

# Forensic science needs both the ‘hedgehog’ and the ‘fox’

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## Abstract

Forensic science faces many challenges, some high profile and others that are less visible. It is argued that a holistic understanding of the complex matrix of forensic science is critical to robust and transparent forensic reconstruction approaches. This paper explores the value of incorporating the contrasting approaches to complexity of the ‘hedgehog’ and the ‘fox’, by illustrating their comparative strengths. The value of such collaboration in the context of a holistic understanding of the complex interactions that exist within forensic science, offers insights for developing approaches that can be taken to address the visible and less visible challenges at their root cause.

## Keywords

Forensic Reconstruction  
Hedgehog  
Fox  
Complexity

## Introduction

It has been widely recognised that forensic reconstruction is complex. The interaction between many disciplines, institutions, corporate and individual actors, have produced a matrix that spans science and the law, encompassing policing, justice, research and policy. There can be a danger in oversimplifying when seeking to classify, but it is helpful to consider the observation that individuals can have different approaches when it comes to addressing and understanding complex systems. Berlin [1] outlined the contrast between the approaches of the ‘hedgehog’ (that knows one big thing) and the ‘fox’ (that knows many things) first articulated by the Greek poet Archilochus. The strength of ‘hedgehogs’ has been characterised as the ability to have a clear focus and a single unified view of the world that provides clarity and confidence in understanding the interacting factors at play. The ‘fox’ in contrast is characterised by seeing complexity and nuance and having a more broad, less defined view of the world that is flexible to change in the light of new information and experience. Considering this contrast between the ways of thinking and producing knowledge of multiple actors within a complex system such as forensic science, with its ultimate aim of forensic reconstruction, offers helpful insights.

In the last 10 years forensic science has faced significant challenges to its validity [2-4] and the concomitant calls for a scientific evidence base to underpin the discipline [5-9]. The calls for these challenges to be addressed range from addressing specific issues such as developing empirical evidence bases to understand the dynamics of trace evidence (such as Morgan et al.[10], Meakin et al. [11]) and developing the best approaches to convey weight

and significance within forensic interpretations (such as Cook et al. [12]), through to the call for a unified approach that addresses root causes of the issues that have been exposed within forensic science (such as Margot [13], Roux et al. [14], Morgan [15]). In addressing these challenges there have been broadly two genres of approach taken. One approach has been to identify clearly defined solutions to address specific challenges that have been identified (such as ensuring quality standards of a particular process or form of analysis). In contrast there have also been more broad, often more conceptual articulations of the complex system of forensic science and calls to address the challenges in a way that takes into account the different actors (individuals and institutions), different infrastructures within which knowledge is being created, different drivers of the multiple actors, and critically, the interconnections and feedbacks within that system. To address the challenges facing forensic science it is important to consider the strengths of each approach and resist the tendency to create a dichotomy between the perceived chasm that exists between the 'hedgehog' approach (that tends toward finding a single organising principle to explain complexity and offer a solution to a challenge), and the 'fox' approach (that holds a range of different views that at times can appear contradictory but seeks to identify the diverse factors that contribute to that complexity).

Harnessing the strengths of both approaches offers a way forward within the complex matrix of forensic science, that is sufficiently generalisable and evidence based, yet can also incorporate a sensitivity to individual contexts in specific cases. Therefore, it is valuable to consider forensic science reconstruction as a holistic system (the interaction between the physical, digital and human environments, and the different forms of knowledge that are created and shared in that system) whilst at the same time recognising the specific multifarious issues inherent to that system (such as quality standards, and evidence based practice). In this way specific challenges can be addressed within the context of the whole system, thereby addressing the root causes of those challenges rather than addressing each disparate symptom as it presents itself.

### **The value of a model of the complex forensic science matrix**

There have been various models proposed to address the complexity inherent to forensic reconstruction [15-17]. It is possible to argue that embracing the value of holistic models is important if we are to reclaim the 'endeavour of forensic science' [14] in a manner that brings both explicit and tacit forms of knowledge together [18] in forensic reconstruction approaches [15]. Such models that seek to identify critical components and how they interact with each other are constructive and beneficial. They enable us to identify what is known and what is not known; they direct us to where the gaps are that need to be filled and thereby to areas of research need; they help us to identify and explain what the 'known unknowns' are and where the 'unknown unknowns' are likely to be; and they help us to identify where there is inherent uncertainty which helps us to develop the frameworks that are needed to explain that uncertainty (and to know when it is, and is not, a problem in forensic reconstruction). Models that provide a holistic overview of a complex system are therefore valuable in presenting a view of the broad picture and unifying themes, and also the diverse factors and variables that are integral to that system. They offer the means to bring the 'hedgehog' and 'fox' approaches together.

These models can provide valuable context to a specific issue and thereby offer insights into the type of solution that is most likely to be effective. They can reveal the nature of specific challenges, and thus the type of knowledge on the explicit tacit knowledge continuum that is needed to address them [19]. Broad models can also help to articulate what form of knowledge is being used to underpin the practices at the crime scene, in the lab and how those findings are expressed to investigators and to a court. These insights can increase the transparency of how findings have been reached, and the basis for inferences that have led to our understanding of what an exhibit or findings from the analysis of specimens means in a specific context.

For example, quality standards and regulation are critical to ensuring the delivery of robust and accurate analysis [20]. Situating the (often) explicit forms of knowledge that contribute to standard operating procedures and quality standards within a holistic model of forensic reconstruction provides the means to pinpoint the forms of knowledge these processes and standards are based on, and therefore the issues that they can directly address, and also those that they cannot.

In a similar way judgement and decision making is a critical component that permeates through the whole forensic science matrix [21-22]. Holistic models can demonstrate the integral nature of decision making to every part of a forensic reconstruction. They can offer transparency in terms of where decision making is critical, the type of knowledge underpinning different types of decision, where there is inherent uncertainty, and the extrinsic factors (such as context) and intrinsic factors (such as prior experience) that can impact a decision.

Ultimately holistic models of forensic reconstruction provide an overview of the complex matrix of forensic reconstruction, and can identify where there may be uncertainty that will impact the various stages within the forensic process, the inferences that are made, and the conclusions that can be drawn. To achieve robust reconstructions and to address the challenges we are facing in forensic science, the strengths of the 'hedgehog' and 'fox' approaches need to be incorporated into our problem solving approaches. 'Hedgehogs' tend to have a very clear consolidated view of a topic or a challenge, which reduces uncertainty in favour of offering a clear 'solution' to the challenge. In contrast 'foxes' are more complex thinkers, at ease with the idea that outcomes often emerge from the interactions of multiple variables (different actors, institutions, forces) that are often difficult to predict [23]. Therefore, bringing both approaches together increases our ability to offer solutions to specific challenges that are more likely to have impact.

### **An approach for the key challenges facing forensic science**

One of the key challenges for forensic science is to avoid being side-tracked by one of the louder narratives in the media that the big problem forensic science faces is 'junk science' and 'rogue scientists'. These are clearly important issues but if we focus only on them we risk having too simplified a view of the challenges faced by forensic science. Such a narrow ('hedgehog') focus can lead to confident strong and clear opinions of how to address those challenges but an increased risk that in practice the challenges are not dealt with at their root cause [24] and other challenges are not identified and addressed that are having an equally significantly (or greater) impact. If we are able to incorporate the 'fox' approaches

we increase the chances of addressing the multiple important issues that impact robust forensic reconstruction approaches. In this context, the 'fox' approach is one where uncertainty is more readily incorporated into problem solving tactics that synthesise multiple factors that are in play across the forensic science environment (such as an understanding of decision making, and the connections between different parts of the forensic science process within the whole system). When these attributes are integrated, there is evidence from other domains that the solutions reached are likely to be more 'successful' [24].

Consider, of the many challenges within forensic science, the issues we currently face in terms of communicating the meaning of forensic science evidence [25]. It has been established that forensic science is a complex matrix of actors (individuals and institutions) and contributing knowledge bases (across the sciences, social sciences and humanities) [19]. Therefore, developing a common language by which to communicate across that space that is transparent and unambiguous is highly desirable. Taking the 'hedgehog' approach and articulating clear unifying themes is absolutely critical to achieving this. However, the incorporation of uncertainty, the synthesis of different approaches and the interactions of different forms of knowledge with a consideration of the varied drivers of the different actors invested in forensic science, in line with the strengths of the 'fox', is also critical. A synergetic approach that draws on the 'hedgehog' and the 'fox' will offer a vocabulary that can effectively communicate the meaning of forensic science evidence within the context of the whole matrix to assist investigators and the justice system [26]. It will enable the forensic science community to communicate value in a way that is able to effectively contribute to policy, and top down infrastructural changes, as well as develop the grass roots changes that create environments that promote an innovative culture.

Another challenge is the research landscape in forensic science. Forensic science needs both technological developments to drive forward innovation and capability in crime detection in a rapidly changing world [6], and foundational research that can underpin the practice of forensic science and within that the interpretation of forensic science evidence [5]. We must resist having a sole focus on just one or the other and thereby create a dichotomy between these two approaches. Innovation requires both 'hedgehog' approaches that pursue clear solutions to specific challenges in collaboration with 'fox' approaches that provide an appreciation of the context within which research questions are articulated and research methods are developed. With these two approaches in synergy it is more likely that outcomes can be identified that are implementable in a complex system and that can address root causes of the challenge to be solved.

When it comes to ensuring quality standards, there is again a clear benefit of bringing together the 'hedgehog' and the 'fox'. Addressing the challenges of ensuring quality within forensic science needs both specific targeted approaches that can offer benchmarks for producing standard operating procedures and accreditation (more in line with the 'hedgehog' approach), but also the means to situate those benchmarks and SOPs within the complexity of forensic science reconstruction (drawing on the 'fox' approach). This is clearly a significant challenge, but approaches that bring explicit and tacit forms of knowledge together in a way that engages with the interconnected and complex system of forensic

science, offer great potential for ensuring that quality standards are implemented effectively, and contribute to the broader forensic reconstruction goal [15].

## Conclusion

Whilst acknowledging that forensic science critically needs strategic investment across every domain [27], forensic science needs to bring both ‘hedgehog’ and ‘fox’ approaches together to address the roots of the major challenges the discipline faces. Addressing these challenges in a way that incorporates a holistic understanding of the complex matrix that is forensic science offers huge potential. However, just as a holistic understanding of the whole forensic reconstruction process is critical, the unifying principles of the ‘hedgehog’ and the identification of the range of factors that contribute to the complex landscape we are working within of the ‘fox’, are both fundamental. We lose either approach at our peril.

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