. The extreme context-dependency of prevention (Tilley 1993; Pawson and Tilley 1997; Ekblom 2011) means that converting even the most reliable and evidence-based 'what works...' knowledge into '...and what is workable' practice is far more like innovation than replication. Often, too, a trip to the knowledge cupboard will find it bare of well-evaluated precedent methods for *this* problem in *that* context. A related point is made by Eck (2002) in highlighting the importance of knowledge of principles of situational prevention, rather than of specific tactics, in generating solutions. Whether a preventive project involves customized replication or full-blown innovation creating a plausible effort based on first principles, the feedback and adjustment processes of design, including user trials, are vital. Yet these processes are rarely reported in project descriptions: not done or merely not described?

The process of converting principles to context-customized tactics is inescapably one of design, even if the practitioners don't realize it. And doing the design in a developed and professional way yields significant dividends. As experience shows, even elementary security products like the table-mounted Grippa clip for protecting customers' bags against theft in bars, must be 'high performance' – robust, visible, cheap enough, aesthetically appropriate, safe, gaping wide for big bags, easy-clean, easily-mountable and so on. Likewise, the tricky process of trying to *mobilize* potential buyers and users of designs to actually buy and use them, may learn much from new approaches to social innovation and socially-responsive design.[9] The mobilization process itself has been captured (within 5Is, under Involvement) as CLAIMED (Clarify the preventive tasks/roles that need undertaking, Locate appropriate individuals/organizations to undertake them, then Alert, Inform, Motivate, Empower and Direct). Actually this framework, of general applicability in crime prevention, was distilled from earlier research on enablers and constraints in design against crime (Design Council 2000).

But knowledge transfer is two-way traffic. Conveying to designers awareness and understanding of *causal mechanisms* (Tilley 1993; Pawson and Tilley 1997; Ekblom 2002, 2011) of Intervention, Implementation or Involvement – *how* these processes work – renders the design process a far more scientific, and less hit-and-miss affair. And designers have until recently had little experience of designing and conducting hard, prospective *impact evaluations* of their designs on crime. Attempts to bring these approaches together have included the Bikeoff project,[10] which demonstrated intermediate outcomes of improved secure locking behaviour by cyclists, in response to a new design of bike stand;[11] and the Grippa project, developing and trialling the above-mentioned clips. Although outside events frustrated (for now) the final evaluation of the clips, the process of designing both clips and their evaluation led to the development of a quantitative approach (Bowers et al. 2009) – CRITIC[12] – which combined the planning process for statistical power requirements of the scale of trial, with the costs of producing the prototype clips and coverage of particular bars.

Visualization

Embarrassingly, this chapter is no exception to the tendency for crime scientists and criminologists to neglect the visual dimension, a shortcoming first identified by Gamman and Pascoe (2004). (However, many links are included to appropriate graphics.) This is particularly significant as visualization seems the best way for crime prevention researchers and practitioners to communicate with designers. Designers are known to be highly visual in their thinking and more likely than the general population to be dyslexic (Gamman and Raein 2010),[13] so the textually-heavy messages from conventional SCP experts face obstacles getting through.

There are, of course, some well-known graphical representations of abstract causal and/or practical relationships in SCP, like the enhanced crime triangle at www.popcenter-org, my own Conjunction of Criminal Opportunity (e.g. Ekblom 2011 and www.designagainstcrime.com/files/crimeframeworks/06_cco_classic.pdf), and Ron Clarke's (1977) original diagram of the causes of a vandalism event. Books and manuals on CPTED (Crime Prevention Through Environmental Design) such as *Safer Places* (ODPM 2004) bristle with pictures of buildings illustrating this or that point about, say, surveillance. But the latter tend to be over-detailed and often poor at conveying the key points – line drawings would be better; and the former remain isolated images, not always professionally done using the expertise of graphic/communications designers; they have yet to develop a consistent, rich and informative notation that helps convey the message and link together the field.

One promising area consistently used at the DAC Research Centre has been graphic illustration of Modus Operandi or perpetrator techniques. Examples include bag theft and bike theft, also in animated cartoon form.[14] The purposes of these illustrations have ranged from stimulating and informing designers to communicating 'these are the criminal methods to defend against' for the empowerment of, say, cyclists as potential preventers. Such approaches nicely fit the concept of scripts (below).

Other visualization tools used by designers have included '3D prototyping' equipment, which takes computerized representations of designs (e.g. Grippa Clips, fixed to the rim of tables in bars for preventing bag theft) and 'prints', in layers of plastic, realistic and life-size trial versions of the product. These can then be exposed to iterative tests and critiques from users, police and other stakeholders, trying out improvements before committing to the expensive manufacture process. Examples are on www.grippaclip.com/the-process-2/design-evolution (see Iteration 3). Computer-Aided Design of buildings has similarly enabled 'virtual walk-throughs' of places to reveal vulnerabilities like footholds for climbing or recesses for lurking. In both cases there is scope, still largely unexploited, for using such techniques with offenders and potential victims to explore the fine detail of what makes particular places feel safe and what makes them vulnerable to criminal misdeeds.

Ultimately this has potential to contribute to the development of 'configuration' knowledge (Ekblom 2004) – how criminogenic or fear-inducing properties are generated by (or emerge from) particular combinations of features. Underlying this are the dynamic interactions between theoretical components, that we know as causal mechanisms. Anything that helps SCP think about and test such interactions surely promises a major advance, whether using real humans, simulated agents (Liu and Eck 2008) or preferably both.

The one, important, exception in the visualization armoury of situational prevention is of course the advanced state of crime mapping. But even here design has further contributions to make. Approaches to 'co-design' (Sanders and Stappers 2008) emphasize bottom-up, participant-oriented techniques rather than exclusive reliance on top-down processes (and as such are a step beyond user-centred design). One such example is 'tag mapping', where, for example, cyclists can upload images and comments about the suitability and safety of particular locations for parking their bikes. An example is 'Bikeoff-TV'.[15]

Discourses

But there are verbal besides visual issues. Working in an art, design and cultural studies context one rapidly encounters concepts like 'discourse analysis', and cannot avoid falling over references to French philosophical writers like Foucault (1972) or Derrida (1970). By now many readers from the SCP field will have arched their backs, unsheathed claws and started hissing and spitting. But, in a closely-defined way, the linguistical (as opposed to socio-cultural) side of discourse analysis may help SCP address language problems of its own, and help us articulate what we mean more self-consciously and deliberately, attuning our accounts to different purposes and allowing us to jump out of locked-in ways of viewing particular crime problems/solutions.

There are many alternative ways to describe a given preventive intervention. Take a simple burglary prevention project involving installation of alleygates protecting the insecure rear of terrace (row) houses:

- *Purposive*: serving user (protecting householders), crime reduction (reducing burglary)
- *Performance*: purpose plus ultimate quantitative crime reduction target criteria (e.g. reduce burglary in area by 10%) or intermediate outcome criteria (e.g. alleygate to resist attack by burglars for five minutes)
- *'Reverse-purposive':* frustrating offender's purpose (e.g. disrupting burglary plans)
- *Problem-oriented*: tackling specific problem (burglary) in specific place, perhaps by specific method (e.g. gaining access via rear alleyways)
- *'Ideal Final Result'*: *solution*-oriented descriptions in terms of all the purposes and/or performance criteria (e.g. reduce burglary cost-effectively whilst maintaining user convenience, safety, sustainability and aesthetic quality)
- *Mechanistic*: how the intervention is supposed to work causally/theoretically (e.g. increasing effort and risk by creating target enclosures)
- *'Reverse-causal'*: focusing on the causes of crime the intervention aims to remove, weaken or divert (e.g. tackling poorly-defensible space, compensating for absent guardians)
- *Technical/structural realization*: how the intervention is achieved through a practical procedure or product (e.g. creating enclosure with lockable wrought iron alleygates)
- *Constructional/instructional*: how to manufacture, implement, install or operate method (e.g. alleygate customization, installation and locking procedure)
- *Delivery*: targeting of interventions (e.g. 'primary, secondary, tertiary prevention' or as I prefer, 'universal, selected, indicated' (Ekblom 2011))
- *Mobilization*: how to get people to implement the intervention (e.g. anti-burglary publicity campaign centring on acceptance and use of alleygates)

In everyday parlance of preventive folk these discourses are confused – it's common to see a publicity campaign, say, listed in a series of preventive methods alongside target-hardening, when the campaign could in fact be seeking to *mobilize* target-hardening. It's also obvious from the above list that there is no universally best discourse – some will be best for the strategic planning or impact evaluation stages, others for design, others for standard-setting, manufacture or gaining public acceptance. The important thing is for practitioners and researchers to be *self-aware* of which discourse they are using, which their collaborators are assuming and when is the appropriate occasion for a particular discourse.

Co-evolution and innovation

We cannot remain satisfied with victory in individual battles against offenders' moves and countermoves, but should aim to win sustained campaigns. My early explorations within Design Against Crime led to an awareness that what works now, may cease to work in future when adaptive offenders, perhaps exploiting new technology or social change, learn to circumvent current preventive methods or designs. 'What works' knowledge is a wasting asset (Ekblom 2002), albeit over a timescale rather longer than that of short-term displacement (Ekblom 2005). This awareness in turn engendered an interest in *arms races* between offenders and preventers (Ekblom 1997, 1999, 2005) and the tactics and strategy of how to run them. Strategies like the pursuit of variety, incorporating upgradeability within product designs and so forth are vital for keeping up.

We have already seen how, *tactically*, replication in crime prevention must become more like innovation from first principles given the context-dependence of intervention methods and the finite pool of successful case studies to emulate. Designers have an obvious *strategic* role too in helping preventers generate variety and keep up with those adaptive offenders.[16] But in turn, it's even *more* strategically important to build the capacity and motivation of designers, to *out-innovate offenders*. Developing such capacity to transfer to designers is a key aim of the DAC Research Centre (AHRC 2009). Capacity-building aside, *motivational* appeal to designers, design decision-makers and policy-makers comes partly from the powerful effects of visualization and physical handling, particularly of simple, blindingly-obvious whilst thoroughly developed and sophisticated realizations as with the Stop Thief chair or the caMden bike stand.

One interesting approach to systematically boosting innovation is the Soviet 'Theory of Inventive Principles', TRIZ (Altshuller 1999). TRIZ was devised during World War 2 by a scientist examining thousands of patents for potential exploitation by the Soviet navy, and continued by him and colleagues during a spell in a labour camp. It identifies 40 generic inventive principles observed to recur time and again in an enormous range of inventions. Principle 2, for example,[17] is:

> *Taking out* – Separate an interfering part or property from an object, or single out the only necessary part (or property) of an object.
>
> - Locate a noisy compressor outside building where compressed air is used.
> - Use fibre optics to separate hot light source from location where light is needed.
> - Use sound of barking dog, without the dog, as burglar alarm.

TRIZ also identifies 39 generic 'contradiction principles' like 'strength versus weight'; and look-up tables identifying what inventive principles have previously helped to resolve particular contradictions.[18] 'Reverse-TRIZ'[19] changes the basic question from 'what went wrong?' with a product or system (e.g. vulnerable to crime), a checklist type of approach, to 'how do I *make* it go wrong?', conducive to a more active, 'saboteurial' analysis. TRIZ also identifies a series of 'evolutionary trends' in particular technological domains (e.g. a *fixed* linkage between components, to *hinged*, to *fully-flexible*, to *electric field-based*). These help anticipate where to expect the next innovation in a given product. Perhaps this could be applied to forecasting new perpetrator techniques?

The 'Ideal Final Result' discourse above comes from TRIZ. The alleygate example referred to a range of conflicting or competing requirements or 'troublesome tradeoffs' between security, privacy and convenience. (Armitage and Monchuk (2009) describe an in-depth exploration of conflicts and synergies between security and sustainability of housing.) TRIZ maintains that, far from obstacles, explicit statements of contradictions actually help the designer to focus on key issues to address. This facilitates the true creative leap, as with those fire escapes whose final run of steps is suspended above reach of intruders, and only slides down under the weight of fleeing occupants – thereby supplying both security *and* safety rather than forcing choice or compromise.

Besides these tradeoffs with other values, contradiction lies at the heart of the definition of a given crime. Hot products tend to be attractive to criminals for precisely the same reason as they appeal to legitimate owners/users, both for their inherent value and their stealability. Pocketability of music players, say, is good for both using and stealing; attempts to design against theft by making players bulky would be laughed out of court. Effective design thus relies on fine discrimination between user and abuser, much as anti-cancer drugs must finely discriminate between zapping tumours whilst leaving unharmed the nearly-identical healthy tissue. Such discriminations must often use electronics although one could imagine, say, a mobile phone moulded to fit an individual user's ear.

Finally we should not neglect *criminal* creativity. Space precludes coverage but an excellent overview of the 'dark side' of creativity is in Cropley et al. (2010).

Dynamics, scripts and script clashes

Designers above all seek to understand their products *in use*. This means in practice that while static dissections of causes of crime like the Crime Triangle or the Conjunction of Criminal Opportunity (CCO) are informative, they are insufficient to help designers address the *dynamics* of criminal events. Even the simplest snatch theft has such dynamics; the world of SCP has begun to capture them in terms of *scripts* (Cornish 1993).

Analysis of dynamics tends to be disruptive. It forced the modification of CCO (Ekblom 2011),[20] and questioned the universality of CRAVED (Ekblom and Sidebottom 2007). Concealability of the product, for example, is *helpful* to the thief at the 'flee' stage of his/her script; but *un*helpful at the 'seek' stage when it's hidden in the owner's pocket. This leads into the understanding that honest users have scripts too, and some script elements will centre on security, including perhaps 'hide music player in backpack before going out'. (Designers sometimes facilitate this hiding, by for example incorporating 'earphone wire

ports' in the backpack so the player stays protected from thieves or rain whilst the wires convey the music to the user's ears. At other times, they mess up – we all know what those fancy white wires advertise in terms of product value.) Offender and user scripts may co-evolve – imagine the first *bike-parking script* ('lean bike against shop wall, enter... return, find bike, ride off'), the first *bike theft script* ('see bike, get on, ride off'), and subsequent *elaborations* of move and countermove (including 'lock bike', 'obtain lever to break lock', etc).

Considering the interplay between offender and user scripts leads naturally to the concept of *script clashes*, which neatly link with contradictions, introduced above:

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

Understanding such script clashes is pivotal to SCP, which becomes an exercise in designing environments, products, procedures etc to tip the balance to favour the good guys, whilst respecting all other requirements.

A final point on scripts is to note that in a certain sense, places, systems and objects can be said to have them – consider the script you are required to run through to buy a ticket from a ticket machine. This is otherwise known as 'persuasive technology' (Lockton et al. 2008). Fraudsters may of course not follow the 'official' script.

Conclusion

SCP theory and practice can learn plenty more lessons from design, that space precludes from covering (that limited space indicating Ron Clarke's *Festschriftwürdigkeit*). For example, there is the requirement to avoid producing 'paranoid products' (Gamman and Thorpe 2007) such as subway ticket machines with inbuilt explosives-sniffers or more generally to steer clear of 'vulnerability-led' design (Durodié 2002) in which the abuser-unfriendly tail wags the user-friendly dog. There is also the need to avoid rushing into superficial, awkward and inadequate 'technofixes', usually in response to a crime harvest (Pease 2001) that follows the original designer's neglect of security. And there is the possibility of connecting concepts of 'emotional design' (Norman 2003) to Wortley's (2008) situational precipitators which prompt, provoke, pressure or permit crime rather than simply providing instrumental opportunity.

The exploration of the design world by SCP has not been a simple case of 'grab the goodies and leave'. We're in an academic era where multidisciplinarity is favoured and the true merger of interdisciplinarity is considered a boon. Drawing on design means a real stirring of the multi-disciplinary melting-pot, because some of the issues and examples covered above

have involved ideas from SCP being taken across to the design world and then brought back again in a developed, and design-articulate form, to crime prevention practitioners.

Whether Design Against Crime and Situational Crime Prevention should or could ever get as far as to produce a new interdiscipline is respectively for colleagues to opine and the future to reveal, but certainly the pursuit of that vision is an exciting one. Ron Clarke has drawn much of the map and continues to blaze the trail.

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End notes

All sites accessed 19 February 2011

[1] In one Home Office listing it was mislabelled 'A crime-free cat'.
[2] www.designcouncil.org.uk/crime
[3] E.g. www.britishdesigninnovation.org/?page=newsservice/view&news_id=5454
[4] www.designagainstcrime.com/projects/puma-bike/

[5] www.designagainstcrime.com/projects/stop-thief-chair/
[6] http://designagainstterrorism.wordpress.com/work/
[7] Intelligence, Intervention, Implementation, Involvement and Impact, and many subheadings under these. See http://5isframework.wordpress.com
[8] 5Is was not created in a direct leap from problem (implementation failure) to solution (5Is), but via an intermediate, design-like stage of *problem* to *specification* for knowledge framework to *solution* realising specification.
[9] E.g. www.designagainstcrime.com/methodology-resources/socially-responsive-design/
[10] www.bikeoff.org/
[11] www.designagainstcrime.com/projects/camden-stands/
[12] www.grippaclip.com/publications/academic-papers/critics-link-to-spreadsheet-calculator/
[13] Perhaps indicatively, a conference mug commissioned for Project MARC (Armitage and Pease 2007) presented CRAVED correctly except 'Disposal'.
[14] www.designagainstcrime.com/methodology-resources/perpetrator-techniques and www.bikeoff.org/design_resource/ABT_problem_who_steals.shtml
[15] http://bikeoff.beta.tagmap.co.uk/
[16] One assumes crooked designers exist too – as suggested by the use of 3D printers to produce realistic and accurately-machined card-skimming add-ons to cash machines. http://i.materialise.com/blog/entry/attention-atm-skimming-device
[17] From www.triz-journal.com/archives/1997/07/b/index.html
[18] E.g. at www.triz40.com
[19] E.g. at www.innovationtools.com/Articles/ArticleDetails.asp?a=224
[20] And see www.bikeoff.org/wordpress/wp-content/uploads/2009/02/2007_thinking_thief_crime_frks_for_dac.pdf