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Understanding the concept of 'demand' in policing: a scoping review and resulting implications for demand management

Julian Laufs [a], Kate Bowers [b], Daniel Birks [c,d] and Shane D. Johnson [a]

[a]Dawes Centre for Future Crime, University College London, London, UK; [b]Jill Dando Institute of Security and Crime Science, University College London, London, UK; [c]School of Law, University of Leeds, Leeds, UK; [d]The Alan Turing Institute, British Library, London, UK

ABSTRACT

As literature around policing and society grows, there is increased use of, and focus upon the concept of police 'demand'. The concept itself, however, is ill-defined and no consensus exists about how it should be measured. This paper addresses these issues by undertaking a scoping review of literature on the topic, and by exploring how demand has been conceptualised in both academic and practitioner communities. The review reveals that while key interdependencies between police demand and supply are widely discussed, they are often analysed in isolation. To add to the academic discussion of police demand, the paper introduces a comprehensive conceptualisation including the various forms police demand can take and the different manifestations of drivers for police demand. Subsequently, it outlines several approaches that might be levied to increase the effectiveness and efficiency of demand management approaches. These include the consideration of trade-offs that need to be considered. For example, there is a need to balance any resources allocated to deal with proactive demand reduction and that necessary for (reactive) response. Considering the dynamics of police demand and – by necessity – supply through the lens of complex adaptive systems we propose potential ways forward that capitalise on this framing.

1. Background

The twenty-first century has seen policing agencies become involved in an increasingly diverse range of roles, often while managing relatively restricted resources, leaving them struggling to meet demand (Walley and Adams 2019). Consequently, a key priority for applied policing relates to better understanding and anticipating changes in short-, medium- and long-term demand. Changes to offence rates and types, reduced officer numbers, and structural population changes, are all likely to impact police demand in complex ways.

Illustrating the importance of these issues, a recent UK Home Affairs Committee report (House of Commons 2018) concluded that UK policing is struggling to cope with rises in crime (old and new) and is not fit for purpose, with resources available not matching demand. The authors of that report strongly recommend that police funding be prioritised in the next Comprehensive Spending Review. However, the challenges to policing are not limited to there simply being too few resources. In addition, the understanding of demand varies greatly between forces (HMIC 2014, Walley and Adams 2019) and as noted in the UK Association of Police and Crime Commissioners and National

Police Chiefs Council's Policing Vision 2025 'most forces do not have a thorough evidence-based understanding of demand, which makes it difficult for them to transform services intelligently and demonstrate they are achieving value for money' (National Police Chief's Council 2017, p. 2). Problems the police have to address vary in terms of scale, harm and whether responses are dealt with locally, regionally or require national coordination. Some priority areas for which demand needs to be better understood (and met) include online crime, high harm crimes against the most vulnerable, and serious and organised crime. Additionally, demand is poorly understood for volume crimes, which have – after a period of reduction – been on the rise again (Johnson and Rhodes 2009, HMIC 2014, Brown *et al*. 2018). Furthermore, events such as the 2011 UK riots remind us of the need to plan for major incidents of public disorder that require a national response. As this diverse set of problems suggests, this paper uses a comprehensive and all-inclusive definition of policing. Without diving into a full philosophical or historical discussion of policing, we note that when mentioning the term, we mean all forms of policing, or in Brodeur's words, both high and low policing (Abold 2012), as well as related activities.

It is clear that models of police resourcing are required to allow police agencies to both understand the drivers of demand, and best optimise the allocation of existing resources to minimise threat, risk and harm to communities. Yet, understanding demand is a non-trivial task. An array of factors, both internal and external to police organisations, influence demand. Moreover, these factors are often highly interdependent (meaning that all choices have opportunity costs) and difficult to model using traditional analytical techniques.

This paper constitutes the first part of a larger project to develop computational models of the police supply and demand system, and as such has a two-fold purpose. First, we take stock of current knowledge about police demand and how it can be understood and conceptualised. To do this, we conducted a scoping review of the existing literature, both academic and practitioner-generated, and synthesise the findings of the research identified, discussing how demand has been defined, what types of demand have been identified, and how it has been measured. Using these findings, we employ an iterative approach to develop a definition of police demand as the paper progresses, discussing various elements of the concept. Subsequently, we synthesise the findings of the literature search in the form a conceptual model to better frame different types of police demand and its drivers (Figure 3). The paper is organised as follows. In the next section, we discuss methodological approaches to reviews and the one taken here. We do this, rather than beginning with the usual 'literature review', since our paper *is* a review of the literature. Next, we provide details of our search strategy and approach to synthesis before presenting the findings and implications of the review.

2. Methodological approaches to reviews

One problem with traditional ad-hoc literature reviews (Gough *et al*. 2017) is that they can be based on a limited/biased set of articles known to the reviewer(s), which may or may not reflect the wider literature. Search strategies may be opaque, and the search engines used limited to particular types of publications. As such, two independent reviews conducted at the same time on the same topic may identify a different set of articles and consequently come to different conclusions. A key feature of systematic and scoping reviews is the use of a transparent search strategy that can be replicated by others, which minimises bias in terms of what literature is ultimately synthesised (Laufs *et al*. 2020).

However, while transparent search strategies are mandatory, the specific methodological configurations are down to the individual reviewers. Moreover, reviews can vary in breadth and depth, depending on their aim and the available resources (Gough *et al*. 2017). Where a topic is already well-defined, or the review question is simple (e.g. does intervention X reduce problem Y), reviewers can produce a-priori research protocols that can be rigidly followed during the review process. However, where the research question is more complex, more iterative methods may be required to better frame the question and synthesise the evidence (Greenhalgh *et al*. 2004, 2005).

In such cases, the strict adherence to a pre-defined (static) protocol may not be the most useful or appropriate strategy. Instead, the protocol may need revision throughout the process.

Though some may criticise iterative or branching approaches as lacking in methodological rigour, they simply follow the fundamental notion that different research questions require different methods and that this applies to reviews as well as other research methodologies (Gough *et al*. 2017). Like most reviews, such reviews still seek to aggregate or 'add up' findings from multiple studies and to configure or 'organise' findings from the literature to provide a better understanding (Sandelowski *et al*. 2007, 2012, Voils *et al*. 2008). Like such reviews, we here take a systematic question-driven approach that employs more iterative review and literature search methods that closely reflect the original problem-driven research questions (Patterson *et al*. 2003, Pope *et al*. 2007, Sandelowski *et al*. 2007).

3. The current review

Here, we report the findings of a scoping review (Arksey and O'Malley 2005) of research on police demand. The aim of such studies is to map out the available research to identify the types of evidence available, to identify key concepts, to summarise the various ways in which research is conducted on a particular topic, and to identify key knowledge gaps (Munn *et al*. 2018).

Our review aimed to address three core issues. Firstly, to explore how 'policing demand' is defined and used in the literature, and in what context it is usually framed. This included exploring synonyms and terminology surrounding the field of police demand, both in an academic and policing context. It also meant examining different conceptualisations of policing demand in terms of their focus (e.g. on internal or external demands) and their operationalisation (e.g. how they are measured).

Secondly, we sought to identify relevant case studies or operational foci within the literature (e.g. public order policing or police decision making) to act as illustrations. This included surveying both academic and non-academic publications and clustering publications thematically.

Finally, the review aimed to provide an overview of what the most commonly used data sources in the literature on police demand are (e.g. calls for service data) and where literature on police demand and its management can predominantly be found. This element is useful in assessing the current state-of-the-art and identifying gaps in evidence and understanding what needs attention.

To address these questions, we employed a systematic search process that was conducted in three steps. The literature search was carried out by adhering to strict methodological standards in order to map out the nature of the research field (Arksey and O'Malley 2005) and to create a better understanding of police demand (Abrami *et al*. 2010, Thomas *et al*. 2013). The search was conducted in three distinct steps to ensure the relevancy of the included items and to give the authors an opportunity to reflect on the search process as a whole and adapt where necessary. After the search terms were refined (step 1), exploratory searches were used to identify publications central to the academic debate (step 2). Next, backward searches (i.e. searches for studies cited in the articles already identified) and forward searches (i.e. identifying literature that cites the corpus of already identified articles) were carried out to produce a list of relevant publications (step 3). We specify this approach more formally in the Method section below.

4. Method

4.1. Step 1: scoping searches and search terms

In the first step, preliminary searches were carried out to identify relevant search terms and to clarify any terminological discrepancies within the literature (e.g. different terms used synonymously). These search terms were generated through an initial ad-hoc review of the literature and through consultation with experts in the field who provided insights into possible data sources, research, and terminology. Three categories of search terms were used, namely:

(1) terms related to (addressing) 'demand', including 'resourc*', 'efficiency', 'tasking', and 'decision making';
(2) modifiers such as 'polic*', 'reduction', 'optimisation', 'management', and 'emergency'; and
(3) other terms related to more practical considerations for modelling police demand such as 'simulation models', 'decision making', and 'response time'.

To include variants of words with the same word stem, wildcards were used (e.g. resourc* would identify terms such as resourcing, resource and resources). The wildcard 'polic*' was ultimately not used as it returned an abundance of results related to policy.

4.2. Step 2: exploratory searches

After the list of search terms was compiled, structured literature searches were carried out using three different databases (Google Scholar, Scopus, Web of Science). The initial searches returned over 6000 results. Consequently, the search criteria were refined to increase the rate at which relevant articles were identified, e.g. results related to 'policing of hygiene regulations' and other unsuitable matches were filtered out. Figure 1 provides an overview of the steps in the search process and the number of articles identified or excluded at each stage. These stages will now be discussed. The database searches returned between 100 (Google Scholar) and 344 (Scopus) results depending on the search engine and search configurations used (not all search engines enable use of the same Boolean operators and as such the same string searches could not always be applied).

Titles and abstracts were then screened against a set of pre-defined selection criteria. Studies that were included in this stage were then re-screened based on their full text. The selection criteria for both stages included:

- Articles must have had thematic relevance, i.e. must directly or indirectly have dealt with demand management.
- Outputs had to have a focus on policing or police management.[1]
- Outputs that focused on management or resource allocation in non-specific public service organisations were considered on a case-by-case basis, depending on whether they had relevance with regards to the previous criteria (i.e. those with relevance to policing or emergency services were selected).

Applying these criteria, we identified 34 articles that directly addressed and more importantly, explicitly mentioned police demand. This was a rather small number of search results which on inspection appeared to be due to the inconsistent language used in the literature and the broad and diverse range of studies that address issues of police demand.

To supplement the above search, relevant policing journals were hand searched for the period 2009 until 2019. These journals were *Policing and Society*, *Policing: An International Journal, Policing: A Journal of Policy and Practice, and the International Journal of Police Science and Management.* These searches yielded the following results:

- Policing and Society: 3 additional studies
- Policing: An International Journal: 7 additional studies
- Policing: A Journal of Policy and Practice: 3 additional studies
- International Journal of Police Science and Management: 0 additional studies

As discussed, our inclusion criteria were not limited to academic research. This was partly because we wanted to include applied research and the discussion of police demand in real world settings. And, partly because we wanted to circumvent the pitfall of publication selection bias. For this reason, grey literature was included in the review (for an in-depth discussion on the importance of
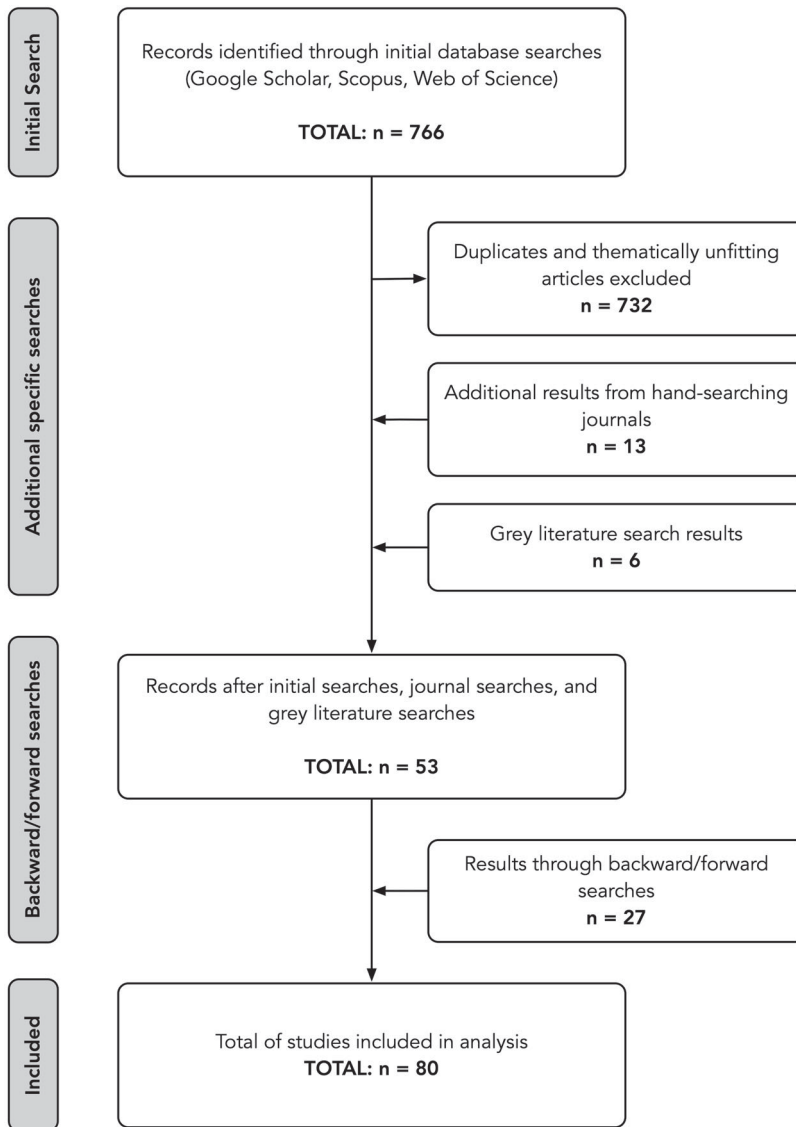
Figure 1. Search and filtering stages of the review.

grey literature see Wilson 2009, Mlinarić *et al*. 2017). Searches of the grey literature were carried out using three different databases (British Library EThOS; Open Grey) and three institutional websites (Home Office, NPCC, Metropolitan Police). These searches yielded an additional 6 results bringing the total to 53.

4.3. Step 3: selecting studies and backward/forward searches

After an initial set of key studies was identified, backward and forward searches were carried out to find further relevant literature (Hinde and Spackman 2015). This snowballing approach (commonly used in systematic reviews) did not only yield additional results but was also useful because it indicated which conceptualisations of police demand were more or less successful in terms of citations in the literature over time (Jalali and Wohlin 2012, Hinde and Spackman 2015). The articles identified through these searches were screened using the same selection criteria discussed above.
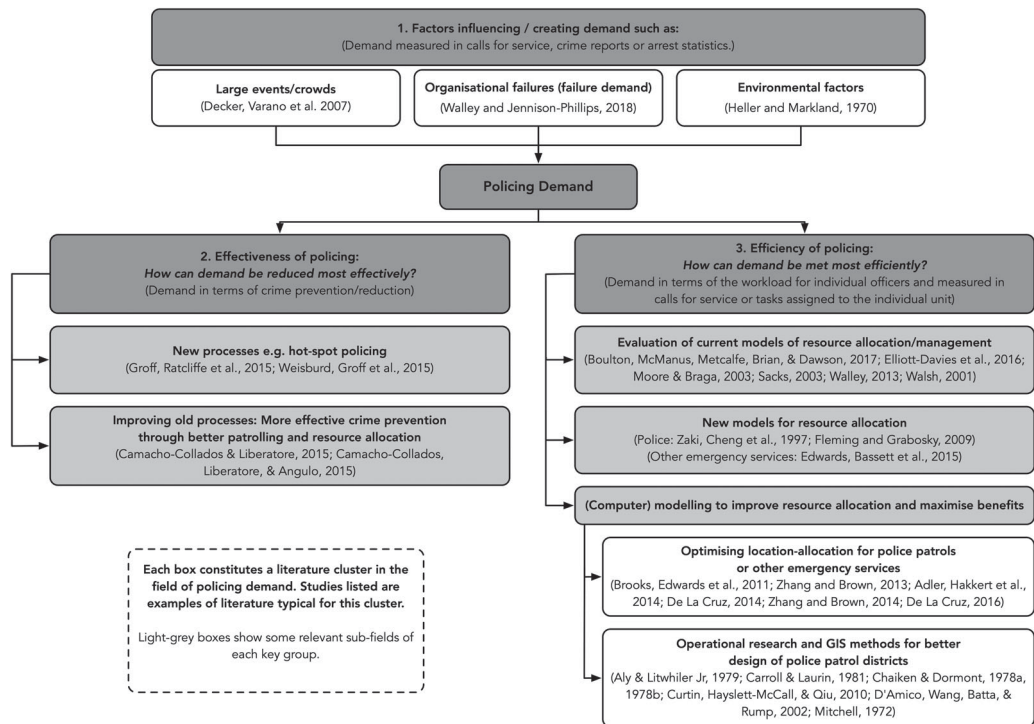
Figure 2. Clusters and themes in the literature surrounding police demand.

Of the 100 articles initially identified in this way, after careful scanning of the titles, abstracts, and finally full papers, a further 27 were included, bringing the total to 80 sources (see Figure 1). While these articles may not have explicitly mentioned the term demand, they nevertheless addressed it in one form or another.

The results can be clustered around several broader themes that emerged from the literature (see Figure 2). The first theme focuses on what policing demand is and how it comes to be. The second includes literature that discusses demands in terms of effectiveness (i.e. in terms of crime reduction). Lastly, the third theme includes those studies that have examined police demand in terms of efficiency, which includes internal processes of the organisation as well as the workload for individuals or units (Wilson and Weiss 2014). The following sections of this paper follow these themes and discuss them in more detail. Each of the sections further serve to introduce an element of our conceptualisation of police demand (see Figure 3).

As such, we will first discuss how demand has been portrayed and measured in the policing literature. Next, we examine what drivers of demand have been identified in the policing literature and between which different types of demand we can distinguish. Lastly, we discuss ways to improve the measurement and management of demand and provide some suggestions for further research in the field.

5. Results: understanding demand

5.1. 'Demand' in the literature

Though the term 'demand' is often used in the literature in relation to crime prevention and policing, no universal definition exists. Instead, 'demand' in terms of policing has been defined in a number of different ways, often dependent on the focus of the research (Davies and Bowers 2019). It is therefore
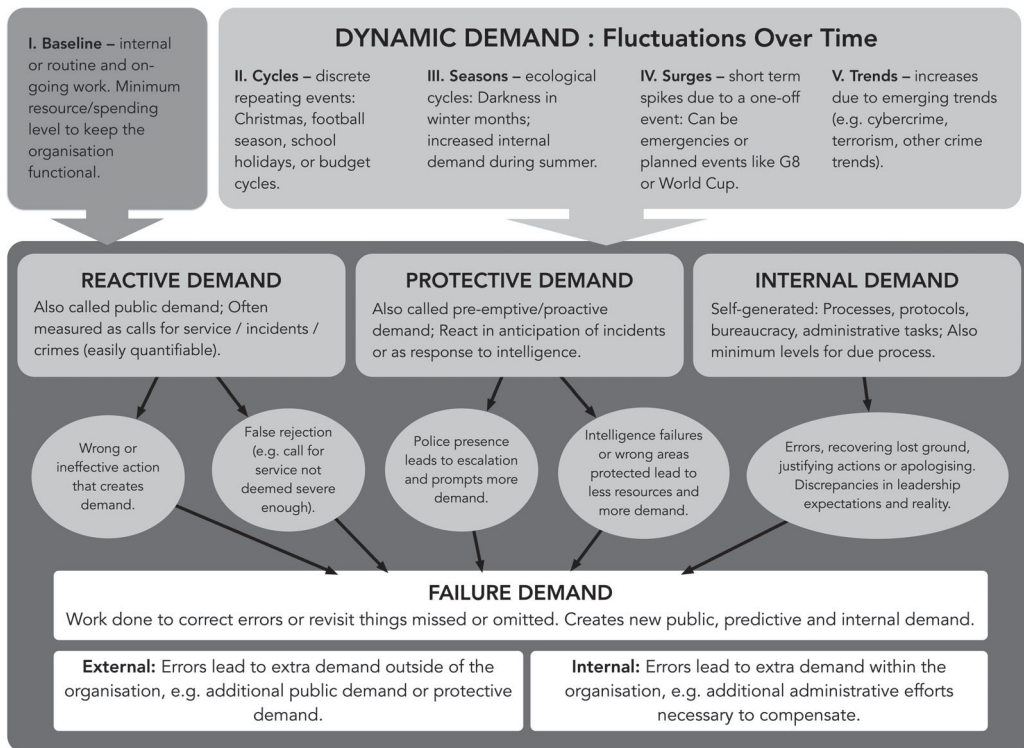
Figure 3. Visualisation of police demand and its drivers.

crucial to discuss what 'demand' is taken to mean in the context of policing and crime reduction before diving into a deeper discussion of more advanced concepts and models. In the following, we iteratively explore different sides of demand in order to construct a more comprehensive understanding of the term.

Much of the literature on police demand stresses its complexity and emphasises the diverse factors impacting the drivers of the system and our understanding of it (Boulton *et al.* 2017, National Police Chief's Council 2017, Walley and Jennison-Phillips 2018). This, however, stands in stark contrast to the practice of measurement in many (academic) publications. Here, authors frequently equate demand with calls for service, i.e. those instances where police were actively called to the scene of a crime or a disturbance. Out of the 53 studies we identified that explicitly mentioned and dealt with police demand, 24 used calls for service as their (de-facto) sole measure for demand (see Table 1 below). While clearly suboptimal in terms of understanding the multifaceted nature of police demand, this approach is understandable given that calls-for-service are one of the most conspicuous drivers of demand and often the focus of performance measures imposed by external parties such as government, and in the UK police crime commissioners and HMICFRS. Moreover, using calls-for-service as a direct measurement is considerably more reliable than many other dimensions of demand for which reliable data may not exist and may be hard to obtain without significant organisational change.

More recent studies criticise this simplification and suggest that a more nuanced approach to measuring demand is needed (Taylor Griffiths *et al.* 2015), since responding to calls for service (reactive policing) is only a small part of police officers' tasks. Suggestions include defining demand as the need for police presence due to both crime *and* non-crime related activities and also for the purpose of prevention *or* deterrence as well as 'self-generated' demand arising from administrative processes and errors (Maxfield 1982, Elliott-Davies *et al.* 2016). To measure these, researchers have suggested

Table 1. Studies distinguished by the demand measure and data sources used.

Author/year	Demand measure	Additional information
Adler *et al.* (2014)	Calls for service	
Boulton *et al.* (2017)	Calls for service	
Brooks *et al.* (2011)	Calls for service	
Camacho-Collados and Liberatore (2015)	Crime Risk	Past crime data / interviews with service coordinators and agents involved in public safety operations to identify characteristics of 'good' patrol sector partition
Camacho-Collados *et al.* (2015)	Crime Risk	Case study of the Central District of Madrid, using past crime data (105,755 incident reports)
Curtin *et al.* (2010)	Calls for service	
D'Amico *et al.* (2002)	Calls for service	
De La Cruz (2016)	Calls for service	
Decker *et al.* (2007)	Calls for service / official crime reports/ police arrests	
Elliott-Davies *et al.* (2016)	Workload for individual officers	Semi-structured focus groups
Fleming and Grabosky (2009)	Calls for service	
Greasley and Smith (2017)	Calls for service	
Green (1984)	Calls for service /service time required	
Groff *et al.* (2015)	Calls for service / Crime prevention	
Heller and Markland (1970)	Calls for service	
Heslin *et al.* (2017)	Cost (also attendance of officers), time, resources	Police Neighbourhood Harm Reduction Register (NHRR) and the National Strategy for Police Information Systems (NSPIS) Custody system (to measure police involvement) + RiO electronic patient record system within the local mental care trust (to measure mental health issues)
Johnson and Rhodes (2009)	Calls for service	
Kane *et al.* (2018b)	Use of human and financial resources	Systematic literature review to answer questions about effectiveness of police-mental health service models for responding to people with mental disorder and suspected offending or public safety problems.
Maxfield (1982)	Calls for service	
Mazerolle *et al.* (2002)	Calls for service / Public expectations	
Moore and Braga (2003)	Calls for service / Crime prevention	
Sacks (2003)	Calls for service / Crime prevention	
Sarac *et al.* (1999)	Calls for service	
Taylor and Huxley (1989)	Calls for service	
Taylor Griffiths *et al.* (2015)	Calls for service	
Walley (2013)	Calls for service	
Walley and Jennison-Phillips (2018)	Need for policing and service (including failure demand)	Sample of non-urgent incidents as recorded by the police (recorded calls, emails, linked incident logs, crime logs) that occurred during the first two weeks of February 2017
Weisburd *et al.* (2015)	Crime reduction	Experimental study with a block-randomised design, analysing 232 police beats
Wilson and Weiss (2014)	Workload for individual officers	Systematic literature review
Zaki *et al.* (1997)	Calls for service	
Zhang and Brown (2013)	Calls for service	
Zhang and Brown (2014)	Calls for service	

that we might look at, for example, calculating patrol time or tasks assigned to the individual officer (see e.g. Taylor Griffiths *et al.* 2015), or the overall workload of the individual (Elliott-Davies *et al.* 2016).

We follow this notion and on the very basic level consider police demand as actions expected of the police with the goal of maintaining safety and public order. However, while this may help to understand what is meant by demand, a parsimonious and simplistic definition like this does not do the highly complex concept justice.

To illustrate the discrepancy between the complexity of demand and the diverse range of factors that influence it on the one hand, and the practical measures used in the literature to quantify it on the other, Figure 3 shows a conceptual model that emerged from our synthesis of the findings of the literature review. The different elements of the model are introduced and elaborated in subsequent sections of the paper, but it is presented at this stage of the paper to illustrate the above discrepancy early on. The figure is intended to serve as a visual aid to elaborate the connections between drivers and different types of demand. In many ways, this draws on the National Police Chiefs' Council's 2017 report entitled 'Better Understanding Demand – Policing the Future' (NPCC Performance Management Coordination Committee 2017, Walley and Adams 2019), but it includes additional notions about how demand should be understood that were identified through our analysis of the literature.

5.2. Drivers of demand

A key body of literature identified in our systematic search was focused on the drivers of police demand, also depicted in Figure 2. When looking at its drivers, the complexity of modelling or even describing 'demand' in terms of policing becomes especially clear. The most important consideration here is that demand is by no means a static measure and is influenced by a variety of diverse factors. Like the NPCC (2017) report, in our review we identified five different categories of factors that drive fluctuations in the demand for police service.

The first and most important driver of demand is the so-called *baseline*. The baseline describes the routine, steady level of police demand (i.e. staff and resources) that is always required to maintain day-to-day operations in response to everyday crime and policing issues (NPCC Performance Management Coordination Committee 2017). For the purpose of exploring the topic of demand, it is not important (or the aim of this review) to ask why police are needed on a day-to-day basis. Thus, we avoid a discussion of how crimes come to be, and of the various roles that police can take in a society, and only consider this baseline in terms of demand. Opting for this parsimonious approach means that we just consider there to be a steady need for a quantity of police to maintain – the operational status quo and – order within society absent any major external influences. As such, baseline demand contains the natural variation that police forces must adapt to. These are variations that are not explained by a specific driver but are merely minor random fluctuations in demand. Regardless of these (stochastic) variations, however, it is possible to estimate a baseline as police forces consider possible variations and plan with contingency resources.

While this baseline is certainly the most intensive driver of policing demand, it is highly complex and hard to measure (Walley and Jennison-Phillips 2018, Walley and Adams 2019). While it is possible to simply ask police forces what minimum level of resource they require at a given point in time to remain operational, the answer will be highly dependent on the local context and thus it seems unlikely that – for any exercise that seeks to estimate demand for more than one locality – a general formula exists to easily determine this (Johnson and Rhodes 2009, Boulton *et al.* 2017).

As a result, most studies focus on particular aspects of baseline demand, such as how much time officers spend on individual tasks (Caputo *et al.* 2018), the organisational cultures and their effect on patrol practices (Hassell 2006), or how crime-to-cop ratios affect patrol officer productivity (Bonkiewicz 2016). In addition to these rather niche studies on the issue, a substantial body of literature exists that explores how patrol routes and beat areas should be designed in the first place (see amongst others Carroll and Laurin 1981, Green 1984, Adler *et al.* 2014, Camacho-Collados and Liberatore 2015, Araujo *et al.* 2017). However, neither the former, nor the latter consider the bigger picture

of baseline demand. This is highly heterogenous in nature and, as will be discussed in more detail below, includes reactive, protective and internal drivers – and is as such much broader than the findings of many studies might suggest.

The second important type of driver of fluctuations in police demand are those that are periodic and have an identifiable rhythm, often referred to as *cyclical* factors. These include responses to calendar (or other discrete) events that occur on a regular cycle such as Christmas, Halloween or the festival of Diwali (Cohn and Rotton 2003, McDowall *et al.* 2012). The political nature of large-scale cultural events such as pride parades or carnivals often create a need for increased protective policing in the form of public order policing, and community engagement, and can generate organisational demand in terms of marketing and internal communication (Pickles 2019). The impact each of these events have on police demand are once again highly dependent on context, and their impact may not be limited to discrete spikes in demand.

Another type of periodicity – sometimes discussed interchangeably with discrete events – are *seasons of the year* (Field 1992, McDowall *et al.* 2012). While cycles are associated with discrete dates, the scheduling of which involves human agency, seasons are determined by ecological cycles (or their consequences) such as darkness in winter months, or the increased (relative) organisational demand that occurs during summer months when most police staff traditionally take leave (McDowall *et al.* 2012, National Police Chief's Council 2017). The literature for both categories is marked by studies which attempt to explain crime (and policing) spikes that occur at certain times of the year (see e.g. McDowall *et al.* 2012) and the impact of environmental factors – such as weather or time of day – on crime and policing (Heller and Markland 1970, Bernasco *et al.* 2017, van Sleeuwen *et al.* 2018). While many of these studies make valid contributions to the discussion of police demand, they often focus solely on reactive demand rather than examining the whole picture.

A further type of driver is the response to surges in vulnerability and crime due to unexpected, or *one off incidents* (NPCC Performance Management Coordination Committee 2017). Examples include the marginalisation of certain groups after terrorist attacks (Githens-Mazer and Lambert 2010, Perry 2014) which can lead to increased societal rifts, larger social problems, and politically motivated crime. Other studies look at the impact of natural disasters, such as floods, climate change, or epidemics (Heller and Markland 1970, Agnew 2017, Zahnow *et al.* 2017), or large, one-off events such as the hosting of a large sporting event (Decker *et al.* 2007, Donaldson and Ferreira 2007).

The penultimate driver of demand identified in the literature refers to (localised) *emerging trends*, which can lead to fluctuations in demand over a period of time. These trends usually describe new types or forms of crime, or non-crime problem, that were previously unseen (at least in the local context) but that suddenly take up disproportionate amounts of resources because the police are not equipped, or trained, to deal with them, or no strategies or specialists are available to address the problem appropriately (Rosenfeld *et al.* 2007, Ransley and Mazerolle 2009). How crucial specialised resources can be is explored by McMillan (2015) who discusses the need for specialised officers in rape or sexual offence cases. McMillan's (2015) work is an excellent example of how trending demand is created because it highlights not only the need for resource specialisation in effective victim support but also for processing time and procedural justice. Other examples of 'trending' problems include serious and complex crimes such as cybercrime (Sarre *et al.* 2018) or drug offences (Rothberg and Stith 2018, Goodison *et al.* 2019) but also relatively less serious issues such as the theft of scooters (Brown 2017).

In addition to exogenous factors, budget and performance evaluation cycles are important too. Not only do they impact the internal demand of the organisation but they can have concrete effects on policing operations and enforcement (Guillamón *et al.* 2013, Bracco 2018). The latter is often the case when performance targets or political agendas skew the focus of day-to-day operations, creating new tasks and additional targets to fulfil. Also of relevance is the study by Collier (2006), which explores the role of activity-based costing and the politicisation of police budgets.

Collier (2006) finds that the latter can significantly impact the demands that police are subjected to and the available resources they have to respond.

Having synthesised our findings from the policing literature, we note that there exists a considerable body of literature that examines the drivers of demand in other fields, such as ambulance services and private sector institutions from which we might learn. However, it is important to recall that this paper focuses on and involved the systematic search of the literature pertaining to policing, which presents unique challenges and is hard to equate to other fields. In synthesising this literature, our findings reflect shortcomings in it, and we acknowledge that the divide between our understanding of the drivers of demand in policing and in other fields highlights the need for an increased focus on the operational realities of policing and an exploration of the utility of concepts and approaches from other sectors.

5.3. Types of demand: public, protective, organisational

As mentioned above, calls for service represent only a fraction of actual police demand. As such, another important component of our conceptualisation of police demand is the distinction between different types. Following the literature, we distinguish between three types of demand in policing: Reactive (or public) demand, protective (or preventative) demand, and organisational demand (De La Cruz 2014, Walley and Jennison-Phillips 2018). In what follows, these three distinct types of demand will be defined, and the different ways that have been suggested to measure or quantify them reviewed and critiqued. In addition, the specific example of public order policing will be used as a case study to better illustrate how different types of demand interplay in a single scenario. In the UK, public order policing represents the 'policing of planned and spontaneous public events (such as protest and football) and the policing of any events or trigger incidents which result in, or may result in, public disorder' (College of Policing 2019). This is a particularly useful example to consider because the types of events that generate this kind of demand are (generally) limited in time and space and so considering them allows us to distinguish between types of demand while only considering one driver (see previous section). Additionally, we acknowledge that modern policing is far from the anachronistic crime fighting model of policing propagated in the Home Office's (1995) Review of Police Core and Ancillary Tasks. Instead, police have to respond to a variety of crime and non-crime problems which will be addressed in the following accordingly.

The first type of demand, commonly referred to in the literature as reactive or public demand, is demand for the police to respond to crimes or incidents that have been reported to them (NPCC Performance Management Coordination Committee 2017, Walley and Adams 2019). As such, it is often measured in terms of calls for service and is portrayed as activity that is focussed on fighting crime, i.e. traditional reactive policing (Boulton et al. 2017). In terms of public order policing, reactive demand would include the resources needed to respond to a deteriorating situation, such as a spontaneous riot, or an unexpected incident at a large event, such as a clash between rival football clubs. These resources can include both personnel and equipment deployed to tackle the incident and diffuse the situation.

In recent years, the use of calls for service as a proxy to measure reactive demand has been heavily criticised for a number of reasons (Taylor Griffiths et al. 2015). Firstly, authors such as Hill and Paynich (2013) and Johnson and Rhodes (2009) argue that calls for service should not be thought of as a measure for crime as the majority of police calls (between 80% and 90%) are not related to crime prevention or control, but rather concern dispute resolution, calls for assistance, or noncriminal behaviour complaints. Secondly, it has been noted that calls for service are not the only way that the police can come to know about incidents (Ballesteros et al. 2012). For example, members of the public may report incidents in person, or through smartphone apps, or the police may uncover incidents through online intelligence or in response to incidents encountered (Desmond et al. 2016, Welsh and Roy 2017, Mongia et al. 2018). Despite the increasing criticism of the use of

calls for service data, and arguments for the use of more comprehensive and differentiated measures for demand (Taylor Griffiths *et al*. 2015), as will be shown below, there is little evidence of the use of alternative measures in the literature to date.

In summary, calls for service are an imperfect measure of public demand and do not capture all police activity that occurs in response to an incident or public requests for police service (NPCC Performance Management Coordination Committee 2017). However, these data are the most commonly used in empirical studies.

The second type of demand, protective demand, includes the other side of police work. Namely, all types of preventative or proactive work where the police act in anticipation of an incident to prevent it from happening or, better still, to root out any underlying causes, with the latter often carried out in coordination with other (social) services and as part of a larger social or security policy (Weisburd *et al*. 2015). This includes, for example, patrolling hot-spot areas proactively, or measures of deterrence such as increased presence in airports or train stations. It also includes education programmes in schools, and youth and community work (Gottfredson *et al*. 2002, Crawford and Evans 2017). In terms of our public order policing example, protective demand would include preparations made to reduce risk at events such as a royal wedding, or officers deployed to different camps of protesters in the streets. The size and type of the deployment will vary, but in such cases, the logistics of providing cover are organised in advance with the purpose of preventing public safety incidents.

Thus, the most important distinction between these first two types of demand is that while reactive demand is in response to incidents, protective demand is in anticipation of them (NPCC Performance Management Coordination Committee 2017). Protective demand is rather neglected in the academic literature and a likely reason for this is that it is difficult to measure. While outcome measures – collected to estimate the success of preventative programmes (see e.g. Sherman *et al*. 2002, Guerette and Bowers 2009) – and studies about the time spent on preventative tasks like neighbourhood policing (see e.g. Koper 1995, HMIC 2012, Weisburd *et al*. 2015) have long existed, they rarely deliver objective measures that quantify the resources expended during preventative action. Examples of costing exercises include the 'Value for Money Profiles' of police forces which are published annually by HMICFRS (2020). Such profiles may lay a foundation for more efficient work as reports stress again and again that police tasks should be costed and delivered in a cost-efficient manner, and outsourced to external agencies, if necessary (Home Office 1995, HMIC 2014, HMICFRS 2019).

The third form of demand, organisational demand, refers to what might be described as self-generated demand created by processes, protocols, administrative tasks and bureaucracy. While reactive or protective demand are aimed at reducing crime or improving security, organisational demand involves the use of resources to guarantee due process and to keep the organisation operational (Walley and Jennison-Phillips 2018). Organisational demand in terms of public order policing would include, for example, administrative processes to register officers working hours and coordinate them with other work schedules, payroll structures to ensure salary pay-out, but also individual officer's time spent on writing reports about crime incidents, briefings or evaluations (Webster 1970, Parks *et al*. 1999, Weisburd *et al*. 2015, Boulton *et al*. 2017).

It would also include issues of communication and leadership. Harrison and Adlard (2018), for example, discuss the importance of effective intra-police communication and leadership in public order policing to avoid the generation of 'additional disorder' (the topic of failure demand is discussed below). While one might argue that classifying report-writing and other administrative tasks directly related to reactive incidents are part of reactive demand, we suggest that these tasks are more usefully conceptualised as being distinct as this provides a better understanding of what impacts upon officer time. As an illustration, consider that administrative requirements can and do change over time. While this can affect the time required to engage in administrative activities, it need not directly impact upon on the time officers spend on patrol or responding to incidents. As such, along with the authors of the papers we reviewed, we believe it is important to maintain this distinction.

Especially in times of austerity, many attempts have been made to improve the management of organisational demand. These have included the application of management or business principles to police management or by streamlining bureaucracy (Adams *et al.* 2009, Walley and Jennison-Phillips 2018). In addition, many official reviews of police practices include suggestions on how to cut costs in the organisational realm of policing by using less experienced officers or even outsourcing organisational and administrative tasks (Home Office 1995, Walker 1996, HMIC 2014, HMICFRS 2019). However, even though organisational demand may take up a significant amount of resources, and interventions have been implemented to reduce it, it often receives less attention than other forms of demand (NPCC Performance Management Coordination Committee 2017). One of the most successful attempts at quantifying organisational demand was undertaken by Greene and Pakes (2012), who measured the cost of missing persons investigations, and estimated the exact time and monetised costs for these types of investigations. According to their survey, the lowest estimated cost for such investigations – involving neither repeated actions nor surprises – was about £1,325.44, whereas an average investigation cost about £2,415.80. For reference, this makes such investigations about three times more costly than robbery investigations and four times more than burglary investigations (Greene and Pakes 2012). Put differently, for a one-year period, the resources required to police missing persons in the UK equates to about 19,188 police officers working full time, or 14% of the total number of officers across the country (Greene and Pakes 2012).

While such studies suggest that administrative demand varies by crime type, Malm *et al.* (2005) find that over the past 30 years, incidents have generally required increasing amounts of administrative resources to police them. These developments are attributed to increasing amounts of paperwork needed for court decisions, slowly eroding police capacities (Malm *et al.* 2005) as well as the changing role of the police driven by an expanding risk infrastructure and public and media expectations (Ericson and Haggerty 1997, Ericson 2007). What these numbers show is that changes to organisational demand can have potentially significant effects in terms of national resources.

5.4. Failure demand and service quality

A similarly complex facet of demand in policing is what happens if demand is not adequately addressed, if no action is taken at all, the action taken is incorrect, or communication processes fail (National Police Chief's Council 2017, Walley and Jennison-Phillips 2018). Because the original problem is not solved, additional demand is created, the solution to which is often more labour and resources (Walley and Jennison-Phillips 2018). Referred to as *failure demand*, a concept that emerged from systems thinking (of which organisational processes are an example) in the service lean management literature (Seddon and Brand 2008, Seddon *et al.* 2011), this is an important element of demand, but it is the least recognised and under-researched aspect of it (National Police Chief's Council 2017, Walley and Jennison-Phillips 2018). Regardless of the source of failure demand, however, authors such as Seddon (2008), (Seddon and Brand) or Boland and Fowler (2000) emphasise the fact that failure demand is a systemic problem and as such requires a systems perspective to understand and reduce it. Seddon and Brand (2008: 9) suggest that 'failure demand is a product of a system and it cannot be eradicated without changing the system'. Taking such a systems perspective provides new insights into structural flaws and highlights that many existing policing practices go against fundamental principles of good systems design.

In order to distinguish between administrative inefficiencies, inefficient organisational setup, and operational errors, we categorise failure demand as either internal (or administrative) or external (or operational) failure demand. Internal failure demand describes failures that originate from within the organisation. These can cover a broad range of issues from accounting errors and inefficiencies in the organisational setup, to mismatches between leadership expectations and reality and drops in productivity as a result of reforms and innovation projects (Haake *et al.* 2017). As no organisation is perfect, internal failure demand may, in many ways, be the most stable and predictable form of demand. However, despite its predictability, it has the potential to waste enormous amounts of

resource (Seddon 2008, Seddon and Brand 2008, Walley and Jennison-Phillips 2018). Ericson (2007) suggests that police officers spend almost half their time on 'accounting for their actions' and that accountability and procedure govern how officers 'think and act'. Because internal failure demand is largely limited (but not exclusive) to administrative processes and organisational issues, some models of police demand consider failure demand to be a sub-category of organisational demand (see e.g. National Police Chiefs' Council (2017). As discussed, internal failure demand can occur if processes fail or grave errors happen within an administration (Seddon 2008). However, it can also occur if the resources spent completing a task exceed those required. This can happen, for example, as a consequence of overly bureaucratic processes (e.g. when three forms are needed when one would suffice), a fact that is often overlooked (Shane 2010a, 2010b).

The other side of failure demand is external failure demand. This is easily illustrated with respect to calls for service. If a call for service is deemed not critical and is not responded to, the original problem may escalate, meaning that more resources will be required to deal with it compared to if it had been addressed in the first instance (Stafford 2016). A similar scenario occurs if the initial call for service is answered but the officers responding provide an inadequate response by, for example, dismissing the caller or wrongly addressing the situation (Boulton et al. 2017). This form of failure demand can often be traced back to a lack of training –for example, in the engagement with minority communities – or an already existing level of distrust between the community and the police (see e.g. Hera 2017, Bullock and Johnson 2018, Pickles 2019).

In the context of public order policing, failure demand occurs (for example) where competing perceptions of risk amongst cooperating police services can lead to unintended public order policing outcomes (Whelan and Molnar 2019). In such cases, failure demand may be addressed through organisational change and the more efficient management of police services (Whelan and Molnar 2019). For example, ineffective public order policing operations (e.g. riots or protests have been staged in response to an initial police response) have led to failure demand, which in turn has led to significant shifts in the use of risk management strategies within the police and the use of 'hard' and 'soft' tactics (Decker et al. 2007, Fernandez 2008, Gorringe and Rosie 2008, 2013).

As crime is only one element of policing (Collier 2006), external failure demand can, also be the result of police officers' involvement in non-crime problems. Here, the lines between failures of the police and other social agencies become especially blurred. In many instances, there is thus a shared responsibility for the created failure demand. An example of this is in response to mental health cases, which have – for a variety of reasons – have increasingly become a driver of police calls for service (Patel et al. 2016, Thomas and Forrester-Jones 2018). For example, the number of people detained by the police in the UK for compulsory treatment under the provisions of the Mental Health Act 1983 (i.e. mental health cases handled by the police) has increased from 40,000 in 2003/04 to over 63,000 in 2015/16 (Thomas and Forrester-Jones 2018). As such, the police are increasingly becoming the 'last resort' and a 'de-facto 24 h social service' (Steadman et al. 1995, Lamb et al. 2002, Patel et al. 2016).

Kane et al. (2018a) examined mental health cases handled by the police. They found that, relative to those without mental health issues, those with them were just as likely to be arrested, but they were more likely to be charged with criminal offences, and less likely to receive a caution. In addition, incidents involving mental health patients often resulted in longer periods of police custody than similar incidents for which there were no mental health issues recorded (Kane et al. 2018a).

Though the longer time spent in custody may be explained by (for example) delays in seeing a mental health professional, or the extra time needed for an individual to stabilise before their release, this still represents a form of failure demand. This is because mental health interventions in police custody are (or should be) a last resort rather than the de facto response.

Whilst more research is needed on the nexus of mental health interventions and police demand, it is clear that the cycle of arrest, charge, conviction, prison, release and re-arrest is neither the most ethical, nor the most effective or efficient model (Kane et al. 2018b).

In some cases, this type of failure demand[2] is created because officers who have to deal with mental health patients are not properly trained and consequently cases have to be revisited later (Heslin *et al.* 2017, Kane *et al.* 2018b). However, it is more often the case that the appropriate service providers (Thomas and Forrester-Jones 2018) had failed to taken action at earlier points in time or, at the time of the arrest, were unavailable, once again highlighting the issue of failure demand for police created by the lack of other social services (Steadman *et al.* 2000, Mclean and Marshall 2010). This often leads to police officers having to search for safe places to accommodate mental health patients. This can mean that patients do not receive the appropriate (and much needed) care, and also generates a significant drain on police resources (Steadman *et al.* 2000). Heslin *et al.* (2017) map and discuss the cost this new 'patient pathway' incurs for police services. Along with most other studies in the field (Hails and Borum 2003, Heslin *et al.* 2017), they conclude that this shift towards the use of the police in this context has negative consequences on all fronts.

In terms of failure demand, this shows that in many instances not only are the police ill-equipped to respond to such cases, but that the absence of adequate mental health services causes further failure demand and an additional strain on police resources. The (mis-) handling of mental health cases by the police is thus not only a form of failure demand in itself, but because of the lack of adequate support services and training, it creates more demand across the board.

6. Improving the measurement and management of demand

In the previous section we discussed the various forms police demand can take and the different manifestations of drivers for police demand, as identified through our systematic search. We now outline several approaches identified during the review that might help to increase the effectiveness of demand management approaches, we reflect on gaps in understanding, and consider potential ways forward. As with previous sections, what follows is synthesis of what emerged from the review, rather than reflecting the authors own views. The literature that dealt with refining or improving police demand management fell into two categories: research which discussed the more comprehensive measurement of demand in the first place and research that made suggestions regarding the efficient and effective management of demand. Here, we summarise the research on these two elements in turn.

6.1. Prioritising using alternative measures: harm and public perception

A known issue with relying on crime incidents, or calls for service, when planning police deployment is that doing so assumes that all crimes are equally harmful and take the same amount of time to deal with (Sherman *et al.* 2016). This makes, for example, the identification of crime hotspots using count data alone a crude measure of need (Sherman 2013). As a result, a number of researchers advocate the use of crime-harm measures in the identification of areas requiring police resources (Greenfield and Paoli 2013, Ignatans and Pease 2015, Ratcliffe 2015, Sherman *et al.* 2016, Sullivan and Su-Wuen 2016, Weinborn *et al.* 2017). Crime harm indices weight crime types so that areas afflicted with those deemed more serious (e.g. assault, sexual offences, murder) are prioritised over those perceived as less serious (which often happen in higher volumes). For example, the Cambridge harm index (CHI) weights crimes using the number of days a person would receive in prison if they were convicted of that offence (Sherman *et al.* 2016). Harm-based approaches have implications for the quantification of policing demand. That is, crimes with a higher level of seriousness may be assumed to require more resource in terms of reactive demand and organisational demand. We note, however, that while this may serve as a general rule, there are a number of exceptions. For example, consider cybercrimes, for which even relatively low-harm offences could require tremendous amounts of specialised resources to deal with them.

It is also important not to underestimate the degree to which the public's attitude towards, and perception of, the police influences demand in terms of police resource. Given that policing is a

public service, public opinion can force the police to spend resources on specific issues and public perception of police work is often seen as an indicator of police performance (Fielding and Innes 2006). Some studies, for example, suggest that the public's fear of crime can be a determining factor influencing police spending and resource allocation (Bove *et al*. 2019, Brady and Fink 2019).

In addition, factors such as police legitimacy, public perception and confidence in the police can determine when and how citizens call the police (Bradford *et al*. 2009a, 2009b). This in turn not only directly affects where the police are active but can subsequently create demand. For example, reducing perceived legitimacy may lead to the marginalisation of groups of society (Wheeler 2016, Friedman and Albo 2017, Wheeler 2018, Rock 2019). In the short term, this may lead to a reduction in calls for service, but in the long term this may impair the effectiveness of crime reduction strategies, leading to failure demand.

In the UK context, surveys such as the Metropolitan Police Public Attitude Survey (METPAS), which quantify levels of public satisfaction at the borough level (BMG Research 2014) or the Crime Survey for England and Wales (Office for National Statistics 2020) which does so at the regional of national level, are particularly useful for measuring public satisfaction. This is important because satisfaction may not be directly related to area level crime rates, or the impact of policing on them. As such, a high level of satisfaction with the police may not be assured by purely focusing police resource in areas with high counts of crime or calls for service. For example, fairly crime-free communities might not be satisfied with the level of visible patrols in their areas, if these are determined by historic crime patterns. Hence, if a necessary outcome of policing is to keep the public happy with the service provided, then this too should be acknowledged as a generator of demand. Hence, demand needs to be conceptualised in terms of the wider objectives of the police in serving the public, rather than being restricted to solely crime-related outcomes.

6.2. Dealing with demand: effectiveness vs. efficiency

Another clear theme in the literature we identified through our review was the debate about effectiveness and efficiency in responding to demand, a discussion closely tied to issues of failure demand. Especially in times of limited resources, there is a growing need to improve the response to and the management of demand. Both, issues of efficiency and effectiveness, can be summarised under the concept of 'public value', which describes 'what [police] do, how they do it, and the relationships they build with citizens in the process' (Edwards and Skidmore 2006, p. 9). As such, it describes all contributions of the police to society, including outcomes in relation to reactive and protective demand, and the efficient use of public funds (Kearns and Muir 2019).

While a 'public value'-approach may be useful in some instances as it emphasises stakeholder needs and expectations, ongoing police performance assessment based on 'public value' alone is uncommon (Caputo *et al*. 2018). Thus, we suggest that distinguishing between effectiveness and efficiency is not only useful to ensure clarity within the complex field of demand but also necessary because they ultimately estimate different things.

Firstly, forces can address the effectiveness of their efforts, i.e. to what extent appropriate services are being provided by the police force, whether these services fulfil their goal, and whether they effectively reduce crime or increase security (Cordner 1989, National Police Chief's Council 2017). Outcome measures for effectiveness are thus whether a set objective has been completed. For example, in terms of reactive demand this might be whether an incident has been resolved. For protective demand, this might be whether crimes or unwanted behaviour still occur. Because improvements to the effectiveness of reactive and protective demand are to some extent measured by whether crime is contained or prevented, literature in this field often frames demand in terms of reduction and is concerned with the overall impact of policing on crime. This includes, for example, literature on crime reduction strategies such as hot-spot policing (Groff *et al*. 2015, Weisburd *et al*. 2015) or improvements to make processes (i.e. policing efforts) more effective (Camacho-Collados and Liberatore 2015, Camacho-Collados *et al*. 2015).

Secondly, policing efforts can be assessed in terms of their efficiency, i.e. whether the services provided are cost effective (see e.g. Manning 2004, Manning 2010) and how well services use the resources at their disposal (Sun 2002, NPCC Performance Management Coordination Committee 2017). Outcome measures of efficiency are whether resources have been used well, e.g. whether the best possible route (in this context both the physical journey to a call for service, and a procedural/administrative route of actions) has been taken to address a call for reactive demand, or whether administrative efforts are completed by a minimum amount of staff (Taylor Griffiths *et al*. 2015).

The literature in this field is highly diverse. Amongst others, it includes studies aimed at evaluating current models of resource allocation and management (i.e. those that introduce models to prioritise resource spending on specific issues or suggest better ways to manage existing resources) (Walsh 2001, Moore and Braga 2003, Sacks 2003, Walley 2013, Elliott-Davies *et al*. 2016, Boulton *et al*. 2017). Other authors, such as Zaki et al. (1997) suggest new models to aid resource allocation for police and crime prevention agencies by optimising the dispatching processes of police units.[3] Additionally, there are those approaches that seek to challenge, or at the very least question the status quo of vertical formal command and resource management structures. For example, Giacomantonio (2014) introduces a typology of boundaries faced by public police organisations in their day-to-day operations, stressing the importance of 'horizontal personal connections and informal activities' to improve the efficiency of inter-force cooperation, with Hills (2016) coming to a similar conclusion by suggesting that institutional resources, discipline or formality are not the key variables affecting police work. Lastly, authors like Collier (2006) suggest that the politicisation of the budgeting and resource allocation discussion leads to a discrepancy between the rhetoric of decision makers and organisational realities.

Of special importance when attempting to model police demand are the many studies that seek to use different modelling approaches to improve resource allocation and maximise benefits in police work. The focus of these studies is often concerned with the optimisation of location-allocation problems as they relate to the locations and routes for police patrols (Brooks *et al*. 2011, Zhang and Brown 2013, Adler *et al*. 2014, De La Cruz 2014, 2016), or the design of police patrol districts (Aly and Litwhiler 1979, Carroll and Laurin 1981, D'Amico *et al*. 2002, Curtin *et al*. 2010, Zhang and Brown 2013, Zhang and Brown 2014). As mentioned in earlier sections, the understanding and modelling of police demand, and its dynamics and drivers, is rather limited. As such, studies from other fields may be useful in bridging this gap in the literature, as resource modelling is further advanced for other emergency services (see e.g. Mendonça and Morabito 2001, de Souza *et al*. 2015, Zeinali *et al*. 2015, Aringhieri *et al*. 2016).

Overall, the literature on both the effectiveness and efficiency of policing is highly diverse and many models exist that seek to either improve current processes or propose new ones. These new approaches are, however, often highly case specific both in terms of their focus and in terms of their outcome measures of effectiveness and efficiency. While the former often describe an overall reduction in certain crimes, the latter tend to focus more on the amount of resources spent. Nevertheless, somewhat ironically this is often done without a focus on demand dynamics and the concept of demand itself is seldom acknowledged. By orientating such research in terms of where it helps the police meet demand (improving effectiveness and/or efficiency) and the type of demand it serves (e.g. reactive, protective or organisational) we can begin to see where gaps exist and provide conceptual clarity regarding policing activities.

7. Discussion

The primary aim of this scoping review was to synthesise current knowledge about police demand in terms of how it is conceptualised and how it might be measured. To this extent, we have reviewed the literature and produced a conceptualisation of police demand based on it. In doing so, we also sought to inform future research that explores how to model the interaction between demand and

the processes through which police configure their responses to it – namely, supply. As discussed above, modelling of demand has been conducted in both applied and academic fields at various scales of abstraction. While the majority of these approaches underlie a desire to optimise resource allocation decision-making they rarely – if ever – explicitly incorporate the notion of supply. Similarly, published literature on strategic (as opposed to tactical responses such as hotspots policing) police resource allocation has largely ignored police demand. Thus, to our knowledge, within the academic policing literature reviewed here the two approaches to understanding and modelling supply and demand have remained largely disparate.[4]

Building on our conceptualisation of police demand and the literature found through our review, we now discuss why such distinctions may be counterproductive and how research might be conducted to explicitly address this important gap in the literature and, moving forwards, support more effective means of demand management.

Following other scholars who have considered the structure of public service delivery, here we argue that like many contemporary problems, police supply and demand may best be understood if one contextualises it through the lens of complex adaptive systems (CAS) – that is, systems made of many components (e.g. police officers, offenders) that interact in rich and complex ways and adapt as a result (Holland 2006). While this framing will likely neither be contentious nor revelatory to many readers, we believe it is important in structuring how academics might consider developing practical research capable of increasing the evidence-base surrounding police supply and demand dynamics.

For those unfamiliar with CAS we now briefly summarise some of their key properties. While no single definition exists, CAS are typically characterised by *feedback* – where the outputs of one process influence the inputs of another (such as increased crime rates in a location resulting a high levels of policing); *emergence* – where regularities are observed that cannot easily be described, understood or predicted through an understanding of the activities, or decision making processes of the agents or actors that make up the system of interest (e.g. police officers); *non-linearity* – where the effects of inputs on outputs (e.g. the impact of an increasing number of police officers on crime) do not follow simple relationships – for example, 5 additional police officers might reduce crime in an area by 2%, while 10 more may decrease it by 20%. Alternatively, the marginal benefits of each additional officer may decrease rapidly; *tipping points* can also occur where the accumulation of individual action over time can lead to rapid and significant changes in system behaviour (e.g. recruiting more police officers may have little effect on crime until a critical number are recruited); *adaptation* – where individual agents in the system (e.g. police officers) adapt their behaviour in response to the behaviour of the system itself; and, *path dependence* – where future system states are constrained by previous ones.

It is hopefully easy to see how policing and police demand can (and should) be framed in terms of a CAS. Unfortunately, these (and other) properties of CAS present fundamental challenges for those who seek to analyse and understand police demand using traditional (statistical) analytical approaches. Consequently, CAS require new ways of thinking and new methodological approaches. By means of an illustrative example, we now briefly discuss the first of these characteristics – feedback – and how its properties might manifest in considering appropriate means to understand and quantify police demand and supply.

Viewed through a CAS lens, feedback and interdependence are core to the police supply and demand system. Given that resources are finite, in responding to demand, the police must at times choose one course of action over another (Walley and Adams 2019). These *opportunity costs* will have knock-on effects elsewhere in the supply and demand system. To illustrate, we return to our public order policing example. If an unexpected event occurs this creates immediate reactive demand. In order to meet that reactive demand current resources may need to be re-tasked accordingly. But how should the police identify these resources? Removing resources currently responding to other (perhaps less 'harmful') reactive demand may ultimately produce circumstances that lead to future failure demand. Removing resources involved in protective demand may, in turn, lead to a

number of scenarios including increases in future reactive demand, the potential for generating additional failure demand, time lost (which in itself is an important resource) due to the administrative (and other) processes involved in the reallocation of resources, and potentially associated internal demand in justifying these decisions. While this example is clearly overly simplistic, it demonstrates how a single event can have multiple effects on police demand, effectiveness and efficiency. Like any complex system it is reasonable to assume that these effects will be difficult to anticipate (at least in their entirety) and may well lead to unintended consequences. Moreover, such impacts are likely to vary in different contexts.

While understanding these interdependencies poses a challenge, it is essential to try to do so to increase our understanding of police demand and the effectiveness and efficiency of existing police demand management. While the notions of interdependence – and more generally complexity – are often acknowledged in verbal and written models that make up much of the demand literature – to the best of our knowledge they are rarely formally expressed in analytical frameworks and applied by those who seek to optimise demand management. In part this is understandable, such an approach requires a more holistic representation of the different types of demand and supply at play, the impacts they can have on one another, and the availability of data necessary to quantify these attributes (for the purposes of analytic calibration and validation). Moreover, even with such insight, this approach necessitates the use of complexity-appropriate thinking and methods. It is here that we are cautiously optimistic about advances in both the types of administrative data collected by policing agencies, and the computational methods that may utilise them to model the complex system that results. It is under this rationale that our research will now proceed. It is our hope that this paper offers an initial conceptual framework of demand around which future modelling efforts (both ours and others) regarding supply and demand dynamics can be oriented.

Notes

1. While some might argue that a focus on exclusively policing related literature narrows the perspective of this paper and limits the understanding of demand management it can provide, this choice is purposeful. Part of the aim of this paper is to take stock and understand how police demand has been conceptualised thus far.
2. Especially in this context we have to stress that failure demand is neither meant to put anyone at fault, nor meant to assign blame. Instead, it merely describes a situation, where problems are not addressed by the most suitable unit. Most mental health cases are best handled by appropriate medical institutions, however, there are some cases where the police are more appropriate respondents. Both cases can, if handled wrong, create failure demand.
3. This may include studies from other areas of public service management as tools, patterns, and lessons learned may be transferable.
4. The modelling of supply and demand and their interaction may be underway within police or other organisations. However, no such work was identified in the review. As such, if it does exist, it is impossible to assess its maturity/sophistication.

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ORCID

Julian Laufs http://orcid.org/0000-0001-8358-3544
Kate Bowers http://orcid.org/0000-0002-0965-492X
Daniel Birks http://orcid.org/0000-0003-3055-7398
Shane D. Johnson http://orcid.org/0000-0002-0184-9896

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