Achieving Cumulative Progress in Understanding Crime: Some Insights from the Philosophy of Science

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Abstract

Crime is a serious social problem, but its causes are not exclusively social. There is growing consensus that explaining and preventing it requires interdisciplinary research efforts. Indeed, the landscape of contemporary criminology includes a variety of theoretical models that incorporate psychological, biological and sociological factors. These multi-disciplinary approaches, however, have yet to radically advance scientific understandings of crime and shed light on how to manage it. In this paper, using conceptual tools on offer in the philosophy of science in combination with theoretical work represented in this special volume of *Psychology, Crime and Law*, I provide some perspective on why explanatory progress in criminology has remained elusive and evaluate some positive proposals for attaining it.

Introduction

Criminal behaviors—murder, rape, incest, arson—are structurally complex phenomena insofar as investigators may probe various parts of the fabric of the world to locate their causes. Since the scientific search for the causes of crime began in the 18th century (Rafter, 2011), criminology has expanded to include psychological and biological approaches in addition to sociological and legal ones. Today, there is growing consensus among contemporary criminologists that progress in understanding crime will not be possible within the confines of any single scientific discipline. Rather, explaining and preventing criminal behavior requires an integrative approach that unifies insights from biology, genetics, sociology, psychology, neuroscience and related fields. Indeed, when we survey the landscape of contemporary criminology we find a plurality of interdisciplinary theoretical and explanatory approaches to crime. To date, however, this pluralism has not radically advanced scientific understandings of criminal behavior nor shed adequate light on how to prevent it.

In this paper, I offer one perspective on why interdisciplinary progress in criminology has remained elusive and evaluate some proposals for facilitating it. Part of the problem, I suggest, partially on the basis of the disciplinary review papers contained in this special issue, is that what we find within and across different scientific fields that study the causes of crime is unbridled rather than coordinated pluralism: investigators working within the same and across different fields of criminology have different ways of identifying, conceptualizing and classifying criminal behaviors and their causes as well as different methods and evidential standards for investigating them. These differences, rather than facilitating cumulative progress, serve as barriers to effective interdisciplinary communication that is necessary to facilitate causal discovery. The

relevant question thus becomes, how might practices within and across these different areas of science change to make an interdisciplinary understanding of crime an attainable goal?

In order to answer this question in this paper, I begin, in section 1, by introducing some conceptual tools from the philosophy of science. These tools merely serve as heuristics for understanding the structure of those areas of science that are interested in understanding crime and how progress given this structure may be achieved. In section 2, I consider specific cases in which scholars have tried to put forward integrative accounts of crime. I apply the conceptual tools to evaluate what is going on in these cases and relate this analysis to how practitioners in these fields themselves conceive of the problems. I go on to note that the kind of obstacles to progress that what we find in criminology are not unique to it; investigators undertaking research on mental illness face similar challenges. I end by evaluating several proposals offered in this special issue for securing interdisciplinary progress in crime research and supplement them with some additional guidelines I regard as important for putting the various fields of criminology on a trajectory for success.

Conceptual tools

One aim of this special issue of *Psychology, Crime and Law* on "Understanding Crime" is to address the question of how those disciplines engaged in investigating the causes of criminal behavior may make progress in understanding and explaining it. In recent years, a small number of scholars involved in the empirical study of crime have looked to philosophical models of scientific progress for normative guidance (Durrant and Ward, 2015; Ward, Wilshire, and Jackson, 2018). In this section, I describe a set of conceptual tools on offer in philosophy of science for thinking about scientific progress, especially in areas of science that investigate

complex phenomena. I then use these tools, in the next section, to evaluate some representative scientific approaches to crime. This analysis is intended to be a complement to that theoretical work in the sciences of criminology showcased in this volume (Day, Tamatea, and Gaia, 2019; Durrant, 2019; Fortune and Heffernan, 2019; Dixon, Harkness, and Wegerhoff, 2019; Raine and Ling, 2019; McGee and Farrington, 2019; Ward and Carter, 2019; Weaver, 2019).

Much contemporary work in philosophy of science may be viewed as a reaction to ideas about science put forward by the logical positivists in the first half of the 20th century (Oppenheim and Putnam, 1958; Nagel 1961). One fundamental positivist idea is that phenomena and the scientific study of phenomena may be subdivided into levels with each branch of science (e.g., sociology, psychology, physics) situated at a single "level of analysis" taking one specific "level of organization" of matter (e.g., social groups, individuals, atoms) as its focus of inquiry. Levels of analysis are organized hierarchically, lower levels study the parts (e.g., individuals) of the wholes (e.g., social groups) under study at a higher level. The hierarchical ordering relation among levels is from complex to simple, from large to small, from less to more fundamental, or from whole to part. Each level may be treated as discrete and theoretically independent from another and investigators at each level deploy particular terms to individuate those kinds of entities and properties that are "fundamental" to their science and its associated theory. On this picture, sociology studies social groups and is at the topmost level, psychology studies individuals that comprise social groups and is one level down, biology is at the next level down insofar as it studies the somatic parts of individuals, and physics, because it studies the most fundamental units of matter of which everything else is composed, is at the lowest level.

The logical positivists believed that scientists should seek unified understandings of phenomena (Nagel, 1961; Oppenheim and Putnam, 1958). On one model proposed by Ernest

Nagel, unification was to be achieved by the process of *intertheoretic reduction*. The basic idea is that progress in science occurs when a theory that corresponds to one branch of science situated at one level of analysis is reduced to a theory corresponding to a branch of science situated at a lower-level of analysis. Intertheoretic reduction requires the satisfaction of two conditions: *connectability* and *derivability*. According to the connectability condition, the terms in the reduced theory must be connected to the terms in the reducing theory by means of bi-conditional bridge laws that specify an identity relation between the terms and their referents. The derivability condition, in contrast, requires that the reducing theory be capable of explaining all the phenomena the reduced theory was originally able to explain. The classic example is the reduction of thermodynamics to statistical mechanics; not only can the latter theory purportedly explain the same phenomena that former could, but terms contained in thermodynamic theory (e.g., "temperature of a gas") could be shown to be bidirectionally equivalent to terms in statistical mechanics (e.g., "mean kinetic energy of molecules comprising the gas"). The ultimate aim of all of science, on Nagel's model, was the gradual reduction of all higher-level sciences to fundamental physics.

Philosophers of science still traffic in talk about levels of organization and analysis but recognize both as imperfect heuristics for understanding the structure of the world and science (Bechtel, 1986; Machamer and Sullivan, 2001; Potochnik, 2010; Potochnik and McGill, 2012). Few, if any, however, endorse the idea that progress in science involves intertheoretic reduction. In fact, most work in philosophy of science in the latter half of the 20th century and early 21st century has been directed at critiquing and proposing alternatives to Nagel's model for understanding the structure of science and the nature of scientific progress.

In the 1970's, for example, philosophers of science suggested that the appropriate unit of analysis for understanding the organization of different areas of science was not "level" but rather, some alternative such as *field* (Darden and Maull, 1977), *domain* (Shapere, 1974), or *discipline* (Bechtel, 1986). Moreover, the kinds of interactions regarded as occurring within and among different scientific fields involved something other than establishing reductive relationships between different theories. Fields of science came to be regarded as consisting of individual investigators who shared explanatory problems in common. Sometimes, when confronted with an intractable problem, scientists working in one field turned to scientists working in another for guidance, borrowing an experimental method or a theoretical tool (Bechtel, 1986; Darden and Maull, 1977). There were also instances in which scientists working in different fields joined forces to solve explanatory problems of mutual interest and theories in those fields appeared to "co-evolve" (Churchland and Sejnowski, 1988). By considering case studies particularly from the biological and mind-brain sciences, philosophers explained that interdisciplinary relationships between different areas of science could be many and varied (Bechtel, 1986; Bechtel and Richardson, 1993; See also Mitchell, 2003, Chapter 6 on "integrative pluralism"). Scientific progress involved far more complex interactions within and across fields than the logical positivists had appreciated.

In conjunction with this new appreciation of the structure of science, philosophers became concerned with goals in science other than theory development. In the late 1950s, the nature of scientific explanation became the new focus as philosophers began to critically evaluate the deductive-nomological (D-N) model of scientific explanation (Hempel and Oppenheim, 1948). On this model, explanations were conceived as arguments; the premises consisted of statements of laws and initial conditions that were taken to logically imply the observations to be explained

or predicted. Critics of the model claimed not only that it got explanation in physics wrong, but also that it was descriptively inadequate when it came to sciences like biology and psychology that sought to explain phenomena of interest in the absence of laws (Bechtel, 2008; Bechtel and Richardson, 1993; Cummins, 1975, 1983; Fodor, 1968; Salmon, 1989). To this end, in the latter half of the 20th century, alternative accounts of scientific explanation were proposed. One alternative, *mechanistic explanation* bears directly on questions of explanatory progress and the feasibility of developing integrative explanations for complex phenomena like crime (Bechtel, 2007; Bechtel and Richardson, 1993; Craver 2007; Machamer, Darden, and Craver, 2000; Piccinini and Craver, 2011; See also Stinson, 2016; Stinson and Sullivan, 2017).

Mechanisms are causal systems that contain entities/components and their activities/processes that are organized so as to give rise to the behavior of that system (Craver, 2007). A mechanistic explanation describes how those parts, namely, entities/components and activities/processes and their spatiotemporal organization, actively give rise to that behavior. To take an example, a mechanistic explanation of the depolarization of the neuron would include the coordinated opening and closing of sodium and potassium ion channels in the cell membrane, which permit changes in the flow of ions across the membrane.

Descriptions of mechanisms are typically put forward to explain complex phenomena (e.g., criminal behavior, mental illness, cognition) that are a consequence of entities and activities operating at multiple different levels or scales of organization within a nested hierarchy. Mechanistic explanation is thus consistent with an account of scientific progress in which different fields of science that investigate different levels of organization each contribute to filling out the multi-level details of the explanation. Findings from individual fields, then, "are used, like the tiles in a mosaic, to elaborate the mechanism sketch, showing piecemeal which

components and properties are relevant to the mechanism and how those components are organized spatially, temporally, and actively within the mechanism" (Craver 2007, 524). To take Craver's example, the mechanism of spatial memory in rodents is widely described as involving the formation of a spatial map in the hippocampus, which is brought about by changes in synaptic plasticity in area CA1 of the hippocampus, which is mediated by activation of N-methyl-D-aspartate receptors in area CA1 neurons. Findings from neurophysiology, cellular and molecular and behavioral neuroscience have all contributed to the development of this mechanistic explanation (See also Sullivan, 2010, 2016).

Gualtiero Piccinini and Carl Craver (2011) provide a more explicit statement of how mechanistic explanatory integration works by considering the relationship between explanations in psychology and neuroscience. Although psychology and neuroscience are regarded as distinct scientific fields, Piccinini and Craver argue that they are not explanatorily autonomous; while both areas of science aim to explain cognitive capacities, only neuroscience is successful insofar as it identifies both the functional and the structural details—the activities and the entities—of the physical systems that realize psychological processes and properties. Piccinini and Craver may be described as conceiving of the two forms of explanation as situated at different points on an explanatory completeness continuum. Functional analyses or "mechanism sketches" lie at one end; complete mechanistic explanations lie at the other. Once neuroscience fills in "the structural aspects that are missing from a functional analysis," it "turns into a more complete mechanistic explanation" (Piccinini and Craver, 2011, 308).

Mechanistic explanatory integration has obvious descriptive advantages over intertheoretic reduction as a model for understanding scientific progress. First, it is applicable to areas of science that lack bona fide theories. Second, explanatory progress is achieved as different areas

of science contribute findings to common explanations of common phenomena while maintaining their status as autonomous disciplines or fields. The model also can accommodate a variety of types of relationships that may exist between different scientific disciplines or fields, although its advocates particularly value interactions that facilitate explanatory unification.

Despite certain advantages over the Nagelian model, however, mechanistic explanatory integration has at least one important limitation. In order for two theories from different areas of science to be reductively related to each other, Nagel recognized that terms designating the kinds to which one theory referred had to have (roughly) the same referents as the terms in the other. The two terms had to be "connectable" via bridge laws that specified their bidirectional equivalence. The model of mechanistic explanatory integration, in contrast, leaves mysterious precisely what is being fitted together when "results" from the same and different fields are fitted together in mechanistic explanations. Mechanistic explanations involve terms that designate entities, activities and phenomena to be explained. A prerequisite for results arising from the same and different areas of science to fit into a single mechanistic explanation of a common phenomenon is for the terms designating causal variables and explanatory targets to have the same referents. The meanings of the terms must be stable within and across different fields of science that contribute to the mechanistic explanation in order for integration to be possible (Sullivan, 2016).

If I am correct, mechanistic explanatory integration needs to be supplemented with some tools for thinking about other aspects of scientific practice that are important to developing successful explanations (Sullivan, 2009, 2015). For reasons of space, I cannot discuss the different typesof practices that may be relevant to the development of integrative multi-level explanations of crime, so I focus here on conceptual practices. Methodological practices are

certainly also relevant, as differences in evidential standards upheld within and across different fields of science may also impact the feasibility or legitimacy of explanatory integration. The recent replication crisis in science has called attention to the fact that sometimes investigators working within the same field do not maintain the same standards. (See Baron and Sullivan, 2018; Haig, 2019; McGee and Farrington, 2019; Sullivan, 2015).

By conceptual practices, I mean to capture the ways in which investigators deploy concepts so as to pick out (a) phenomena that are the targets of explanation as well as (b) the causal variables they identify to explain those phenomena. Prior to a scientist running an experiment, she will have grouped together instances of what she takes to be the same phenomenon or variable under a concept or construct. She may rely on how other investigators in their field define the concept, but she may also define it slightly differently. Folk psychological understandings of the concept may shape the definition that she provides (Sullivan, 2014) or she may instead be influenced by how practitioners working in a different or related scientific field understand the concept. Some examples of constructs in criminology include: *antisocial behavior, aggression, risk factor, crimogenic need, interpersonal violence, fear-conditioning, well-being and desistance*. These constructs originate with a concept that an investigator associates with certain observations, which serves as a basis for theory building and the development of procedures for detecting instances of them in experimental settings.

Once an investigator has selected a capacity or property of interest, which is designated by a construct, she specifies a set of procedures for producing, detecting, and/or measuring an instance of it in an experiment or research study. In other words, she operationally defines the term (Chang, 2010). For example, an investigator might operationally define a construct like *antisocial potential* as an individual's propensity to commit antisocial acts or "prosocial

behavior" in terms of degree of attachment to one's parents (McGee and Farrington, 2019). Ideally, she aims for the set of procedures that she selects to detect instances of the construct to have a high degree of *construct validity*. In other words, she aims for the match between what she investigates in her experiments and the instances of the phenomena or property she takes to be grouped under the construct to be valid (Cronbach and Meehl 1955). Experiments may have anywhere from a low to high degree of construct validity. The higher the degree of construct validity, the closer the match between the variables or effects under study in the research study and the variables or phenomena designated by the constructs.

Several features of conceptual practices in science are relevant to the issue of explanatory integration as well as to the development of theories that incorporate concepts from different areas of science. First, investigators working within the same field may not necessarily agree about how to define a given construct. Second, they may disagree about the best procedures for producing, detecting and/or measuring instances of those constructs in experimental settings. Third, investigators may, in light of their research findings, revise their understandings of constructs or the procedures they use for producing, detecting and measuring instances of them across experiments, irrespective of how other members of their field understand those terms. Fourth, these features of conceptual practices that may apply within a single scientific field may also hold true across fields. In other words, there may potentially be variation with respect to (1) how investigators from different fields use terms and (2) what procedures they use to produce, detect and measure instances of the kinds the terms pick out.

Armed with these conceptual tools, I want to consider several examples of integrative theories or mechanistic explanations in contemporary criminology with an eye towards identifying obstacles to interdisciplinary progress in understanding criminal behavior. For

reasons of space, this analysis is not exhaustive; I do not consider all of the different fields or details of those fields that comprise contemporary criminology. What I offer is at best a first pass at pinpointing the precise places where obstacles to explanatory progress emerge within and across fields. It is to a large extent based on the meta-analytic work undertaken by scholars in this special issue who have sought to engage in a critical examination of their own fields' contributions to understanding and explaining crime. The philosophical analysis I provide is intended as a complement to this field-specific analytic work.

The Conceptual, Theoretical and Explanatory Landscape in Criminology

In order to appreciate why criminologists believe that explaining criminal behavior requires an interdisciplinary approach, it is worthwhile to consider several examples. Burns and Swerdlow (2003) describe the case of a forty-year-old male schoolteacher who began making sexual advances towards his stepdaughter and soliciting prostitutes. He had no prior history of engaging in these behaviors. An explanation for these changes in his behavior may have potentially appealed to (a) the act of his spouse rejecting his sexual advances, (b) his feelings of inadequacy in response to this act, (c) a loss of self-control, or (d) a brain abnormality. Clearly, these different variables may have been related to each other in complex ways and interacted dynamically in the production of the behavior. Ideally, any explanation provided for his behavior would track the real as opposed to the hypothetical causes. It was determined that the man did have a tumor that was large enough to disrupt normal functioning of the frontal lobe and hypothalamus, and that its growth correlated with the onset of his criminal behavior.

In another case, Andrew Goldstein, who had a history of schizophrenia, threw Kendra Webdale to her death in front of a New York City subway train (*People v Goldstein*, 2004). An

explanation for this violent act may have posited (a) a history of mental illness, (b) an abnormality in his brain, (c) his feelings of social rejection on the basis of his mental illness, (d) failure to take his medication, (e) his inability to differentiate right from wrong, or (f) his lack of self-control. Again, an explanation for Goldstein's behavior could have appealed to any and all of these variables and their dynamic interactions. Although, Goldstein originally claimed he was unable to recognize the difference between right and wrong, he later admitted that he willingly and knowingly committed the crime.

The *psychology of criminal conduct* has as its aim to explain the onset and maintenance of anti-social behavior, which includes actions like those described above that negatively impact the well-being of others. The field at one time relied exclusively on sociological theories of crime (Andrews, Bonta, and Wormith, 2011; Fortune and Heffernan, 2019), but as psychological approaches to the field developed, investigators recognized causal variables internal to individuals who committed crimes (e.g., psychological and biological risk factors) were as important as external factors (e.g., social, cultural and familial environments) in understanding their behavior. During the past several decades, as the field has grown, an interfield theory known as the *General Personality and Cognitive Social Learning Theory of Criminal Conduct* (GPCSL) has been developed and refined. The aim of the theory is to explain antisocial behavior by means of a broad "range of psycho-social-biological factors which contribute to the likelihood of antisocial behavior occurring and its maintenance over time" (Fortune and Heffernan, 2019, XX). Using this theory and its related components (the Central Eight risk factors, the Risk Need and Responsivity Model and related principles (Fortune and Heffernan, 2019)) investigators may appeal to a variety of different psychological, social, environmental and biological risk factors to

explain why an individual committed a crime and to predict the likelihood that they will engage in offending behavior in the future.

A variety of different constructs are associated with the GPCSL framework. "Risk factor" is itself a construct, and different investigators define the concept in different ways (Fortune and Heffernan, 2019). Constructs designating the Central Eight risk factors for anti-social behavior include: (1) *a history of antisocial behavior, (2) antisocial personality traits, (3) criminal thinking, (4) criminal associates, (5) substance abuse,(6) family/marital problems,(7) poor work/school performance and (8) lack of prosocial leisure activities*. Other terms have been introduced into the literature that subdivide the Central Eight into subconstructs. The list of subconstructs includes: *intimacy deficits*, *self-regulation problems*, *emotional congruence with children, negative affect* and poor *coping skills*, to name only a handful. As Fortune and Heffernan (2019) note, some of these subconstructs are very general and correspond to a host of different causal variables, whereas others are more specific, thereby casting a narrower causal net. Additionally, different investigators provide different operational definitions for the Central Eight as well as these sub-constructs, which means that the meanings of the constructs are not stable within the field. This is a barrier to the integration of findings from psychological research studies aimed at determining the causes of crime. It is also an obstacle to effective intradisciplinary communication.

We also encounter a number of interfield theories when we look to sociological approaches to criminal behavior (Dixon, Harkness, and Wegerhoff, 2019)). The *multifactorial model of multiple perpetrator sexual offending* (MMMPSO), for example, has been used as a basis for understanding individual, sociocultural and situational factors that may contribute to group-based sexual violence (Harkins and Dixon, 2010). In their paper in this volume, Dixon,

Harkness and Wegerhoff (2019) use the MMMPSO as a basis for developing a similar multifactorial theoretical framework for explaining *interpersonal violent crimes*, including assault, rape and murder, which they dub the *Multifactorial Model of Interpersonal Violence* (MMIV). On this model, violent crimes are explained by appeal to complex interactions among factors or features in (a) the sociocultural contexts in which individuals exist (e.g., racial or gender inequality), (b) the situational contexts in which they find themselves (e.g., in wartime or in prison; as a member of a particular family, subculture or anti-social peer group) and (c) psychological processes internal to the individuals themselves (e.g., identification with a particular social group, desire for inclusion within a social group (e.g., a gang)). Each of these factors working in isolation or in combination could result in an individual committing a violent crime and "researchers and practitioners are therefore able to draw upon this framework to facilitate the identification of a broad range of potential causal factors across multiple explanatory levels" (Dixon, Harkness, and Wegerhoff, 2019).

The MMIV framework that Dixon and colleagues propose is similar to that of the GPSCL insofar as it posits a number of different constructs to pick out psychological features of persons, features of social groups of which they are a part and features of the ecological contexts in which they live. The framework is also associated with a number of risk factors for committing interpersonal violent crime including constructs such as: *need to belong to a social group, having deviant peers, peer acceptance and poor parental supervision*. It thus leaves open the possibility that different investigators will disagree about which constructs are important or interpret and operationally define the available constructs differently, which would clearly be a barrier to integrating results across different research studies aimed at explaining interpersonal violence. There is also some degree of overlap between the constructs associated with the MMIV model

and those associated with the GPCSL framework, prompting a question about how, if at all, models in different fields of criminology may be related.

If we instead look to experimental biology and neuroscience (Raine and Ling, 2019), we begin to see explanations that appear a bit more mechanistic and more multi-level—that explain criminal behaviors or crime-related behaviors in terms of the entities and activities situated at different levels of organization within those human beings who commit crimes. For example, subcortical areas of the brain, including the brainstem, amygdala, medial prefrontal cortex, parahippocampus and visual cortex have been described as being involved in *subconscious threat detection*, a construct that is operationally defined in terms of the activation of neural circuits taken to comprise an "innate alarm system". This system is understood to be an evolutionary adaptation; individuals who had this system would have been able to avoid threats to their survival and thus their reproductive success in the evolutionary history of the species. Evidence to date suggests that in persons with post-traumatic stress disorder (PTSD), this innate alarm system is "hyperreactive" in response to "fear and trauma related stimuli" (Lanius et al., 2017, p. 109). Thus, when persons with PTSD experience a threat in the form of such stimuli, they may react violently, resulting in them committing a criminal act.

The interesting question with respect to this mechanistic explanation and similar explanations in the biological sciences that aim to link psychological traits and functions to structural features of organisms, is whether the constructs investigators use, like *subconscious threat detection*, *fear* and *trauma* are operationally defined across investigators in a similar way. Sullivan (2009, 2016) has argued previously that because investigators in neuroscience are at liberty, just as investigators in other areas of science, to define constructs generally and

operationally as they deem appropriate, this poses a challenge for integrating results from the same and different areas of neuroscience into a common explanation of a common phenomenon.

Although I have considered only a very small subset of the kinds of theories, models and explanations that we find in contemporary criminology, if we view them from the perspective of the conceptual tools identified in the previous section, some general themes emerge. First, criminology spans multiple levels of analysis and nowhere do we encounter instances of relationships between different fields that conform to Nagel's model of intertheoretic reduction. Rather, when investigators working within a field or across fields recognize the limitations of a specific disciplinary approach for explaining criminal behavior, they look to conceptual and theoretical resources in other fields for guidance. Across those fields that comprise contemporary criminology, this has resulted in a diverse array of interfield theories and mechanistic explanations that are used to understand criminal behavior.

Second, as a general rule, it does not appear that investigators from within the same or across different fields are actively collaborating currently to solve explanatory problems of mutual interest. Rather, researchers from different fields import a variety of different conceptual, theoretical, or explanatory tools from other fields to elaborate their theoretical models or mechanistic explanations. Indeed, they are at liberty to include those causal variables (i.e., constructs) within their models that they consider most relevant and emphasize the ones they consider to be most important. We see this in all three of the examples that I considered. For example, biological variables play less of a role in the GPCSL than psychological variables, and sociological variables are also not as prominent as psychological ones. As Fortune and Heffernan (2019) note, revisions to the model have led to sociological variables playing a less prominent role in the model over time. Similarly, sociological variables are prominent in the MMIV

framework, psychological variables are far less so, and biological variables play no obvious role. The mechanistic explanation of criminal behavior refers to psychological constructs ("fear") but primarily includes a description of entities and activities situated at different levels of organization in the brain. As McGee and Farrington (2019) put it, differences in emphasis on causal variables across theories tend to correlate with the orientation of the researchers who have developed these theories. It seems reasonable to expect that an investigator's training will impact the importance they place on specific causal variables due to better familiarity with those variables.

Under ideal circumstances in which investigators within each field of criminology (e.g., psychology, sociology) (1) agreed on how to define theoretical constructs used within that field to pick out causal variables and explanatory targets and (2) collectively engaged in trying to ensure the validity of those constructs, we might expect that developing intrafield theories of mechanistic explanations would be straightforward. Yet, we do not encounter such ideal circumstances in the fields that comprise contemporary criminology. Instead we find that investigators working within and across fields, even those who use the same theoretical framework, may put forward different general and operational definitions for the same constructs (Fortune and Heffernan, 2019; McGee and Farrington, 2019; Ward and Carter, 2019), barring the possibility of seamlessly integrating research findings from different studies purportedly related to the same construct. Additionally, the constructs used to pick out explanatory targets and the causal variables used to explain them are in some cases "lumpy"—grouping together heterogenous as opposed to homogeneous phenomena or grouping together multiple variables that ought to be treated of independently (Fortune and Heffernan, 2019; Ward and Carter, 2019; Ward and Fortune, 2016; Ward, Wilshire, and Jackson, 2018).

What we find, then, when we look across the conceptual, explanatory and theoretical landscape of contemporary criminology is unbridled and uncoordinated intradisciplinary and interdisciplinary pluralism. Investigators within and across the various fields represented are at liberty to define terms as they deem appropriate, combine insights from whatever areas of science they deem relevant to their investigative and explanatory aims, and use whatever methods they regard as adequate for achieving their goals. Such conceptual, theoretical and methodological pluralism is an impediment to the development of integrative explanations of criminal behavior.

The way forward

Despite the absence of conceptual and methodological coordination within and across those fields that comprise contemporary criminology, investigators do share at least one goal in common—they want to identify the causes of criminal behavior for the purposes of explanation, prediction and control. This goal is implicit in the two of the models of scientific progress I considered above. Intertheoretic reduction is consistent with the idea that the ultimate aim of science is to explain phenomena by reference to interactions among the most fundamental units of matter. Mechanistic explanation, in contrast, recognizes that mechanisms are multi-level yet is associated with a view of progress in which phenomena (behaviors of mechanisms) are explained only at that point at which our explanations track the causal structure of the world. On both models of scientific progress, science is supposed to move towards the etiological and track the real-world causes of complex phenomena like crime. The problem is that neither model explains precisely how to coordinate practices within and across different areas of science to achieve this goal.

We find at least two suggestions in the philosophy of science literature for how fields that investigate complex phenomena that are struggling to make progress in the ways just described might achieve it. Consider a field like psychiatry, which is not so dissimilar from criminology (in fact, there is a lot of overlap. In the 1950's, the American Psychopathological Association (now the American Psychiatric Association (APA)) was struggling to make progress in understanding the causes of mental illness because research scientists and practitioners approached the scientific study of mental illness from different vantage points. At that time, *the Diagnostic and Statistical Manual of Mental Disorders* (DSM-1) contained many psychodynamic terms like "conversion", and "mental conflict"—constructs that were used in different ways by practitioners coming from different theoretical backgrounds (Hempel, 1959/1965; Haslam, 2013). This prompted miscommunication and was regarded as a problem that needed to be solved if psychopathology was to make progress in understanding mental illness.

In an invited address to the APA (1959/1965), philosopher of science Carl Hempel offered one solution. He suggested that investigators having different theoretical backgrounds ought to begin by agreeing what the kinds in the classification system should be. Then they should specify the criteria for individuating those kinds in terms of observable surface features. The resulting operationally defined categories were intended to facilitate communication among investigators having different theoretical perspectives who were engaged in a common research project but lacked a shared vocabulary. Operational definitions, however, were not the endgame of science according to Hempel; they served only as an important practical starting point. Sciences should strive to move away from operational definitions to conceptual taxonomies having systematic or theoretical import. In other words, they should aim to discover general laws or theoretical

principles which reflect uniformity in the subject matter under study and which provide a basis for explanation, prediction, scientific understanding, and control.

One problem with Hempel's solution is the lack of direction he provides as to how to ensure a workable and stable taxonomy that facilitates mutual understanding across scientists who share an explanatory goal in common, when this same taxonomy is supposed to be modified in light of causal discovery. If taxonomic categories are meant to be revised as new information about mechanisms comes in, the categories will not be stable. Yet if the categories are in flux until science "gets the worlds right", it is not clear how they will continue to facilitate the interdisciplinary communication for which they were originally intended.

In their contributions to this volume, McGee and Farrington (2019) and Fortune and Heffernan (2019), though they are working in different fields of criminology, make suggestions for resolving construct instability within their respective fields that resemble Hempel's proposal to the APA. Specifically, they claim that an important pathway to progress is for investigators working within a given field to collectively identify a set of intradisciplinary constructs and collaboratively put forward definitions of those constructs with an eye towards developing a classification system that will track the causes of crime and allow for findings related to the phenomena of interest to be integrated across research studies. To these proposals, I will only add that such aims will not be attainable if there fails to be ongoing collaboration among investigators working in each of these fields—a kind of collaboration that is not currently present. Moreover, if the ultimate aim of stabilizing the constructs in these fields is the integration of findings across different fields that investigate criminal behavior (i.e., interdisciplinary integration), then such collaborative endeavors ought to be interdisciplinary. Fortune and Heffernan favor the development of field-specific or what they call "local theories"

first, once investigators within a given field such as forensic psychology agree on a classification scheme. However, if multi-level explanations are indeed the goal, conceptual, theoretical and explanatory practices eventually will have to be coordinated within and across different scientific fields (See Sullivan 2018 for further discussion about strategies for coordinating practice across fields).

An alternative to Hempel's proposal recently proposed in the philosophical literature advocates a different route for moving from the descriptive to the etiological. Instead of investigators from different areas of science collaboratively operationally defining their categories, they can begin looking at the wealth of data collected across different areas of science as a means to determine if any "robust patterns" emerge (Tabb and Schaffner, 2017). The patterns that will be detected will always be perspective-relative, though proponents of this alternative insist that this does not compromise their reality. Patterns exist in the world and while "there are many possible grounds for delineating [them] [. .] on the basis of our diverse theoretical frameworks, [. . .] only some will be meaningful" (Tabb and Schaffner, 2017, 344). This view is consistent with the idea that some theoretical vantage points may be more advantageous than others for detecting meaningful patterns. Moreover, only important patterns ought to serve as a basis for deciding on the categories that are to become the focus of interdisciplinary inquiry. This of course, however, leaves open the possibility that researchers hailing from different theoretical backgrounds may disagree on which perspective(s) should take priority.

In two of the papers contained in this volume (Durrant, 2019; Ward and Carter, 2019; See also Durrant and Ward, 2015), we encounter a prescription for future progress in criminology that exemplifies the "robust patterns" approach. In their paper, Ward and Carter (2019, pp)

identify a number of problems with current systems that classify criminals on the basis of the offenses they commit (e.g., sexual or violent crime), the likelihood that they will commit an offense ("risk level"), the number and type of dynamic risk factors they present with (where the more factors that are present, the more at risk the individual is for offending or recidivism) and "their underlying antisocial dispositions". They claim that these classification systems are not explanatory nor do they point to causal variables that could be targeted to prevent criminal behavior. Moreover, the behavioral patterns to which they point are not sufficiently "robust"—they do not detect meaningful categories that suit either pragmatic or explanatory interests.

Ward and Carter (2019) advocate a classification strategy that begins with the recognition that a set of robust "behavioral patterns" across the phenomenal landscape of crime emerge when one adopts a different theoretical perspective – namely, when one asks: What is the function of an individual's criminal behavior? and What goal are they trying to achieve by engaging in that behavior? The basic idea is to determine what function committing a crime serves for the individual. As they put it, from this "functional perspective", which has its orgins in evolutionary biology (Durrant and Ward, 2015), "criminal behavior is remarkably like normal behavior and may well have adaptive outcomes for the person concerned, despite being necessarily undesirable from a social/legal perspective" (Ward and Carter, (2019) pp.). Shifting to this perspective, they claim puts the focus on interactions between "core motivational systems" and "contextual variables" in an individual's environment. Moreover, it integrates data from cognitive neuroscience, evolutionary biology, psychopathology, disability research and ethology, to name only a handful of fields.

Ward and Carter's proposal bears some resemblance to a recent initiative instituted by the US National Institute of Mental Health (NIMH), the *Research Domain Criteria Project*

(Cuthbert and Insel, 2013). Proponents of RDoC believe that current categories of mental illness are insufficient for guiding the discovery of causes and that mental disorders are better understood as disruptions in different domains of psychological and behavioral functioning. To this end, the RDoC task forces identified a set of constructs designating psychological and behavioral functions that are intended to facilitate the integration of data from various scientific fields including psychology, systems neuroscience, and neurobiology. The success of RDoC, however, is taken to be contingent on the maintenance of an organizational infrastructure that ensures the collective stabilization of constructs designating psychological and behavior functions so as to facilitate the development of integrative mechanistic explanations (See also Kutschenko, 2011; Ankeny and Leonelli, 2015, 2016; Sullivan 2016, 2017; Tabb, 2017). Thus, we might imagine that the development of a similar interdisciplinary infrastructure will be required if the shift to a functional perspective in criminology is to be successful.

Conclusion

Contemporary criminologists agree that understanding, explaining and preventing crime requires an interdisciplinary approach. As the papers in this special issue indicate, the conceptual, methodological, theoretical and explanatory pluralism that we encounter within and across the scientific fields that comprise contemporary criminology are barriers to understanding and explaining crime. Overcoming these obstacles will require intensive collaborative efforts within and across these different fields to ensure conceptual clarity and methodological and explanatory rigor. The meta-analytic work showcased in this volume is an important first step for facilitating intra- and inter-disciplinary dialogue requisite for progress.

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