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Do body-worn cameras reduce disparities in police behavior in minority communities? Evidence of nuanced influences across Black and Hispanic neighborhoods

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Abstract

Research Summary: The adoption of body-worn cameras (BWCs) is often promoted in response to contentious police use of force incidents involving minority civilians. BWCs are expected to improve policing outcomes by enhancing accountability, although researchers have yet to determine whether BWCs can reduce racial/ethnic disparities. I examine whether BWCs mitigate the influence of neighborhood racial/ethnic context on arrests and use of force using cross-classified logistic regression models to examine the outcomes of 900,000+ police–civilian contacts in Phoenix. Arrests were significantly more likely to occur in Hispanic and Black neighborhoods before and after BWC deployment, even accounting for situational, officer, and neighborhood characteristics. When BWCs were activated in Black neighborhoods, the odds of arrest decreased by 38%. However, BWCs did not moderate the influence of neighborhood percentage of Hispanic on arrest. The neighborhood racial/ethnic context was not associated with the use of force pre- or post-BWC deployment.

Policy Implications: Although BWCs have been associated with several positive outcomes, their ability to reduce racial/ethnic disparities appears to be overstated. As such, more targeted approaches to reducing disparities in policing outcomes are needed. For example, leveraging the information collected through BWCs could facilitate enhanced supervision to identify officers engaging in racially disparate practices and hold them accountable. Although neighborhood racial/ethnic context was a robust predictor of arrest, these results point to nuanced influences of BWC activation in minority communities. This could be due to differential causes of arrest in Black and Hispanic neighborhoods.

KEYWORDS
arrest, body-worn cameras, disparity, neighborhood, police, race/ethnicity, use of force

Policing scholars have theorized about the causes of differential policing across minority communities for decades (Black, 1976; Herbert, 1997; Kane, 2002; Wilson, 1978). Although various explanations have been examined—including officer-level bias (either implicit or explicit), police deployment patterns, differential engagement in crime, and/or structural racism (Lum, 2021; Warren et al., 2006)—little consensus about the causes of these disparities has been reached. The evidence regarding effective strategies to remedy these inequities is similarly inconclusive (Lum et al., 2016). One of the most commonly discussed contributors to disparities is individual police officers' use of discretion (Brown, 1988). Although central to the police role, officer decision making has traditionally been difficult to oversee and evaluate (Goldstein, 1960; Walker, 1993). Recent technology, however, has made it easier to see what an individual officer does during a specific civilian encounter. One of the most highly promoted technologies in recent years is police-worn body-worn cameras (BWCs).

The number of studies examining the impact of BWCs on police behavior in the United States has increased dramatically. More than 70 BWC studies were included in a 2019 systematic review (Lum et al., 2019) compared to 21 articles in a review conducted just two years earlier (Maskaly et al., 2017). These studies often begin with a reminder that the widespread adoption of BWCs in police agencies across the United States exploded after the death of Michael Brown in police custody in Ferguson, Missouri in 2014. The almost immediate public demand for officers to wear BWCs in response to these types of incidents suggests that BWC adoption is motivated, at least in part, by a desire to reduce racial disparities in police behavior. In response to this outcry, former President Obama convened the President's Task Force on 21st Century Policing. The task force report, written by leading police executives and scholars, defined several avenues for improving police effectiveness and public trust in the police. The deployment of BWCs was a key recommendation (Final Report of the President's Task Force on 21st Century Policing, 2015), which was supplemented with substantial federal funding for agencies to purchase and implement BWCs (over $80 million through the BJA BWC Training and Technical Assistance Program, https://www.bwctta.com/about-us).

The underlying message behind the federal recommendation and financial support for BWCs is that this technology will increase police accountability and transparency, thereby improving police behaviors by providing enhanced oversight of police use of discretion. Given traditional challenges with internal supervision in policing, the ability for BWC footage to document police officer behaviors and provide additional opportunities to evaluate police performance could culminate in more legalistic policing by enhancing officers' self-awareness (Ariel et al., 2015). This benefit is often tied to improving police outcomes in minority communities and during interactions with minority civilians by reducing the influence of extralegal factors on police decision making. Although this argument is widely invoked, almost no research has assessed whether police BWCs have resulted in more equitable outcomes across racial/ethnic groups (see, for exceptions, Huff et al., 2021; Hughes et al., 2020).

Given continued attention to the role of technology in policing more generally and the potential for technology to reduce racial/ethnic disparities in police–civilian encounters specifically, it is important to understand whether BWCs change police behaviors in minority communities. This study seeks to address this gap in the literature by examining the factors that influence police use of discretion in almost 1 million police–civilian contacts prior to and following the adoption of BWCs as part of a randomized controlled trial in Phoenix, Arizona. I specifically assess whether the deployment of BWCs changed the factors associated with arrests and use of force and whether BWCs exert differential influences on the outcomes of police–civilian encounters in minority neighborhoods when they are used.

1 | THEORETICAL BACKGROUND

To assess the impact of any program or policy, it is imperative to consider *why* we would expect a particular response to influence police behavior. Numerous theoretical perspectives have been proposed to explain the application of social control in minority neighborhoods, often including both legal and extralegal explanations for variation in police behavior across space (i.e., differential offending and differential enforcement). The introduction of BWCs is anticipated to influence police behavior by improving the transparency and accountability of police officer actions both internally within police organizations and externally to the community the officer serves, thereby enhancing legalistic policing. As such, anticipated effects associated with BWCs are often explained using deterrence-related perspectives operating at the individual officer level, which could reduce the influence of extralegal factors, such as neighborhood racial/ethnic composition, on officers' use of discretion in similar incidents that occur in different places. This section reviews relevant theories to better understand why police behavior varies across neighborhoods and how BWCs might alter officer behavior and minimize that variation.

1.1 | Variation in police behavior across neighborhoods

Beginning with seminal work by Donald Black, social control has been considered a quantitative variable that is used differentially to maintain order. He argues that the police will use higher levels of law to resolve incidents involving minority civilians and those that occur in minority neighborhoods (Black, 1976, 1980). This is often presented as a response to racial threat, whereby

White civilians view minorities as a risk to their position in society when the minority population achieves a certain size or infringes upon previously White-dominated areas (Blalock, 1967). This perceived threat associated with geographic distributions of minority populations culminates in civilian expectations for the concentration of crime control efforts, such as arrests, in those areas. As such, officers are not responding to individual encounters or offenses but rather to broader perceived threats related to racial/ethnic population distributions, even in the absence of conscious intent on the part of officers themselves (Weitzer, 2017). In addition to arrest behaviors, some have theorized that the police will be more aggressive and forceful during interactions that occur in minority neighborhoods (Bayley & Mendelsohn, 1969). Recent scholarship suggests that the group-position model applies to police officers, who could develop perceptions that minority civilians are crime prone due to repeated exposure to offenders and hostility to the police, with these perceptions contributing to more forceful police responses toward minority civilians in disadvantaged and minority communities (Weitzer, 2017).

In addition to overenforcement in minority communities, some scholars suggest that underenforcement is equally problematic (Wilson, 1978). For instance, the benign neglect explanation suggests that officers will conduct fewer arrests in areas with large minority populations (Liska & Chamlin, 1984), sometimes attributed to intraracial (e.g., Black-on-Black) crime being treated less formally by police (Black, 1976, 1980). Others have similarly suggested that the police are less responsive to minority victims in disadvantaged communities (Liska & Chamlin, 1984; Wilson, 1978), which could reduce the use of arrests in these areas. Prior research is consistent with these perspectives, lending support to the benign neglect thesis for explaining variation in arrests across neighborhoods (Kirk & Matsuda, 2011; Parker et al., 2005).

Several theoretical frameworks highlight the importance of accounting for crime to better understand police use of discretion. Scholars have long recognized that crime is not evenly distributed across space but is concentrated in a small number of geographical areas (Weisburd, 2015). Given that police officers are tasked with enforcing the law, it seems reasonable that arrests and even use of force could be more likely to occur in high crime areas as a result of officers performing their central job duties. Some have argued, however, that officers will respond to incidents in high crime areas *less* vigorously due to cynicism about the effectiveness of police intervention in these neighborhoods (Klinger, 1997), which could reduce the likelihood of arrests. These findings have been confirmed in a study examining officer decision pathways across neighborhoods, which found that officers were more likely to downgrade calls for service in violent areas; notably, officers were also more likely to downgrade incidents in areas with larger Black populations, even when violence was accounted for (Lum, 2011).

Many high crime areas are also located in neighborhoods with large minority populations, which can create challenges untangling the influence of racial/ethnic composition and crime on the deployment of police resources and the application of police discretion (Bittner, 1970). Balancing the need to allocate police resources to high crime areas with concerns about disproportionate minority contacts involving innocent civilians is a subject of continued debate (Wheeler, 2020). As a result, theories discussing variation in officer behavior across neighborhoods have been split into racially neutral explanations grounded in concentrations of crime and resource deployment relative to intentionally discriminatory policing in which officers use their discretion differently depending on race/ethnicity (Kane, 2003). Either explanation could result in greater numbers of arrests in minority neighborhoods (Gaston, 2019a). In short, several theoretical perspectives posit that police behavior varies across neighborhoods, influenced by both racial/ethnic populations and spatial distributions of crime, with continued debate surrounding the underlying causes of observed disparities.

1.2 | The influence of BWCs on police behavior

Although police decision making has traditionally been viewed as occurring in a low visibility environment (Goldstein, 1960), new technology is increasing our ability to examine police behavior during individual incidents (White & Malm, 2020). Police officers have long been considered to have a "cover your ass" mentality to ensure continued employment (Van Maanen, 1978), and heightened national attention to police behavior and police reform have likely enhanced this orientation among officers who are feeling immense scrutiny due to what some have called a legitimacy crisis in policing (Todak, 2017). For instance, recent research has identified high rates of police turnover following protests related to the death of George Floyd in Minneapolis, Minnesota, a fatal police use of force incident captured using a BWC (Mourtgos et al., 2021). As such, a combination of current sentiment toward the police and additional scrutiny facilitated by BWCs could change the way officers behave.

The adoption of BWCs has often been suggested to influence police use of discretion through a combination of increased self-awareness and deterrence (Ariel et al., 2017). Essentially, the argument is that officers who wear BWCs will be more cognizant of the fact that their activities could be reviewed and that this footage could be used to ensure that their actions are in line with policy (Adams & Mastracci, 2019; Ariel et al., 2015). As such, increased self-awareness could result in more legalistic policing if officers react to the BWC by relying less on their discretion and instead adhere strictly to departmental and other legal standards. Notably, the influence of BWCs on behavior has been tied to the amount of discretion officers have to activate their BWC (Ariel et al., 2017), suggesting that merely assigning officers to wear BWCs is insufficient for maximizing the utility of this technology. The self-awareness effect of BWCs depends on a BWC actually being turned on to deter poor officer behavior by increasing the likelihood of performance issues being identified (Hedberg et al., 2017; Huff et al., 2020). However, some have suggested that this increased exposure to scrutiny due to BWCs could result in officers disengaging from proactive police enforcement, a suggestion that has received mixed support across prior research (Groff et al., 2020; Wallace et al., 2018). One explanation for the limited influence of BWCs on police proactivity is that officers are principled agents who adapt to BWCs as part of their job function (Adams et al., 2021).

Given prior policing theories, which suggest that discretionary decision making can culminate in racial/ethnic disparities (Black, 1980; Herbert, 1997), illuminating the use of officer discretion could reduce disparities in police behavior across different racial/ethnic neighborhood contexts. Thus, the cumulative effect of increased scrutiny in general and increased attention to police treatment of minorities specifically could change police behavior in minority neighborhoods because BWCs facilitate surveillance of police–civilian interactions.

2 | LITERATURE REVIEW

Grounded in these theoretical traditions, a multitude of studies have examined factors that influence police use of discretion and the impact of BWCs on the outcomes of police–civilian encounters. Arrest and use force decisions are particularly consequential. Researchers generally examine contributing factors associated with the encounter, officer, community, and organization (Riksheim & Chermak, 1993; Sherman, 1980). Numerous studies have similarly assessed the influence of BWCs on the arrest and use of force (Lum et al., 2019; White & Malm, 2020). This section discusses influences on arrest and use of force, followed by prior research examining the impact of BWCs on these outcomes.

2.1 | Arrests and use of force

Despite the illusion of full enforcement, in which officers were believed to conduct arrests in every incident involving reasonable suspicion prior to the "discovery" of police discretion (Walker, 1993), it has become widely recognized that officers retain a level of discretion when making arrests (Brooks, 1997). Perhaps no other decision in the criminal justice process is more consequential than the decision to arrest, with these decisions having substantial impacts on arrestees, their communities, and the criminal justice system (Engel et al., 2019). As highlighted throughout the introduction, police use of force also has consequences that extend well beyond an individual incident and can reverberate across national and even international discussions about proper policing. Given these considerations, both arrests and use of force have been the subject of numerous studies intended to identify the types of situations, officers, and places in which these events are most likely to occur. Although numerous contributing factors have been examined, the current review focuses heavily on the influence of macrolevel factors on disparities within these outcomes.

The impact of civilian race ethnicity on arrests and use of force has received substantial research attention. A meta-analysis indicates that minority suspects are significantly more likely to be arrested than their White counterparts (Kochel et al., 2011). A review of studies examining racial disparities in police use of force, however, identified little consensus on the extent of these disparities across prior research (Hollis & Jennings, 2018). Other researchers have examined whether individual officers contribute to disparities in arrest and use of force. Despite the persistence of "bad apple" explanations, there are substantial challenges to isolating the influence of individual officer decision making on observed racial/ethnic disparities. The use of internal benchmarks to identify officers who engage in more racially disparate practices than their peers are subject to practical barriers due to data limitations and political barriers that inhibit police agencies from gathering these data (Engel & Calnon, 2004). Although numerous methodologies for identifying officers who engage in racial/ethnically biased behavior have been proposed (see Ridgeway & Macdonald, 2009), the true influence of individual officer behaviors on broader patterns of disparities in policing remains an open question.

The influence of community racial/ethnic composition on racial/ethnic disparities in arrest and use of force has also received considerable attention, with prior research identifying somewhat mixed findings. For instance, discretionary arrests were significantly more likely to occur in both Hispanic and Black neighborhoods relative to those with larger White populations in Phoenix (Huff, 2021). Research in Chicago, however, found that the probability of arrest was lower in Black neighborhoods (Kirk & Matsuda, 2011). Research in a west coast city also indicated that arrests were less likely to occur in neighborhoods with larger Black populations (although not a significant difference) but were significantly more likely to occur in neighborhoods with large Hispanic populations (Lum, 2011). Research examining population change over time in New York City indicates that increases in Hispanic populations increase minority misdemeanor arrest rates in all neighborhoods, although increases in Black populations only increased Black misdemeanor arrest rates in previously White-dominated neighborhoods (Kane et al., 2013). As such, these findings suggest nuanced relationships between different types of arrests and across distinct racial/ethnic groups.

The influence of neighborhood racial/ethnic composition on the use of force has been widely studied, with some researchers finding that minority populations are the strongest predictors of force, even accounting for other factors (Arnio, 2019; Lautenschlager & Omori, 2018). For example, neighborhood percentage of Black residents was the most robust predictor of force in New York City, even controlling for neighborhood levels of disadvantage and violence (Lautenschlager & Omori, 2018). Other research conducted in New York City found that officers were 4% more likely to draw a firearm for every 10% increase in neighborhood percentage of Black/Hispanic residents (Kramer & Remster, 2018). Neighborhoods with larger Black and Hispanic populations were both more likely to experience police shootings in Houston (Arnio, 2019). Although researchers in St. Louis found that shootings were more likely to occur in Black neighborhoods, they did not identify the same trends in Hispanic neighborhoods (Klinger et al., 2016). As such, police use of force appears to differ across Black and Hispanic neighborhoods.

Finally, some researchers have assessed the simultaneous influence of factors operating at the encounter, officer, and neighborhood levels on arrest and use of force. Multilevel research examining arrests pursuant to traffic stops in San Jose, California, did not identify any significant relationship between officer characteristics and arrests when situational and neighborhood characteristics were accounted for (Tillyer et al., 2019), highlighting the importance of assessing factors occurring at multiple levels of explanation. Early research examining police use of force indicated that officers were more likely to use force in neighborhoods with larger Black or more racially heterogeneous populations, even when controlling for important situational factors and the race of the involved suspect (Smith, 1986). Other studies have similarly found that neighborhood minority populations are significantly associated with the use of force outcomes, even when controlling for suspect resistance (Lersch et al., 2008). More recent multilevel research in New York City indicated that differences in the use of force rates across suspect races/ethnicities were attributable to the racial composition of the precincts in which the suspects were encountered, with these effects persisting even when accounting for precinct levels of crime (Levchak, 2017). These results collectively indicate that police decision making is influenced by numerous factors that could culminate in and contribute to observed racial/ethnic disparities across neighborhoods.

2.2 | The impact of BWCs on arrest and use of force

Although several studies of BWCs have used rigorous research designs, prior research has identified somewhat mixed findings regarding the impact of BWCs on both arrests and use of force (Lum et al., 2019; White & Malm, 2020). Furthermore, extant research largely addresses the direct impact of BWCs on various outcomes. Almost no research to date has examined the potential for BWCs to reduce racial/ethnic disparities in police outcomes across either civilian demographic backgrounds or neighborhood contexts.

Little consensus has been reached about the effect of BWCs on arrests. Some researchers have found that BWCs increase the likelihood of arrest. For example, researchers in Phoenix found that BWCs significantly increased the likelihood of arrest, but only when BWCs were actually activated by responding officers, not using measures of BWC assignment alone (Huff et al., 2020). This suggests that the impact of BWCs on arrests could depend on the use of this technology in the field. Although some studies have identified increases in arrests associated with BWCs, others have found the opposite effect. For example, a study of propensity-score matched officers in Philadelphia identified a 39% reduction in arrests among BWC officers relative to control officers, a notable result given that control officers increased the number of arrests they conducted during the same time period (Groff et al., 2020). Finally, some researchers have found no relationship between arrests and BWCs (Wallace et al., 2018).

In the only study to examine differences in arrests across neighborhoods using pre- and post-BWC implementation data to date, researchers in Louisville found that BWCs reduced the number of felony arrests in Black neighborhoods (Hughes et al., 2020). However, their study was limited to changes in aggregate rates and did not account for the influence of BWCs on individual incidents. Furthermore, the Louisville Police Department deployed BWCs by division, as opposed to using an experimental or quasi-experimental design, limiting their ability to assert that BWCs are the sole cause of the observed relationships in their study. Nonetheless, their results suggest that BWCs could change policing patterns in Black neighborhoods.

Despite promising results from early BWC studies (Ariel et al., 2015), the impact of BWCs on the use of force has fairly been mixed (Lum et al., 2019). BWC officers in Las Vegas were 13% less likely to be involved in the use of force incidents relative to control officers (Braga et al., 2018). Others, however, have identified null relationships between BWCs and the use of force (Ariel, 2017), and some studies even indicate that BWCs are associated with a greater likelihood force (Huff et al., 2020). As in all use of force research, the varied findings could be due to inconsistent definitions of the use of force, different use of force reporting requirements across police agencies, or the relative rarity of these events, which could limit statistical power (Lum et al., 2019). Absent from this research is any discussion of whether BWCs reduce the use of force for racial/ethnic minorities and/or in minority neighborhoods.

These mixed results regarding the influence of BWCs on the use of force have been attributed to the varied amounts of discretion officers have to activate their BWCs across studies (Ariel et al., 2017), suggesting that agencies with more restrictive policies that require officers to activate their BWCs in all police–civilian encounters experience more meaningful reductions in the use of force. Given that self-awareness and deterrence are the anticipated causal mechanism between BWCs and police behavioral change, understanding the true impact of BWCs depends on accounting for whether this technology is actually being used in the field. Namely, a police agency cannot hold an officer accountable for their actions using BWC footage if that footage was not captured (Lawrence et al., 2019).

Some researchers have used intent-to-treat and instrumental variables analysis to examine whether the impact of BWCs varies using measures of BWC assignment at the officer level and BWC activation at the incident level (Hedberg et al., 2017; Huff et al., 2020), with their work reiterating the importance of BWC activation for reducing civilian complaints. Other researchers have directly examined factors that contribute to BWC activation. BWC activation rates varied widely across individual officers in Anaheim, California, and were higher during violent crimes than during other types of incidents (Lawrence et al., 2019). Another study confirmed that BWC activation rates were largely driven by officer activity levels and job-related functions, above and beyond officers' demographic characteristics or attitudes toward BWCs (Adams et al., 2021). Researchers have also identified a pronounced influence of organizational policy on activation compliance, with more restrictive policies substantially increasing BWC activation in the field (Katz & Huff, in, press). Due to the role of discretion in arrest and use of force and the impact of BWC activation on accountability for officer decision making, evaluating the direct influence of BWC activation on police behavior is crucial.

3 | CURRENT STUDY

Given continued calls for the adoption of BWCs to improve police transparency and police-community relations, with many of these arguments suggesting that this technology will improve police behavior in minority communities in particular, the present study seeks to examine whether BWC activation changes the way officers use their discretion. To do so, I use multilevel modeling techniques to address two research questions. First, how do situational, officer, and neighborhood factors influence arrests and the use of force prior to and following the deployment of BWCs? Second, do BWCs change the way officers use their discretion in different types of neighborhoods?

By first identifying the factors that influence police discretion and then assessing whether BWCs change the impact of those factors on behavioral outcomes, this study seeks to directly test whether BWCs can improve equitable outcomes across similar situations in different neighborhood contexts. As such, this study provides a more nuanced assessment of policing in minority neighborhoods while accounting for situational and officer-level factors that are known to influence police behavior. This study further contributes to our understanding of the influence of BWCs on the outcomes of police–civilian contacts in different neighborhoods and specifically examines whether police behavior in minority communities changes when BWCs are used.

4 | METHODS

I use data collected as part of a randomized controlled trial of the impact of BWCs in the Phoenix Police Department (see Huff et al., 2020 for further information about the BWC study). Phoenix, Arizona is the largest city in the state, with a population of 1.6 million residents geographically spread over 516.7 square miles (U.S. Census, 2019). Situated approximately 3 hours from the Mexican border, the majority of residents are White (72.6%; 44.4% non-Hispanic White), followed by Hispanic (41.8%; of any race), and Black (6.8%). In 2016, the Federal Bureau of Investigation reported that Phoenix had higher violent (674.39 per 100,000 residents) and property crime (3,690.38 per 100,000 residents) rates relative to the national averages (386.3 and 2,450.7 per 100,000 residents, respectively). The Phoenix Police Department is a large municipal police agency responsible for policing the city of Phoenix and employs almost 3,000 sworn officers across seven precincts.

The BWC study involved patrol officers assigned to six of the seven precincts that had not previously deployed BWCs. As part of the evaluation, a total of 467 officers agreed to participate in a survey administered prior to BWC deployment, with relatively limited differences in demographic characteristics and activity levels between surveyed and nonsurveyed officers.[1] Officers who participated in the predeployment survey served as the sampling frame for BWC assignment. BWCs were deployed to randomly selected officers on May 24, 2017. Those officers who changed treatment conditions over the course of the study (n = 29; 8 nonrandomly assigned BWCs and 21 switched assignments) and those who were not involved in any civilian contacts after the deployment of BWCs (n = 5) were removed from the analysis, resulting in a final sample of 433 officers for the current study (n = 81 BWC officers; n = 352 control officers). The number of calls-for-service involving each officer was fairly normally distributed (mean = 2,429.86; median = 2,339.00; SD = 752.50). Multilevel models were used to statistically account for the effect of individual responding officers on the outcome of a given civilian encounter.

I use 3 years of administrative police activity data collected for all study officers (November 24, 2015 to November 23, 2018). I split these data into two time periods to examine influences on officer behavior during the 18 months prior to BWC deployment (November 24, 2015 to May 23, 2017) to the 18 months following BWC deployment to randomly selected officers (May 24, 2017 to November 23, 2018). The incident-level data collected from the Phoenix Police Department include computer-aided dispatch (CAD) data, arrest reports, use of force reports, and BWC activation metadata. These data were merged using a unique incident number. The CAD data represent all dispatched 911 calls-for-service and all proactive police–civilian encounters over the study period. The arrest reports, use of force reports, and BWC activation metadata were used to identify whether an individual incident involved any of these outcomes/events. The CAD data also included a serial number for the primary responding officer, which was used to merge data across sources. This study is restricted to those incidents that involved a study officer as the primary responding officer ($n = 942{,}422$ incidents). The police–civilian encounter serves as the unit of analysis.

Given the importance of officer-level characteristics on police behavior, personnel data for all eligible officers were collected from the City of Phoenix Human Resources Department ($n = 433$ officers). The PPD uses single officer patrol cars. As a result, the officer-level characteristics examined are representative of the primary responding officer. In the current study, approximately 20% of incidents involved a single responding officer (20.5%), with almost half of the incidents involving two responding officers (46.5%). A smaller percentage of incidents involved three, four, or five+ responding officers (15.6%, 8.6%, and 8.8%, respectively). Although many incidents involved more than one responding officer, it was not possible to determine the length of time each responding officer was present at an incident. The current approach assumes that the characteristics of the primary responding officer were the most influential on the outcome of an individual encounter given that they were the first officer to arrive on scene, and their actions and descriptions of the situation likely had strong influences on the perceptions and behaviors of other responding officers.

Finally, to account for the influence of spatial context on the outcomes of police–civilian encounters, U.S. Census data from the 2016 5-year estimates of the American Community Survey were collected at the census tract level to account for neighborhood structure ($n = 386$ census tracts). Census tracts are commonly used to approximate neighborhoods given the ready availability of data at this geographic level (Hipp, 2007). As further discussed below, the individual census variables collected tap into elements of social disorganization, racial/ethnic population distributions, and population density across Phoenix. All police–civilian encounters were geocoded in ArcMap and spatially joined to these census tracts.

4.1 | Dependent variables

Two separate dependent variables are used to examine the relationship between BWCs and neighborhood context on police behavior: arrest and use of force. These variables were created by merging the arrest and use of force data to the CAD data using the unique incident number, consistent with the individual encounter serving as the unit of analysis.

Arrest is a binary indicator of whether an individual incident resulted in an arrest (26.2%; $n = 246{,}604$ over the study period). This high rate of arrests is likely due to the inclusion of misdemeanor, felony, and warrant arrests in this study. A single incident could result in multiple arrest reports if the same officer arrested multiple suspects or if multiple officers arrested multiple suspects. The arrest variable does not capture whether an individual incident resulted in multiple arrests, only whether any arrest was conducted during a given incident.

Use of force is a binary variable measuring whether the incident involved an officer using force that resulted in a mandatory use of force report (0.1%; $n = 544$ over the study period). The PPD policy requires the creation of a mandatory use of force report by a supervisor in any incident in which an officer uses intermediate control techniques (e.g., hard empty hands, flashlights), a TASER, carotid control techniques, and/or deadly force. An individual incident could result in multiple use of force reports if multiple officers used force and/or if the same officer used force against multiple suspects. The use of force variable in this study does not capture whether multiple officers used force or whether force was used against multiple suspects, only whether the incident involved a level of force that necessitated the creation of a mandatory use of force report against at least one civilian during a given encounter.

4.2 | Independent and control variables

A large number of independent and control variables are included at the situational, officer, and neighborhood levels. Full coding information and summary statistics for each time period, pre- and post-BWC deployment, are provided in Table 1. Although there were some statistically significant differences among the study variables between the pre- and post-BWC deployment periods, effect size differences indicate very limited change in the types of incidents, officers, and neighborhoods represented in the police–civilian encounters before and after BWCs were deployed (Cohen's $d < 0.2$ for all variables, except for officer tenure [$d = 0.27$]).

At the situational level, BWC activation is a key independent variable used to account for the use of a BWC during an individual encounter. The Phoenix Police Department has a relatively restrictive activation policy, which requires officers to activate their BWC during all police–civilian encounters (for an in-depth discussion of the BWC activation policy and officer compliance, see Katz & Huff, in press). It is important to note that many incidents did not involve officers who were assigned to wear a BWC, contributing to the low percentage of incidents involving BWC activation (17.4%), which should not be considered indicative of low activation compliance (activation compliance was approximately 70% for officers assigned to wear BWCs; Katz & Huff, in press). The use of a direct measure of BWC activation should be considered a strength of the current study given prior research finding variation in activation compliance across officers (Adams et al., 2021; Lawrence et al., 2019) and varied impacts of BWCs on police behavior using measures of activation as opposed to assignment (Hedberg et al., 2017; Huff et al., 2020). Whether multiple BWCs were activated during an individual incident is also accounted for to address potential contamination.

Police–civilian contacts can be initiated either through a civilian requesting police assistance or through an officer proactively initiating a contact. To account for these differences, a measure of proactive contacts has been included in the models to address concerns that civilian- and officer-initiated contacts could differ in meaningful ways. A series of call type variables are also included, with property offenses, subject/vehicle stops, and other call types compared to violent incidents. Prior research finds that suspected offense type is a robust predictor of arrests, with several studies indicating that arrests are more likely to occur in response to serious offenses (Novak & Engel, 2005; Smith & Visher, 1981; Sobol, 2010). Force is also more likely to be used in serious offenses and violent offenses relative to other types of incidents (Lee et al., 2014). The number of responding officers is also examined because the presence of multiple officers could influence the dynamics of the interaction by either constraining officer discretion or increasing tension. For example, some

TABLE 1 Description of study variables

Variable	Description	Pre-BWC (n = 454,521) n (%)/Mean (SD)	Post-BWC (n = 487,901) n (%)/Mean (SD)	t/Chi-square	d
Dependent variables					
Arrest	Dichotomous (0 = No arrest; 1 = Arrest)	112,961 (24.85%)	133,643 (27.39%)	784.95**	−0.06
Use of force	Dichotomous (0 = No use of force; 1 = Use of force)	270 (0.06%)	274 (0.06%)	0.43	0.00
Independent and control variables					
Situational					
BWC activated	Dichotomous (0 = No BWC activation; 1 = BWC activation)	–	84,646 (17.35%)	86,636.36**	−0.64
Incident type	A series of dichotomous variables				
Proactive	Dichotomous (0 = Call-for-service; 1 = Proactive)	64,727 (14.24%)	84,675 (17.35%)	1710.79**	−0.09
Violent	Dichotomous (0 = Not violent; 1 = Violent)	80,440 (17.7%)	81,933 (16.79%)	135.08**	0.02
Property	Dichotomous (0 = Not property; 1 = Property)	119,590 (26.31%)	126,181 (25.86%)	24.63**	0.01
Subject/vehicle stop	Dichotomous (0 = Not subject/vehicle stop; 1 = Subject/vehicle stop)	88,544 (19.48%)	106,446 (21.82%)	782.79**	−0.06
Other	Dichotomous (0 = Not other incident type; 1 = Other incident type)	165,947 (36.51%)	173,341 (35.53%)	98.57**	0.02

(Continues)

TABLE 1 (Continued)

Variable	Description	Pre-BWC (n = 454,521) n (%)/Mean (SD)	Post-BWC (n = 487,901) n (%)/Mean (SD)	t/Chi-square	d
Contamination					
Number of responding officers	Continuous (number of officers present)	2.36 (1.15)	2.41 (1.17)	−20.89**	−0.04
Multiple activations	Dichotomous (0 = 0 or 1 BWC activation; 1 = 2+ BWC activations)	–	6,988 (1.43%)	–	–
Officer					
Assigned BWC	Dichotomous (0 = No BWC; 1 = BWC Officer)	–	123,122 (25.24%)	–	–
Male officer	Dichotomous (0 = Female; 1 = Male)	389 (89.84%)	389 (89.84%)	125.13**	0.02
White officer	Dichotomous (0 = White; 1 = Non-White)	306 (70.67%)	306 (70.67%)	79.62**	−0.02
Bachelor's degree+	Dichotomous (0 = No Bachelor's degree; 1 = Bachelor's degree+)	148 (34.18%)	148 (34.18%)	863.18**	−0.06
Officer tenure	Continuous (years of service)	10.50 (7.29)	8.52 (7.45)	130.20**	0.27
Officer precinct	A series of dichotomous variables				
Black Mountain	Dichotomous (0 = Not Black Mountain; 1 = Black Mountain)	60 (13.86%)	60 (13.86%)	0.11	0.00
South Mountain	Dichotomous (0 = Not South Mountain; 1 = South Mountain)	75 (17.32%)	75 (17.32%)	191.34**	0.03
Central City	Dichotomous (0 = Not Central City; 1 = Central City)	29 (6.7%)	29 (6.7%)	51.85**	−0.01

(Continues)

TABLE 1 (Continued)

Variable	Description	Pre-BWC (n = 454,521) n (%)/Mean (SD)	Post-BWC (n = 487,901) n (%)/Mean (SD)	t/Chi-square	d
Desert Horizon	Dichotomous (0 = Not Desert Horizon; 1 = Desert Horizon)	99 (22.86%)	99 (22.86%)	1927.38**	−0.09
Mountain View	Dichotomous (0 = Not Mountain View; 1 = Mountain View)	90 (20.79%)	90 (20.79%)	535.78**	0.05
Cactus Park	Dichotomous (0 = Not Cactus Park; 1 = Cactus Park)	80 (18.48%)	80 (18.48%)	190.00**	0.03
Neighborhood					
Disorganization	Factor created using exploratory factor analysis of: percentage living below the poverty line, percentage unemployed, percentage receiving public assistance, percentage moved in past 5 years percentage renter-occupied households, and percentage female-headed households	0.38 (0.92)	0.36 (0.93)	11.34**	0.02
Percentage of Hispanic	Continuous (percentage of residents who are Hispanic)	0.42 (0.24)	0.41 (0.24)	31.34**	0.06
Percentage of Black	Continuous (percentage of residents who are Black)	0.08 (0.07)	0.08 (0.07)	4.07**	0.01
Violence rate	Continuous (number of violent incidents/100,000 residents)	36,605.87 (33,027.51)	37,740.89 (33,776.64)	−16.48**	−0.03
Population density	Continuous (number of residents/square miles)	5,867.36 (3,506.68)	5,792.58 (3,527.65)	10.31**	0.02

Note: Incidents cross-nested in officers (n = 433) and neighborhoods (n = 386); uncentered continuous variables are reported here for ease of presentation; all continuous variables are grand-mean centered in the full models. **p < 0.01, *p < 0.05.

researchers have found that incidents involving a greater number of responding officers are more likely to result in arrest (Huff, 2021) and use of force (Morgan et al., 2020; cf. Lim & Fridell, 2014).

The influence of primary responding officers on the outcomes of individual encounters was also accounted for. Given the sheer number of possible combinations of responding officers and officer characteristics, only the characteristics of the primary responding officer are considered. Primary responding officers are the first officers to arrive at a scene, resulting in less influence of backup officers on the decisions made during police civilian encounters. BWC assignment was included to account for whether the primary responding officer was wearing a BWC or was assigned to the control condition.[2] BWC officers served as the primary responder in approximately 25% of incidents, although it is important to reiterate that multiple officers from different treatment conditions could respond to the same incident.[3]

Other officer-level demographic and job-related characteristics, including gender, race/ethnicity, educational attainment, years of service, and assignment, are also examined. Studies indicate that male officers are more likely to conduct arrests (Huff, 2021; Sherman, 1980) and use force (Brandl & Stroshine, 2012; Ouellet et al., 2019; Wright & Headley, 2020) than their female counterparts. Some researchers have found that White officers are more likely to conduct arrests than non-White officers (Novak & Engel, 2005), although a meta-analysis found that officer race is not a robust predictor of force (Bolger, 2015). Despite increasing attention to educational standards in policing, researchers have identified mixed effects of education on arrest (Rosenfeld et al., 2020; Rydberg & Terrill, 2010). Some researchers have found that officers with higher levels of educational attainment are less likely to be involved in the use of force incidents, a finding attributed to stronger verbal communication skills that could facilitate de-escalation (Rydberg & Terrill, 2010). Experience also appears to play an important role. Some studies suggest that officers with fewer years of experience are more likely to conduct arrests (Bonkiewicz, 2017) and use force (Garner et al., 2002; Terrill & Mastrofski, 2002) than their more experienced counterparts. Officers could also use their authority in different ways depending on their geographic assignment (Klinger, 1997), with some research confirming that officers assigned to higher crime areas are more likely to use force than those assigned to lower crime areas (Brandl & Stroshine, 2012).

At the neighborhood level, an indicator of disorganization is used to examine whether officers behave differently during incidents that occur in socially disorganized areas. This variable was created using exploratory factor analysis of the following measures collected from the U.S. Census at the census tract level: poverty, unemployment, public assistance, residential instability, renter-occupied households, and female-headed households. All measures loaded sufficiently onto a single factor (eigenvalue = 3.10; factor loadings from 0.55 to 0.85; $\alpha = 0.78$). Some researchers have found that arrests are more likely to occur in neighborhoods with lower socioeconomic status, even accounting for crime type, offender characteristics, and victim preferences (Smith, 1986). More recent research similarly indicates that officers are more likely to conduct arrests in poor and socially disorganized neighborhoods (Lum, 2011). However, these findings are not universal (Novak et al., 2002; Sobol et al., 2013). Social disorganization has had varying effects on the use of force. Although police shootings were more likely in disadvantaged areas in St. Louis (Klinger et al., 2016), the relationship between disadvantage and shootings only occurred in some segments of Houston (Arnio, 2019).

The percentage of Hispanic and Black residents are included as separate independent variables given the centrality of racial/ethnic context to the current research questions. As discussed above, several studies have examined the influence of neighborhood racial/ethnic composition on arrests and use of force using various theoretical and methodological approaches. Despite this substantial attention, little consensus surrounding the impact of neighborhood racial/ethnic context has been reached. This could be due to the different theoretical and methodological approaches used across prior studies. For instance, some research focuses solely on misdemeanor, discretionary, and drug arrests (Gaston, 2019b; Huff, 2021; Kane et al., 2013). The use of force research also varies across studies examining all force and lethal force (Klinger et al., 2016; Terrill & Reisig, 2003). As such, additional research is needed to better understand the relationships between neighborhood racial/ethnic context and police behavior, especially when assessing the ability for different policing practices to reduce disparities.

To account for the potential influence of violence on my outcomes of interest, a neighborhood violence rate was created by spatially joining violent incidents to individual census tracts and standardizing those counts to 100,000 residents. Prior research shows that officers are more likely to conduct arrests (Johnson & Olschansky, 2010; Tillyer et al., 2019) and use force (Fyfe, 1980; Lee et al., 2014; Shjarback, 2018; Sun et al., 2008; Terrill & Reisig, 2003) in high crime neighborhoods. Neighborhood violent crime rates were the strongest predictor of police shootings in St. Louis, even accounting for other structural conditions, including racial/ethnic contexts (Klinger et al., 2016). Finally, population density is also controlled for using the number of residents per square mile in each census tract.

To examine whether neighborhood context exerts variable influences on police behavior when BWCs are activated, cross-level interaction terms are used. I specifically include interactions between BWC activation and neighborhood social disorganization, percentage of residents who are Hispanic, percentage of residents who are Black, and the violence rate to examine whether BWCs moderate the influence of these factors. This allows me to assess whether the likelihood of an arrest or a use of force occurring in neighborhoods with different social ecological environments depends on whether a BWC is activated and whether the influence of activation differs across different types of neighborhoods (e.g., whether BWC activation is more likely to reduce the use of force in minority neighborhoods). Several multicollinearity checks were conducted, with variance inflation factors and condition indices indicating limited concern (Dormann et al., 2013; Thompson et al., 2017).

4.3 | Analytical strategy

Assessing the outcomes of individual police–civilian encounters is complicated for several reasons. First, prior research indicates that the outcomes of police–civilian encounters are influenced by immediate situational factors, responding officer characteristics, and the neighborhood context in which an incident occurs (Riksheim & Chermak, 1993; Sherman, 1980). Second, the same officers respond to a diverse range of incidents, with these differences at the situational level contributing to variation in the way officers behave during a given encounter. Third, the same officers also engage in encounters in a variety of neighborhoods—from high crime inner city neighborhoods to wealthy suburban neighborhoods—which could lead to variation in the outcomes of similar types of encounters that occur in different places.

To account for this complexity, multilevel models are used to examine the influence of factors occurring at multiple levels of explanation and to provide a comprehensive assessment of police officers' decisions to arrest and use force. Individual incidents are cross-nested within responding officers and neighborhoods because officers respond to incidents in multiple different neighborhoods, as opposed to a hierarchical structure in which each officer only responds to incidents in one neighborhood (Huff, 2021; Tillyer et al., 2019). As such, cross-classified logistic regression models are required to address this data structure. Cross-classified models allow for police–civilian encounters to serve as Level 1 and both the responding officer and the neighborhood to serve as Level 2, thereby allowing the model to capture the unique contribution of officers and neighborhoods on the outcomes of individual police–civilian encounters (see Appendix B for a visual representation of this data structure).

Furthermore, to understand whether the factors that influence arrests and use of force change as a result of BWCs, the data are split into two time periods to examine contributing factors prior to (n = 454,521 incidents) and following BWC deployment (n = 487,901 incidents). It is important to note that the examination of a large number of police–civilian contacts could result in statistically significant results, even when actual differences are small in terms of magnitude. To account for this concern, all findings are presented using both statistical significance and odds ratios, which can be interpreted as a measure of effect size in logistic regression models.

Three separate conditional models are estimated for arrests and the use of force. First, a model predicting each outcome using the data collected prior to BWC deployment is estimated to serve as a baseline for understanding factors that influence arrest and use of force before the implementation of BWCs. Second, a model predicting each outcome using the data collected after BWCs were deployed, including the BWC activation, multiple activations, and officer-level BWC assignment variables, is estimated to determine whether BWCs exert a direct effect on arrests and/or use of force and to compare any differences among other contributing factors across time periods. These two models are used to answer my first research question: how do situational, officer, and neighborhood-level factors influence arrests and use of force? To examine my second research question, whether BWCs moderate the influence of neighborhood context on police behavior, a final model using the post-BWC data, including cross-level interaction terms between BWC activation and neighborhood disorganization, percentage of Hispanic residents, percentage of Black residents, and the violence rate, is used. This model allows me to assess whether the influence of neighborhood context on arrest and use of force differs when BWCs are activated.

To examine whether cross-classified models had more explanatory power than individual hierarchical models accounting for the influence of responding officers or neighborhoods alone, I estimated an unconditional hierarchical logistic model (HGLM) predicting each outcome nested within responding officers and a second unconditional HGLM predicting the outcome nested within neighborhoods for each time period. Likelihood ratio tests were then used to compare each of these HGLMs to an unconditional cross-classified model predicting the outcome cross-nested within both the individual officer and neighborhood for that respective time period. The results suggest that the cross-classified models are a significantly better predictor of arrests and use of force than either of the two-level HGLMs for every outcome and time period, with the exception of the use of force after BWCs were deployed. These results indicate that the cross-classified model did not significantly improve explanatory power over using an HGLM predicting force as a function of individual officers. Collectively, these results suggest that accounting for both officers and neighborhoods improves our understanding of police behavior beyond accounting for either factor in isolation (see Table C1 in Appendix C for the model fit statistics and results of the model comparisons).

5 | RESULTS

Unconditional cross-classified models were used to examine the portion of variance attributable to the random effect for the officer and the neighborhood on arrests and use of force. As shown in Table 2, individual officers had a stronger effect on arrests and use of force than neighborhoods.

TABLE 2 Unconditional model results

	Arrest		Use of force	
	Pre-BWC	Post-BWC	Pre-BWC	Post-BWC
Intercept – Coef. (SE)	−1.08 (0.03)	−1.01 (0.03)	−7.49 (0.07)	−7.56 (0.08)
Random effects				
Responding officer				
VC (SD)	0.20 (0.44)	0.16 (0.40)	0.33 (0.57)	0.57 (0.76)
ICC	0.06	0.05	0.09	0.14
Neighborhood				
VC (SD)	0.05 (0.23)	0.10 (0.31)	0.16 (0.41)	0.12 (0.34)
ICC	0.02	0.03	0.04	0.03
AIC	496,443.40	556,784.40	4,539.30	4,617.60
BIC	496,476.50	556,817.70	4,572.30	4,650.90

Note: A total of 454,521 pre-BWC and 487,901 post-BWC incidents cross-nested in both officers (n = 433) and neighborhoods (n = 386).

Abbreviations: ICC, intraclass correlation coefficient; SD, standard deviation; SE, standard error; VC, variance component.

For instance, the intraclass correlation coefficients indicate that 6% of the variation in arrests is attributable to individual officers and only 2% was attributable to neighborhoods before BWCs. For use of force, 9% of the variation was related to officers, and 4% was related to neighborhoods prior to BWCs. However, responding officers accounted for 14% of the variation in the use of force after BWCs were deployed.

5.1 | Arrest

The arrest results indicate that situational characteristics have a strong impact on these outcomes. Officer precinct assignment and years of service also influenced arrests. The neighborhood context additionally contributed to arrests, with arrests being more likely to occur in both Hispanic and Black neighborhoods. These trends were largely consistent from pre- to post-BWC deployment. BWCs themselves had nuanced influences on arrest, with BWC activation increasing the likelihood of arrest at the incident level. However, officer-level BWC assignment decreased the odds of arrest. BWC activation did moderate the influence of neighborhood context, increasing the likelihood of arrest in disorganized neighborhoods but reducing the likelihood of arrest in neighborhoods with larger Black populations.

Beginning with the pre-BWC deployment model in Table 3, the odds of an arrest were significantly greater during proactive contacts than responses to civilian requests for service (odds ratio [OR] = 2.04; $p < 0.001$). Relative to violent offenses, the odds of an arrest were significantly greater during property offenses (OR = 1.36; $p < 0.001$), but subject/vehicle stops (OR = 0.20; $p < 0.001$) and other call types (OR = 0.43; $p < 0.001$) were associated with significantly lower odds of arrest. The number of responding officers also significantly increased the odds of arrest (OR = 1.22; $p < 0.001$), consistent with the idea that additional officers could result in more legalistic responses. The odds of arrest were significantly greater for incidents involving college-educated officers than for those with lower levels of educational attainment (OR = 1.11; $p < 0.05$). Each additional year of service decreased the odds of arrest (OR = 0.98; $p < 0.001$). Incidents involving officers assigned to the South Mountain (OR = 0.80; $p < 0.001$), Central City (OR = 0.82;

TABLE 3 Arrest models

	Pre-BWCs		Post-BWCs (Direct)		Post-BWCs (Moderating)	
	Coef. (SE)	**OR**	**Coef. (SE)**	**OR**	**Coef. (SE)**	**OR**
Situational						
BWC activation	–	–	0.80 (0.02)	2.23***	0.80 (0.02)	2.23***
Proactive contact	0.71 (0.01)	2.04***	0.86 (0.01)	2.35***	0.86 (0.01)	2.35***
Property	0.31 (0.01)	1.36***	0.04 (0.01)	1.04***	0.04 (0.01)	1.04
Subject/vehicle stop	−1.61 (0.02)	0.20***	−1.67 (0.01)	0.19***	−1.67 (0.01)	0.19***
Other call type	−0.84 (0.01)	0.43***	−0.90 (0.01)	0.41***	−0.90 (0.01)	0.41***
Number of responding officers	0.20 (0.00)	1.22***	0.24 (0.00)	1.28***	0.24 (0.00)	1.28***
Multiple activations	–	–	0.38 (0.03)	1.46***	0.38 (0.03)	1.46***
Officer						
Assigned BWC	–	–	−0.56 (0.05)	0.57***	−0.56 (0.05)	0.57***
Male	−0.04 (0.07)	0.96	−0.12 (0.07)	0.89	−0.12 (0.07)	0.89
White	0.01 (0.05)	1.01	0.02 (0.04)	1.02	0.02 (0.04)	1.02
College educated	0.10 (0.04)	1.11*	0.06 (0.04)	1.06	0.06 (0.04)	1.06
Tenure	−0.02 (0.00)	0.98***	0.01 (0.00)	1.01***	0.01 (0.00)	1.01***
Black Mountain	−0.03 (0.07)	0.97	−0.06 (0.07)	0.94	−0.06 (0.07)	0.94
South Mountain	−0.23 (0.07)	0.80***	−0.18 (0.07)	0.83**	−0.18 (0.07)	0.83**
Central City	−0.20 (0.09)	0.82*	−0.26 (0.09)	0.77**	−0.26 (0.09)	0.77**
Mountain View	−0.13 (0.06)	0.88*	0.09 (0.06)	1.09	0.09 (0.06)	1.09
Cactus Park	−0.01 (0.07)	0.99	0.12 (0.07)	1.13	0.12 (0.07)	1.13
Neighborhood						
Disorganization	−0.01 (0.02)	0.99	−0.03 (0.03)	0.97	−0.04 (0.03)	0.96
Hispanic	0.19 (0.06)	1.21**	0.47 (0.07)	1.59***	0.45 (0.07)	1.58***
Black	0.56 (0.18)	1.75**	0.60 (0.22)	1.82**	0.69 (0.23)	2.00**

(Continues)

TABLE 3 (Continued)

	Pre-BWCs		Post-BWCs (Direct)		Post-BWCs (Moderating)	
	Coef. (SE)	OR	Coef. (SE)	OR	Coef. (SE)	OR
Violence rate	0.00 (0.00)	1.00	0.00 (0.00)	1.00	0.00 (0.00)	1.00
Population density	0.00 (0.00)	1.00***	0.00 (0.00)	1.00*	0.00 (0.00)	1.00*
Cross-level interactions						
Disorganization * BWC	–	–	–	–	0.04 (0.02)	1.05*
Hispanic * BWC	–	–	–	–	0.10 (0.06)	1.10
Black * BWC	–	–	–	–	−0.48 (0.17)	0.62**
Violence rate * BWC	–	–	–	–	0.00 (0.00)	1.00
Intercept	−0.96 (0.09)	0.38***	−1.18 (0.09)	0.31***	−1.18 (0.09)	0.31***
Random effects	VC (SD)	ICC	VC (SD)	ICC	VC (SD)	ICC
Responding officer	0.17 (0.42)	0.04	0.16 (0.40)	0.04	0.16 (0.40)	0.04
Neighborhood	0.03 (0.16)	0.01	0.04 (0.21)	0.01	0.04 (0.21)	0.01
AIC	462,239.00		516,146.00		516,127.70	
BIC	462,481.60		516,423.50		516,449.50	

Note: A total of 454,521 pre-BWC and 487,901 post-BWC incidents cross-nested in officers ($n = 433$) and neighborhoods ($n = 386$); violent calls and the desert horizon precinct used as the reference categories.

Abbreviations: ICC, intraclass correlation coefficient; SD, standard deviation; SE, standard error; VC, variance component.

$^{***}p < 0.001$, $^{**}p < 0.01$, $^{*}p < 0.05$.

$p < 0.05$), and Mountain View (OR = 0.88; $p < 0.05$) precincts also had lower odds of arrest than those assigned to Desert Horizon. Finally, at the neighborhood level, the odds of arrest were significantly higher in neighborhoods with larger Hispanic (OR = 1.21; $p < 0.01$) and Black (OR = 1.75; $p < 0.01$) populations. Specifically, the odds of arrest increased by 21% for each unit increase in neighborhood percentage of Hispanic residents and by 75% for each unit increase in neighborhood percentage of Black residents. Arrests were also more likely to occur in densely populated neighborhoods, although the magnitude of the effect was negligible (OR = 1.00; $p < 0.001$).

The post-BWC direct effects model indicates that incidents involving BWC activation (OR = 2.23; $p < 0.001$) and those involving multiple BWC activations (OR = 1.46; $p < 0.001$) were significantly more likely to result in arrest. BWC activation has a large effect, increasing the odds of arrest by 123% relative to incidents that did not involve BWC activation. The remaining situational predictors remained consistent from pre- to post-BWC deployment. At the officer level, being assigned to wear a BWC was associated with a significant decrease in the odds of an arrest (OR = 0.57; $p < 0.001$), indicating important differences between wearing and using a BWC on the outcomes of individual incidents. Contrary to the predeployment period, officer education was unrelated to arrest, and officers with more years of experience were significantly more likely to conduct arrests after BWCs were deployed (OR = 1.01; $p < 0.001$), although the effect was relatively small, indicating a 1% increase in the odds of arrest with each additional year of service. Officers assigned to South Mountain (OR = 0.83; $p < 0.01$) and Central City (OR = 0.77; $p < 0.01$) again had lower odds of arrest than those assigned to Desert Horizon. At the neighborhood level, the odds of arrest remained higher in neighborhoods with large Hispanic (OR = 1.59; $p < 0.001$) and Black (OR = 1.82; $p < 0.01$) populations, in addition to densely populated neighborhoods (OR = 1.00; $p < 0.05$). The influence of neighborhood racial/ethnic composition increased in magnitude relative to the pre-BWC period, indicating a 59% increase in the odds of arrest with each unit increase in percentage of Hispanic residents and an 82% increase in the odds of arrest with each unit increase in neighborhood percentage of Black residents, post-BWC deployment.

To determine whether BWC activation significantly moderated the influence of neighborhood context on arrests, a final model including cross-level interaction terms was examined. This model identifies all of the same effects as the direct effects model, with the exception that the difference between property and violent offenses became insignificant after including the interaction terms. The cross-level interaction terms indicate that BWC activation significantly moderated the effect of neighborhood disorganization (OR = 1.05; $p < 0.05$), suggesting that the odds of an arrest were 5% greater in disorganized neighborhoods when BWCs were activated. It is important to note that disorganization alone was associated with a negative, although insignificant, effect on arrest in the direct effects model. Although speculative, this could suggest that officers behave more legalistically in disorganized neighborhoods when there is additional BWC footage of the event. BWC activation also significantly moderated the relationship between neighborhood percentage of Black residents and arrest. Incidents involving BWC activation in neighborhoods with larger Black populations were significantly less likely to result in an arrest (OR = 0.62; $p < 0.01$), suggesting that BWC use reduces the odds of arrest in Black neighborhoods by 38%. This is a notable finding given that the direct effect of neighborhood percentage of Black on arrest remains positive and significant (OR = 2.00; $p < 0.01$). BWC activation did not significantly moderate the influence of percentage of Hispanic residents or the violent crime rate on arrest. These results indicate that BWC activation exerts a nuanced effect on arrest in minority neighborhoods that varies across racial/ethnic groups, even when accounting for a wide range of situational, officer, and other neighborhood factors.

5.2 | Use of force

Less of the variance in the use of force was explained by the variables included in the current study. Like arrests, the use of force is largely driven by situational factors such as the way a contact was initiated and the type of incident. At the officer level, years of service was the only significant predictor of the use of force. Force was unrelated to neighborhood context in this study. BWCs again exerted nuanced influences, with activation increasing the likelihood of force and assignment reducing the odds of force. BWC activation did not moderate the influence of neighborhood context on the use of force.

As shown in Table 4, the odds of force being used were greater during proactive contacts (OR = 4.71; $p < 0.001$) and incidents involving a higher number of responding officers (OR = 5.75; $p < 0.001$) prior to BWC deployment. Each additional responding officer increased the odds of force by 475%, consistent with some prior research (Terrill & Mastrofski, 2002). This could suggest that a large number of responding officers is indicative of the severity of the incident or the threat posed by a suspect. Relative to violent offenses, the odds of force were significantly lower during subject/vehicle stops (OR = 0.44; $p < 0.001$) and other call types (OR = 0.71; $p < 0.05$). At the officer level, the odds of force were significantly greater during incidents involving responding officers with a higher number of years of service (OR = 1.06; $p < 0.001$). None of the neighborhood variables significantly influenced the use of force prior to BWC deployment.

The factors that contribute to the use of force after BWCs were deployed are largely consistent with the predeployment findings. The direct effects model indicates that incidents involving BWC activation (OR = 6.59; $p < 0.001$) and those involving multiple BWC activations (OR = 3.48; $p < 0.001$) had greater odds of force. These are large effects, with BWC activation increasing the odds of force by 559%. The remaining situational predictors remained consistent from pre- to post-BWC deployment. Turning to the officer-level effects, being assigned to wear a BWC significantly decreased the odds of force by 88% (OR = 0.12; $p < 0.001$). This is a particularly notable finding given that BWC activation was associated with a large increase in the odds of force at the situational level. Officers with more years of service again had higher odds of being involved in incidents resulting in force (OR = 1.05; $p < 0.001$). None of the neighborhood predictors influenced force post-BWC deployment.

The direct effects identified in the post-BWC deployment use of force model remained consistent in the moderating effects model. The only significant moderating effect suggests that incidents in neighborhoods with higher rates of violence had significantly greater odds of force when a BWC was activated, although the magnitude of this effect was negligible (OR = 1.002; $p < 0.05$), corresponding to a 0.2% increase in the odds of force with each unit increase in the violent crime rate. These results suggest that neighborhood context exerted a limited influence on officers' decisions to use force both prior to and following BWC deployment, and BWC activation itself did not change these relationships. As such, use of force is strongly driven by offense type, which likely contributes to other elements such as the number of responding officers, far outweighing the influence of the variables examined in the present study.

Given persistent debate about the appropriate universe of contacts for examining police use of force, I additionally ran the use of force models restricting the data to incidents that resulted in arrest (as opposed to all police–civilian contacts). The significance and direction of the effects did not differ, so I elected to present the results using all contacts to keep the sample consistent between the models presented here (supplemental results available upon request).[4]

TABLE 4 Use of force models

	Pre-BWCs		Post-BWCs (Direct)		Post-BWCs (Moderating)	
	Coef. (SE)	OR	Coef. (SE)	OR	Coef. (SE)	OR
Situational						
BWC activation	–	–	1.89 (0.18)	6.59***	1.78 (0.21)	5.90***
Proactive contact	1.55 (0.17)	4.71***	1.78 (0.17)	5.94***	1.78 (0.17)	5.93***
Property	0.10 (0.16)	1.11	−0.15 (0.16)	0.86	−0.15 (0.16)	0.86
Subject/vehicle stop	−0.83 (0.23)	0.44***	−1.08 (0.22)	0.34***	−1.08 (0.22)	0.34***
Other call type	−0.35 (0.17)	0.71*	−0.73 (0.18)	0.48***	−0.73 (0.18)	0.48***
Number of responding officers	1.75 (0.09)	5.75***	1.45 (0.08)	4.24***	1.44 (0.08)	4.24***
Multiple activations	–	–	1.25 (0.22)	3.48***	1.24 (0.22)	3.47***
Officer						
Assigned BWC	–	–	−2.15 (0.22)	0.12***	−2.13 (0.22)	0.12***
Male	0.46 (0.27)	1.58	0.19 (0.25)	1.21	0.20 (0.25)	1.22
White	0.11 (0.15)	1.12	0.08 (0.16)	1.08	0.08 (0.16)	1.08
College educated	−0.13 (0.14)	0.87	−0.05 (0.15)	0.95	−0.06 (0.15)	0.94
Tenure	0.05 (0.01)	1.06***	0.05 (0.01)	1.05***	0.05 (0.01)	1.05***
Black Mountain	0.05 (0.25)	1.05	0.11 (0.28)	1.11	0.11 (0.28)	1.11
South Mountain	0.08 (0.24)	1.08	0.06 (0.27)	1.06	0.07 (0.27)	1.07
Central City	−0.04 (0.30)	0.96	0.54 (0.29)	1.71	0.53 (0.29)	1.70
Mountain View	−0.02 (0.21)	0.98	0.24 (0.23)	1.27	0.24 (0.23)	1.27
Cactus Park	0.12 (0.21)	1.13	−0.02 (0.25)	0.98	−0.02 (0.25)	0.98

(Continues)

TABLE 4 (Continued)

	Pre-BWCs		Post-BWCs (Direct)		Post-BWCs (Moderating)	
	Coef. (SE)	**OR**	**Coef. (SE)**	**OR**	**Coef. (SE)**	**OR**
Neighborhood						
Disorganization	−0.10 (0.14)	0.91	0.06 (0.15)	1.06	0.14 (0.17)	1.15
Hispanic	0.49 (0.39)	1.63	0.25 (0.41)	1.29	0.13 (0.49)	1.14
Black	−1.61 (1.27)	0.20	0.14 (1.18)	1.15	0.21 (1.36)	1.23
Violence rate	0.00 (0.00)	1.00	0.00 (0.00)	1.00	0.00 (0.00)	1.00
Population density	0.00 (0.00)	1.00	0.00 (0.00)	1.00	0.00 (0.00)	1.00
Cross-level interactions						
Disorganization * BWC	–	–	–	–	−0.22 (0.25)	0.81
Hispanic * BWC	–	–	–	–	0.26 (0.70)	1.30
Black * BWC	–	–	–	–	−0.36 (2.21)	0.70
Violence rate * BWC	–	–	–	–	0.00 (0.00)	1.00*
Intercept	−15.08 (0.54)	0.00***	−13.49 (0.49)	0.00***	−13.45 (0.49)	0.00***
Random effects	VC (SD)	ICC	VC (SD)	ICC	VC (SD)	ICC
Responding officer	0.07 (0.27)	0.01	0.31 (0.56)	0.04	0.31 (0.55)	0.04
Neighborhood	0.11 (0.33)	0.01	0.06 (0.25)	0.01	0.06 (0.25)	0.01
AIC	3,533.30		3,549.90		3,553.30	
BIC	3,775.90		3,827.30		3,875.10	

Note: A total of 454,521 pre-BWC and 487,901 post-BWC incidents cross-nested in officers ($n = 433$) and neighborhoods ($n = 386$); violent calls and the desert horizon precinct used as the reference categories.

Abbreviations: ICC, intraclass correlation coefficient; SD, standard deviation; SE, standard error; VC, variance component.

$^{***}p < 0.001$, $^{**}p < 0.01$, $^{*}p < 0.05$.

6 | DISCUSSION

Despite continued rhetoric that connects BWC deployment with the potential to enhance racial/ethnic equity in police–civilian encounters, these results suggest that BWCs have a limited and nuanced influence on police behavior in minority neighborhoods. Although BWCs were directly associated with the outcomes of police–civilian encounters, the relationships were complex. BWC activation increased the likelihood of arrest and use of force, but officer-level BWC assignment had the opposite effect, controlling for numerous situational, officer, and neighborhood factors. Arrests were significantly more likely to occur in incidents that took place in neighborhoods with larger Hispanic and Black populations both prior to and following the deployment of BWCs. Although BWC activation significantly reduced the likelihood of arrest in Black neighborhoods, BWC activation did not moderate the likelihood of arrest in Hispanic neighborhoods. Furthermore, police use of force in Phoenix was not associated with the neighborhood racial/ethnic context either prior to or following the deployment of BWCs. This finding is consistent with a use of force meta-analysis, which similarly found that encounter-level characteristics are strongly correlated with force and that community characteristics are not (Bolger, 2015). As such, the current study points toward the need for some caution for police agencies turning to the use of BWCs to address racial/ethnic disparities in policing outcomes in isolation, without addressing broader policies or practices that could contribute to these disparities.

The results identified here mirrored numerous prior studies of arrest discussed above. Arrests were more likely to occur during violent and property offenses, when multiple responding officers were present, and in minority neighborhoods across every model examined. These findings are consistent with the idea that arrests could be more likely to occur in incidents in which officer discretion is constrained, either by the type of offense involved or the presence of other officer witnesses to these events. The finding that arrests were significantly more likely to occur in neighborhoods with larger Hispanic and Black populations, even controlling for important incident-level factors and officer characteristics, reiterates the importance of examining variation in police behavior in minority communities. These findings could suggest that officers respond more legalistically to incidents that occur in Hispanic and Black neighborhoods relative to White neighborhoods. In essence, officers who are concerned about the appearance of biased decision making could turn to strict enforcement (Wilson, 1978).

It is important to note that arrests on their own are not an inherently good or bad police decision. Arrests are intended to promote public safety by holding offenders accountable and to protect victims from further harm. However, disparities in the use of arrests for similar situations by the same officers in different community contexts, particularly in minority neighborhoods, pose considerable concerns for achieving racial/ethnic equity. Racial/ethnic disparities in arrest decisions could be viewed as either attempts to exert control over minority populations in the event of higher rates of arrest or as underprotecting minority victims in the event of lower rates of arrest in minority communities. Given the substantial downstream consequences of arrest decisions for impacted individuals, their communities, and the criminal justice system at large (Engel et al., 2019), ensuring that these decisions are applied equally across similar situations and are not used differentially depending on neighborhood context is crucial for enhancing police legitimacy. It is imperative to ensure that higher arrest patterns across minority neighborhoods do not culminate in legal cynicism among residents, which could ultimately reduce crime reporting and thereby increase neighborhood crime levels (Kirk & Matsuda, 2011).

The consistent influence of neighborhood racial/ethnic composition on arrest both pre- and post-BWC deployment suggests that simply adopting this technology will not erase disparities in different types of neighborhoods. However, the results do indicate that police arrest behavior in Black neighborhoods is significantly related to whether a BWC is activated during a specific encounter. When BWCs were activated in Black neighborhoods, incidents were significantly less likely to result in arrest (a 38% reduction in the odds, all else constant). This finding is consistent with reductions in the number of felony arrests identified in Black neighborhoods after BWCs were deployed in Louisville (Hughes et al., 2020). However, BWC activation did not reduce the likelihood of arrest in neighborhoods with larger Hispanic populations. One potential explanation for these differences is that officers are over utilizing arrests in Black neighborhoods due to extralegal factors but are not engaging in the same practices in Hispanic neighborhoods. Namely, differential arrest in Black neighborhoods due to extralegal factors—net of other situational, officer, and neighborhood factors—could be prevented when BWCs are used because officers are more aware of the potential for their decisions to be reviewed and could turn to alternative resolutions. If the higher likelihood of arrest identified in Hispanic neighborhoods is driven by legally relevant differences in incidents in these neighborhoods, BWCs are unlikely to change these patterns.

Although BWCs are commonly evaluated based on their influence on police behavior, several advocates have suggested that this technology will also influence civilian responses to the police. Given research suggesting that civilian support for the police differs across Black and Hispanic communities (Weitzer, 2017), this variation could drive the divergent findings if individuals in Black areas respond to BWCs by reducing their cooperation with the police and those in Hispanic neighborhoods do not. The finding that arrests were less likely to occur in Black neighborhoods when BWCs were used could be influenced by social norms in these areas that discourage cooperation with the police. This could be related to the code of the street, which suggests that individuals in high crime Black neighborhoods could refrain from reporting crime to the police or cooperating in investigations to avoid police harassment or being deemed a "snitch" within the community (Anderson, 1999; Kane, 2005). Namely, resident concerns about protecting their identity could be enhanced when BWCs are used in Black neighborhoods, reducing victims' and witnesses' willingness to identify offenders or provide evidence that could support the use of arrest. This is a crucial concern given that the ability of the police to identify suspects and make arrests is highly related to civilian cooperation (White et al., 2021).

The findings of the current study could also differ due to the nature of Phoenix, which is situated in Maricopa County. Home to former Sheriff Joe Arpaio, the Maricopa County Sheriff's Office was nationally recognized for taking a hard stance on immigration enforcement, resulting in a civil rights investigation by the Department of Justice to address the unlawful detention of Hispanic individuals (Perez, 2011). Although the Phoenix Police Department and Maricopa County Sheriff's Office are distinct law enforcement agencies, the relationships between Hispanic communities and the police in the Phoenix metropolitan area are unquestionably influenced by this history (Rojek et al., 2019). As such, these strained relationships could influence civilian responses to police in neighborhoods with large Hispanic populations, which could increase the likelihood of arrest if civilians in these areas are more likely to resist officers. This contentious legal backdrop could also increase pressure for officers to respond legalistically to incidents occurring in Hispanic neighborhoods, thereby deferring the resolution of an incident to the courts to avoid scrutiny related to lengthy detentions. Phoenix officers could also be more reliant on arrests in Hispanic communities in response to improper documentation or to book someone into jail where their immigration status will be checked (Garcia, 2020). In sum, future research should more fully address whether legally relevant factors that were not captured in the measures used here could explain the higher likelihood of arrest in Hispanic neighborhoods. Leveraging BWC footage captured in these areas could identify factors that might drive these differences in arrest across minority neighborhoods.

This is not the first study to find that patterns of social control and police behavior vary in Black and Hispanic neighborhoods. For example, research in New York City using the defended neighborhoods perspective suggests that minority threat perceptions were triggered in Hispanic neighborhoods differently than in Black neighborhoods, culminating in different police deployment patterns (Kane, 2003) and misconduct (Kane, 2002), net of economic resource deprivation and crime levels. Researchers in Miami similarly identified differential police stops involving Black and Hispanic individuals, with Black individuals experiencing higher stop rates relative to Whites, although Hispanics did not (Stults et al., 2010). It is important to point out that Miami, like Phoenix, has a large Hispanic population, which could limit the racial threat posed by this group and result in similar police behaviors across Hispanic and White individuals. As such, researchers should continue to assess the influence of racial/ethnic minority contexts using disaggregated measures of race/ethnicity. Reliance on aggregate measures of racial/ethnic minority populations could mask important nuances in police behavior across subgroups. It is important to reiterate that neighborhood levels of violence did not influence police arrests or use of force when situational, officer, and other contextual factors were accounted for. Thus, the relationship between neighborhood racial/ethnic population distributions and police decision making appears to be driven by race and not violence.

Although much of the variation in this study was driven by offense type, these results also indicate that individual officers use arrests and force in different ways and that these officer-level influences are more influential on these outcomes than neighborhood context. Although the variance explained by responding officers in the current study is lower than prior research examining the influence of individual officers on arrests—with only 6% of the variation in arrest attributable to officers in the current study, compared to 36% in Cincinnati, Ohio and 20% of nonwarrant arrests pursuant to traffic stops in San Jose, California (Novak & Engel, 2005; Tillyer et al., 2019), the results highlight the importance of accounting for individual officers to better understand the outcomes of police civilian encounters. Additional research should examine ways to ensure that officers conduct arrests and use force consistently across legally similar situations, even when they occur in different social ecological environments. Some scholars have advocated for enhancing existing data collection systems within police agencies to bolster supervisory systems and enable police organizations to better identify and correct disparities caused by individual officers (Lum, 2021). Although sergeants in Phoenix are required to randomly review BWC footage produced by their officers each month, more intentional and strategic reviews that systematically track patterns of officer behavior could better identify disparities caused by individual officers. Identifying these patterns is crucial for leveraging BWCs to facilitate increased internal accountability and correct concerning behaviors.

The results of the present study should be interpreted within the context of a number of limitations. The current study accounted for the influence of BWCs on the outcomes of police–civilian encounters in two primary ways: (1) whether a BWC was activated during an individual incident and (2) whether the primary responding officer was assigned to wear a BWC. Given that the proposed theoretical mechanisms that link BWCs to officer behaviors require an officer to be wearing a BWC *and* to actually turn that camera on to deter poor behavior, the inclusion of a BWC activation variable at the incident level and a BWC assignment variable at the officer level is meant to fully capture this relationship. Namely, the activation variable captures whether any

BWC footage of an incident was recorded, which could alter the behaviors of all responding officers. For instance, several officers involved in this study noted that they would alert their peers when they activate their BWCs, which also have a visible indicator light when activated. Officers who were assigned to wear a BWC were also highly aware of the presence of this technology, which could alter their behavior relative to officers who were not wearing a BWC. This study did not specifically account for whether any secondary or other responding officers were wearing a BWC that was not activated at the time of the encounter. Although the BWC activation variable would capture whether any BWC was activated, it is not possible to rule out the possibility that some incidents could involve secondary responding officers who were wearing BWCs that were not activated and therefore not captured using the measures included in the present models. A prior impact evaluation of BWCs in Phoenix examined and discussed the potential influence of treatment contamination that occurs when BWCs and control officers respond to the same incidents at length, with results suggesting that varying levels of contamination had minimal impact on the likelihood of arrest and use of force (see appendix 2 in Huff et al., 2020). Future work should seek to isolate the influence of BWCs (both activation and presence) on the outcomes of individual incidents to further address concerns about treatment contamination.

Although the present study sought to examine the potential for BWCs to reduce disparities across racial/ethnic minority neighborhoods, it was not possible to examine the direct influence of civilian race/ethnicity using the available data. A substantial amount of research has examined the influence of civilian race/ethnicity on both arrests (Kochel et al., 2011) and use of force (Hollis & Jennings, 2018), finding evidence of disparity in arrest but less conclusive evidence in use of force, consistent with the neighborhood-level results presented here. Furthermore, some research indicates that the police are more likely to conduct arrests (Gaston, 2019a) and use force (Morrow et al., 2018) against individuals who are perceived as "out of place" in the areas in which they are encountered. As such, increased arrest rates in minority neighborhoods could be driven by higher rates of arrests involving White civilians, a possibility that could not be examined using the current data. Others similarly highlight the importance of assessing in-group bias on officer decision making involving civilians of the same race (Rojek et al., 2012; Tillyer et al., 2019). Although officer race/ethnicity was unrelated to arrest and use of force in the current study, future research should examine whether this relationship changes when civilian race/ethnicity is considered. Although this study did not identify a direct effect of neighborhood racial/ethnic composition on police use of force, future research should more directly assess the influence of BWCs and civilian race/ethnicity in police use of force incidents.

Finally, although many legally relevant and extralegal covariates were included in these models, it is possible that other key variables that were not captured could bias these results. Future researchers should seek to better account for legal explanations of arrest and use of force, beyond offense type, to further isolate the influence of neighborhood racial/ethnic composition and BWC use on these outcomes. For example, arrests are strongly correlated with evidentiary strength, and the presence of a warrant (Engel et al., 2019) and use of force is strongly associated with civilian resistance (Fridell & Lim, 2016; Fryer, 2019; Wright & Headley, 2020). The inability to account for these legal factors and civilian demographic characteristics is a considerable limitation of this study that should be addressed in future research.

These limitations are linked to a broader challenge facing researchers who use administrative police data, which is not collected or managed for research purposes but rather to satisfy the needs of the police agency itself. Police practitioners have expressed similar frustrations about the inability to capture and evaluate trends using data available within their agencies, resulting in the creation of model data collection guidelines (Police Executive Research Forum, 2021). Police agencies should consider implementing these strategies to ensure that all necessary data are collected and stored in a useable format for understanding and correcting concerning officer behaviors within their agencies. Finally, this study represents police–civilian encounters in a single, large municipal police agency in the southwestern United States. Although the study setting provides several advantages by enabling an evaluation of a large number of encounters across racially/ethnically diverse neighborhoods, characteristics unique to the city of Phoenix or the Phoenix Police Department could limit the generalizability of these results. Future research should examine whether these findings hold in other types of agencies in other regions.

7 | CONCLUSION

These results contribute to the rapidly expanding body of research examining the influence of BWCs on arrests and the use of force (Lum et al., 2019; White & Malm, 2020). Although BWC activation was associated with significantly greater odds of arrest and use of force at the encounter level, BWC assignment at the officer level was associated with significant reductions in the odds of each outcome. As such, these results further highlight the importance of distinguishing between the impact of BWC use and BWC assignment on the outcomes of police–civilian interactions.

Moving beyond the direct effects of BWCs, these results additionally find a differential impact of BWC use across minority neighborhoods. This study suggests that BWC activation significantly reduces the likelihood of arrest in neighborhoods with larger Black populations but does not moderate the influence of neighborhood percentage of Hispanic residents on arrest. Furthermore, BWC activation did not change the influence of neighborhood context on police use of force. Prior research examining the influence of BWCs on racial/ethnic disparities across different contexts similarly finds no effect on misdemeanor traffic case processing in Tempe, Arizona (Huff et al., 2021) and increased proactivity but decreased felony arrests in Black neighborhoods in Louisville, Kentucky (Hughes et al., 2020), pointing to nuanced influences of this technology on disparities across outcomes and contexts. This is the first study to assess the influence of BWCs on the use of force in minority neighborhoods specifically, finding no moderating effect of BWC activation. As such, police agencies seeking to reduce racial/ethnic disparities in police–civilian encounters across different neighborhood contexts should pursue more holistic approaches to training and policies delineating when and how officers should use their authority. Agencies can supplement these policies with strategic BWC footage reviews to enhance internal supervision and address concerns arising from improper use of discretion.

The finding that BWCs cannot solve every problem facing policing is not new. Nevertheless, this technology continues to be deployed in agencies across the United States to promote police transparency and legitimacy, among a number of other goals. The often immediate requests for police agencies to adopt BWCs in response to high profile police use of force incidents involving minority civilians indicates that reducing racial/ethnic disparities in policing outcomes is one of these goals. However, these findings suggest that the ability of BWCs to increase equitable policing outcomes on their own, particularly in the case of use of force, could be overstated. Prior research indicates that strategic policy changes can effectively reduce racial/ethnic disparities in police behavior in minority neighborhoods (MacDonald & Braga, 2019). As such, leveraging the information collected through BWC footage to better identify factors that contribute to observed racial/ethnic disparities in police behavior across communities could provide guidance for policy makers interested in reducing these disparities.

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CONFLICT OF INTEREST

The author confirms that they have no conflict of interest to delcare.

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ENDNOTES

[1] Supplemental analyses were used to examine whether officers who did not participate in the survey had different demographic or behavioral patterns than those officers who agreed to participate. A significantly greater proportion of surveyed officers identified as non-White (Chi-square = 5.32; $p < 0.05$) and survey participants had significantly fewer years of service ($t = 3.24$; $p < 0.01$), relative to officers who did not take the survey. There were no significant differences in the number of calls-for-service, self-initiated calls-for-service, arrests, use of force, or complaints between those officers who participated in the survey and those who did not during the 18 months prior to BWC deployment. As such, these results might be more generalizable to non-White officers and those with fewer years of experience. Full results are available upon request.

[2] The inclusion of the BWC activation variable at the incident level captures whether any BWC was activated during an incident, regardless of the treatment condition to which the primary responding officer is assigned. This should capture the self-awareness effect of BWCs for all responding officers at the incident level because officers regularly notify each other when they activate their BWCs.

[3] See Huff et al. (2020) for an evaluation of the impact of BWC assignment, BWC activation, and treatment contamination that occurs when BWC officers and control officers respond to the same incidents on the outcomes of individual encounters, including arrests and use of force. For a breakdown of the number of responding officers before and after BWC deployment, in addition to primary responding officer treatment condition during the post-BWC period, see Table A1 in Appendix A.

[4] Supplemental analyses were also used to examine whether the findings were consistent between reactive and proactive police incidents, as shown in Appendix D. Although there are some minor differences in predictors of arrest and use of force when splitting the data into reactive and proactively initiated encounters, the main findings are largely consistent with the aggregated results.

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APPENDIX A

TABLE A1 Supplemental description of the number of responding officers

Number of responding officers	Pre-BWC (n = 454,521)	Post-BWC(n = 487,901)	
		Primary BWC	Primary control
	n (%)	n (%)	n (%)
1	95,039 (20.91%)	19,459 (15.8%)	78,366 (21.48%)
2	213,456 (46.96%)	53,949 (43.82%)	17,1243 (46.94%)
3	70,462 (15.50%)	20,676 (16.79%)	55,687 (15.27%)
4	37,720 (8.30%)	13,233 (10.75%)	30,013 (8.23%)
5	37,844 (8.33%)	15,805 (12.84%)	29,470 (8.08%)

APPENDIX B
GRAPHICAL REPRESENTATION OF THE CROSS-CLASSIFIED MODELING STRATEGY

Incident 1 (in blue) occurred in Neighborhood I and was responded to by Officer A. Incident 2 (in green) also occurred in Neighborhood I but was responded to by Officer B. Incident 3 (in red) occurred in Neighborhood II and was responded to by Officer A. Finally, Incident 4 (in purple) also occurred in Neighborhood II but was responded to by Officer B. The ability of individual officers to respond to incidents that occur in different neighborhoods creates a cross-nested structure within the data, which inhibits the use of hierarchical models, which would require all incidents that occur in the same neighborhood to also be responded to by the same officer (i.e., all incidents in Neighborhood I would need to be responded to by Officer A, and all incidents in Neighborhood II would need to be responded to by Officer B, without either officer responding to any incidents outside of those neighborhoods). Cross-classified models appropriately capture this data structure by treating incidents as Level 1 and both officers and neighborhoods as Level 2, allowing for an examination of multiple combinations of responding officers and neighborhoods on individual incidents.

APPENDIX C

TABLE C1 Model fit statistics for unconditional HGLM and cross-classified models

	Pre-BWCs			Post-BWCs		
	AIC	**BIC**	**Chi-square**	**AIC**	**BIC**	**Chi-square**
Arrests						
HGLM nested within officers	498,451.00	498,473.00	2,009.90***	559,720.00	559,742.00	2,937.40***
HGLM nested within neighborhoods	506,944.00	506,966.00	10,503.00***	567,734.00	567,756.00	10,952.00***
Cross-classified model	496,443.00	496,476.00		556,784.00	556,818.00	
Use of force						
HGLM nested within officers	4,542.20	4,564.30	4.96*	4,617.80	4,640.00	2.16
HGLM nested within neighborhoods	4,549.20	4,571.30	11.95***	4,648.60	4,670.80	33.01***
Cross-classified model	4,539.30	4,572.30		4,617.60	4,650.90	

Note: Chi-square based on a likelihood-ratio test between the HGLM and the cross-classified model, with significant results indicating significantly improved model fit using the cross-classified model relative to the HGLM.
$^{***}p < 0.001$, $^{**}p < 0.01$, $^{*}p < 0.05$.

APPENDIX D
SUPPLEMENTAL ANALYSES DISAGGREGATED BY REACTIVE AND PROACTIVE CONTACTS

Based on a recommendation from a reviewer, these analyses were additionally conducted separately for reactive (i.e., police responses to civilian requests for service) and proactive (i.e., officer-initiated contacts) police–civilian encounters. Although the results were largely consistent with the aggregated sample using all police–civilian contacts reported in the main text, there are some differences worth noting.

Beginning with the supplemental arrest results presented in Table D1, there were a few variables that were statistically significant in the aggregated results but became insignificant in the disaggregated models. For example, the odds of arrest were significantly higher in Hispanic and Black neighborhoods across every model examined using the aggregated data. Although the direction of the effects remained consistent across the disaggregated models, the odds of arrest were no longer significantly higher in proactive contacts that occurred in Hispanic and Black neighborhoods prior to BWC deployment or in reactive contacts that occurred in Black neighborhoods after the adoption of BWCs. Furthermore, the interaction between BWC deployment and neighborhood disorganization was no longer statistically significant when restricting the data to reactive or proactive contacts. This was a relatively small difference in the aggregated model in terms of effect size (OR = 1.05; $p < 0.05$), which could have been driven by sample size and was interpreted cautiously in the main results.

It is important to note that several variables that were not significantly associated with arrest using the aggregated data became statistically significant using the disaggregated data. For instance, neighborhood disorganization was associated with significantly lower odds of arrest during proactive contacts prior to BWC deployment ($b = -0.10$; $p < 0.05$), although this difference was not observed in any of the post-BWC models. There were also changes in significance across some of the precinct assignments post-BWC deployment. These results suggest that officers assigned to Cactus Park had higher odds of conducting an arrest during reactive contacts than those assigned to Desert Horizon ($b = 0.15$; $p < 0.05$). In contrast, officers assigned to Mountain View had significantly higher odds of conducting an arrest during proactive contacts than those assigned to Desert Horizon after BWCs were deployed ($b = 0.24$; $p < 0.05$). These findings further highlight variation in officer behavior across precincts.

As shown in Table D2, the disaggregated use of force results were also largely consistent with the aggregated results. Most of the differences identified were changes in statistical significance but not the direction of the effects. There were some notable differences in the use of force across neighborhoods during proactive contacts that were not captured using the aggregated data. During proactive contacts that occurred prior to BWC deployment, the odds of a use of force were significantly lower in socially disorganized neighborhoods ($b = -0.91$; $p < 0.01$) but significantly higher in neighborhoods with large Hispanic populations ($b = 1.95$; $p < 0.05$). These differences across neighborhoods were not identified in either proactive or reactive contacts after BWCs were deployed. Furthermore, the cross-level interaction term between BWC activation and neighborhood percentage of Hispanic individuals became significant when the sample was reduced to proactive contacts after BWCs were deployed. Namely, force was significantly more likely to be used during proactive contacts in Hispanic neighborhoods when BWCs were activated ($b = 2.70$; $p < 0.05$). Interestingly, the results in the reactive contacts model are statistically insignificant but suggest that officers are less likely to use force in Hispanic neighborhoods when BWCs are used. This is a notable finding that reiterates the importance of accounting for the manner in which contact was initiated when examining the influence of BWCs on police behavior across neighborhoods. Additional research further examining differences in police arrest and use of force during reactive and proactive contacts is needed.

TABLE D1 Arrest models split into reactive and proactive incidents

	Pre-BWCs		Post-BWCs (Direct)		Post-BWCs (Moderating)	
	Reactive (*n* = 389,794)	**Proactive (*n* = 64,727)**	**Reactive (*n* = 403,226)**	**Proactive (*n* = 84,675)**	**Reactive (*n* = 403,226)**	**Proactive (*n* = 84,675)**
	Coef. (SE)	Coef. (SE)	Coef. (SE)	Coef. (SE)	Coef. (SE)	Coef. (SE)
Situational						
BWC activation	–	–	0.92 (0.02)***	0.31 (0.04)***	0.90 (0.02)***	0.27 (0.04)***
Property	0.28 (0.01)***	0.97 (0.07)***	0.01 (0.01)	0.77 (0.07)***	0.01 (0.01)	0.77 (0.07)***
Subject/vehicle stop	−1.43 (0.02)***	−1.71 (0.06)***	−1.53 (0.02)***	−1.78 (0.06)***	−1.53 (0.02)***	−1.78 (0.06)***
Other call type	−0.86 (0.01)***	−0.66 (0.06)***	−0.90 (0.01)***	−0.95 (0.06)***	−0.90 (0.01)***	−0.95 (0.06)***
Number of responding officers	0.18 (0.00)***	0.41 (0.01)***	0.23 (0.00)***	0.41 (0.01)***	0.23 (0.00)***	0.41 (0.01)***
Multiple activations	–	–	0.38 (0.03)***	0.40 (0.09)***	0.38 (0.03)***	0.40 (0.09)***
Officer						
Assigned BWC	–	–	−0.65 (0.05)***	−0.15 (0.09)	−0.65 (0.05)***	−0.15 (0.09)
Male	−0.04 (0.07)	−0.11 (0.10)	−0.13 (0.06)*	0.01 (0.11)	−0.13 (0.06)*	0.01 (0.11)
White	−0.01 (0.05)	0.09 (0.07)	0.01 (0.04)	0.03 (0.08)	0.01 (0.04)	0.03 (0.08)
College educated	0.09 (0.05)*	0.13 (0.07)	0.04 (0.04)	0.15 (0.07)*	0.04 (0.04)	0.15 (0.07)*
Tenure	−0.02 (0.00)***	0.00 (0.00)	0.01 (0.00)**	0.02 (0.00)***	0.01 (0.00)**	0.02 (0.00)***
Black Mountain	0.00 (0.08)	−0.16 (0.11)	−0.09 (0.07)	−0.05 (0.12)	−0.09 (0.07)	−0.05 (0.12)
South Mountain	−0.21 (0.07)**	−0.35 (0.11)**	−0.16 (0.07)*	−0.33 (0.12)**	−0.16 (0.07)*	−0.33 (0.12)**
Central City	−0.19 (0.10)*	−0.19 (0.14)	−0.19 (0.09)*	−0.38 (0.15)*	−0.20 (0.09)*	−0.38 (0.15)*
Mountain View	−0.16 (0.07)*	0.01 (0.10)	0.05 (0.06)	0.24 (0.11)*	0.05 (0.06)	0.24 (0.11)*
Cactus Park	0.00 (0.07)	−0.07 (0.10)	0.15 (0.06)*	−0.03 (0.11)	0.14 (0.06)*	−0.03 (0.11)

(Continues)

TABLE D1 (Continued)

	Pre-BWCs		Post-BWCs (Direct)		Post-BWCs (Moderating)	
	Reactive (n = 389,794)	**Proactive (n = 64,727)**	**Reactive (n = 403,226)**	**Proactive (n = 84,675)**	**Reactive (n = 403,226)**	**Proactive (n = 84,675)**
Neighborhood						
Disorganization	0.02 (0.02)	−0.10 (0.04)*	0.01 (0.03)	−0.07 (0.05)	0.00 (0.03)	−0.08 (0.05)
Hispanic	0.15 (0.06)*	0.21 (0.12)	0.34 (0.07)***	0.46 (0.14)***	0.34 (0.07)***	0.43 (0.14)**
Black	0.54 (0.19)**	0.12 (0.38)	0.31 (0.22)	1.11 (0.41)**	0.39 (0.22)	1.31 (0.42)**
Violence rate	0.00 (0.00)***	0.00 (0.00)***	0.00 (0.00)*	0.00 (0.00)***	0.00 (0.00)*	0.00 (0.00)***
Population density	0.00 (0.00)**	0.00 (0.00)***	0.00 (0.00)*	0.00 (0.00)*	0.00 (0.00)*	0.00 (0.00)*
Cross-level interactions						
Disorganization * BWC	–	–	–	–	0.03 (0.02)	0.07 (0.06)
Hispanic * BWC	–	–	–	–	0.04 (0.06)	0.19 (0.16)
Black * BWC	–	–	–	–	−0.39 (0.18)*	−1.60 (0.57)**
Violence rate * BWC	–	–	–	–	0.00 (0.00)	0.00 (0.00)
Intercept	−0.84 (0.09)***	−1.11 (0.15)***	−1.06 (0.08)***	−1.18 (0.15)***	−1.06 (0.08)***	−1.18 (0.15)***
Random effects	VC (SD)	VC (SD)	VC (SD)	VC (SD)	VC (SD)	VC (SD)
Responding officer	0.19 (0.43)	0.34 (0.58)	0.15 (0.39)	0.19 (0.43)	0.15 (0.39)	0.42 (0.65)
Neighborhood	0.03 (0.17)	0.07 (0.26)	0.04 (0.19)	0.03 (0.17)	0.04 (0.19)	0.10 (0.32)
AIC	404,916.00	54,169.90	435,201.30	75,357.00	435,193.40	75,347.90
BIC	404,874.00	54,360.60	435,463.10	75,581.30	435,498.80	75,609.60

Note: Incidents cross-nested in both officers (n = 433) and neighborhoods (n = 386); violent calls and the desert horizon precinct used as the reference categories.

Abbreviations: ICC, intraclass correlation coefficient; SD, standard deviation; SE, standard error; VC, variance component.

***$p < 0.001$, **$p < 0.01$, *$p < 0.05$.

TABLE D2 Use of force models split into reactive and proactive incidents

	Pre-BWCs		Post-BWCs (Direct)		Post-BWCs (Moderating)	
	Reactive (n = 389,794)	**Proactive (n = 64,727)**	**Reactive (n = 403,226)**	**Proactive (n = 84,675)**	**Reactive (n = 403,226)**	**Proactive (n = 84,675)**
	Coef. (SE)	**Coef. (SE)**	**Coef. (SE)**	**Coef. (SE)**	**Coef. (SE)**	**Coef. (SE)**
Situational						
BWC activation	–	–	1.79 (0.21)***	2.08 (0.37)***	1.64 (0.23)***	2.01 (0.42)***
Property	0.26 (0.17)	−1.15 (0.53)*	0.12 (0.17)	−1.79 (0.51)***	0.13 (0.17)	−1.85 (0.51)***
Subject/vehicle stop	−1.46 (0.52)**	−1.49 (0.31)***	−1.53 (0.52)**	−1.95 (0.27)***	−1.52 (0.52)**	−1.97 (0.27)***
Other call type	−0.06 (0.18)	−1.71 (0.43)***	−0.33 (0.19)	−2.41 (0.44)***	−0.33 (0.19)	−2.43 (0.44)***
Number of responding officers	2.00 (0.12)***	1.36 (0.12)***	1.68 (0.11)***	1.17 (0.11)***	1.68 (0.11)***	1.17 (0.11)***
Multiple activations	–	–	1.48 (0.24)***	0.52 (0.49)	1.48 (0.24)***	0.48 (0.49)
Officer						
Assigned BWC	–	–	−2.23 (0.24)***	−1.97 (0.40)***	−2.21 (0.24)***	−1.94 (0.40)***
Male	0.15 (0.27)	17.36 (1332.69)	0.06 (0.27)	0.34 (0.44)	0.08 (0.27)	0.36 (0.44)
White	0.09 (0.16)	0.16 (0.30)	0.21 (0.18)	−0.13 (0.26)	0.22 (0.18)	−0.16 (0.26)
College educated	−0.20 (0.16)	0.13 (0.27)	−0.06 (0.17)	0.05 (0.24)	−0.08 (0.17)	0.07 (0.24)
Tenure	0.06 (0.01)***	0.05 (0.02)***	0.06 (0.01)***	0.02 (0.02)	0.06 (0.01)***	0.02 (0.02)
Black Mountain	0.15 (0.28)	−0.20 (0.52)	0.18 (0.31)	−0.06 (0.50)	0.18 (0.31)	−0.09 (0.50)
South Mountain	0.24 (0.27)	−0.51 (0.50)	0.09 (0.31)	−0.16 (0.48)	0.12 (0.31)	−0.17 (0.49)
Central City	−0.10 (0.34)	0.25 (0.55)	0.57 (0.33)	0.37 (0.45)	0.59 (0.33)	0.32 (0.45)
Mountain View	0.11 (0.24)	−0.35 (0.41)	0.32 (0.26)	0.22 (0.36)	0.33 (0.26)	0.19 (0.37)
Cactus Park	0.06 (0.25)	0.36 (0.38)	0.08 (0.28)	−0.24 (0.41)	0.11 (0.28)	−0.29 (0.42)

(Continues)

TABLE D2 (Continued)

	Pre-BWCs		Post-BWCs (Direct)		Post-BWCs (Moderating)	
	Reactive (n = 389,794) Coef. (SE)	Proactive (n = 64,727) Coef. (SE)	Reactive (n = 403,226) Coef. (SE)	Proactive (n = 84,675) Coef. (SE)	Reactive (n = 403,226) Coef. (SE)	Proactive (n = 84,675) Coef. (SE)
Neighborhood						
Disorganization	0.13 (0.16)	−0.91 (0.31)**	0.01 (0.17)	0.17 (0.28)	0.04 (0.20)	0.51 (0.34)
Hispanic	0.04 (0.45)	1.95 (0.73)**	0.59 (0.47)	−0.27 (0.78)	0.76 (0.56)	−1.30 (0.94)
Black	−1.71 (1.41)	−1.62 (2.88)	−0.41 (1.36)	2.13 (2.24)	−0.26 (1.61)	1.28 (2.49)
Violence rate	0.00 (0.00)	0.00 (0.00)**	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
Population density	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
Cross-level interactions						
Disorganization * BWC	–	–	–	–	−0.04 (0.29)	−0.89 (0.47)
Hispanic * BWC	–	–	–	–	−0.55 (0.81)	2.70 (1.35)*
Black * BWC	–	–	–	–	−0.51 (2.59)	1.96 (4.39)
Violence rate * BWC	–	–	–	–	0.00 (0.00)	0.00 (0.00)
Intercept	−16.14 (0.69)***	−27.95 (1332.69)	−14.85 (0.65)***	−9.42 (0.75)***	−14.82 (0.65)***	−9.41 (0.75)***
Random effects	VC (SD)	VC (SD)	VC (SD)	VC (SD)	VC (SD)	VC (SD)
Responding officer	0.04 (0.21)	0.00 (0.00)	0.22 (0.47)	0.00 (0.00)	0.21 (0.46)	0.00 (0.00)
Neighborhood	0.17 (0.41)	0.00 (0.00)	0.00 (0.00)	0.22 (0.47)	0.00 (0.00)	0.23 (0.48)
AIC	2,703.80	809.00	2,555.70	982.90	2,558.30	985.20
BIC	2,932.20	999.60	2,817.50	1,207.20	2,863.70	1,246.90

Note: Incidents cross-nested in both officers (n = 433) and neighborhoods (n = 386); violent calls and the desert horizon precinct used as the reference categories.
Abbreviations: ICC, intraclass correlation coefficient; SD, standard deviation; SE, standard error; VC, variance component.
$^{***}p < 0.001$, $^{**}p < 0.01$, $^{*}p < 0.05$.