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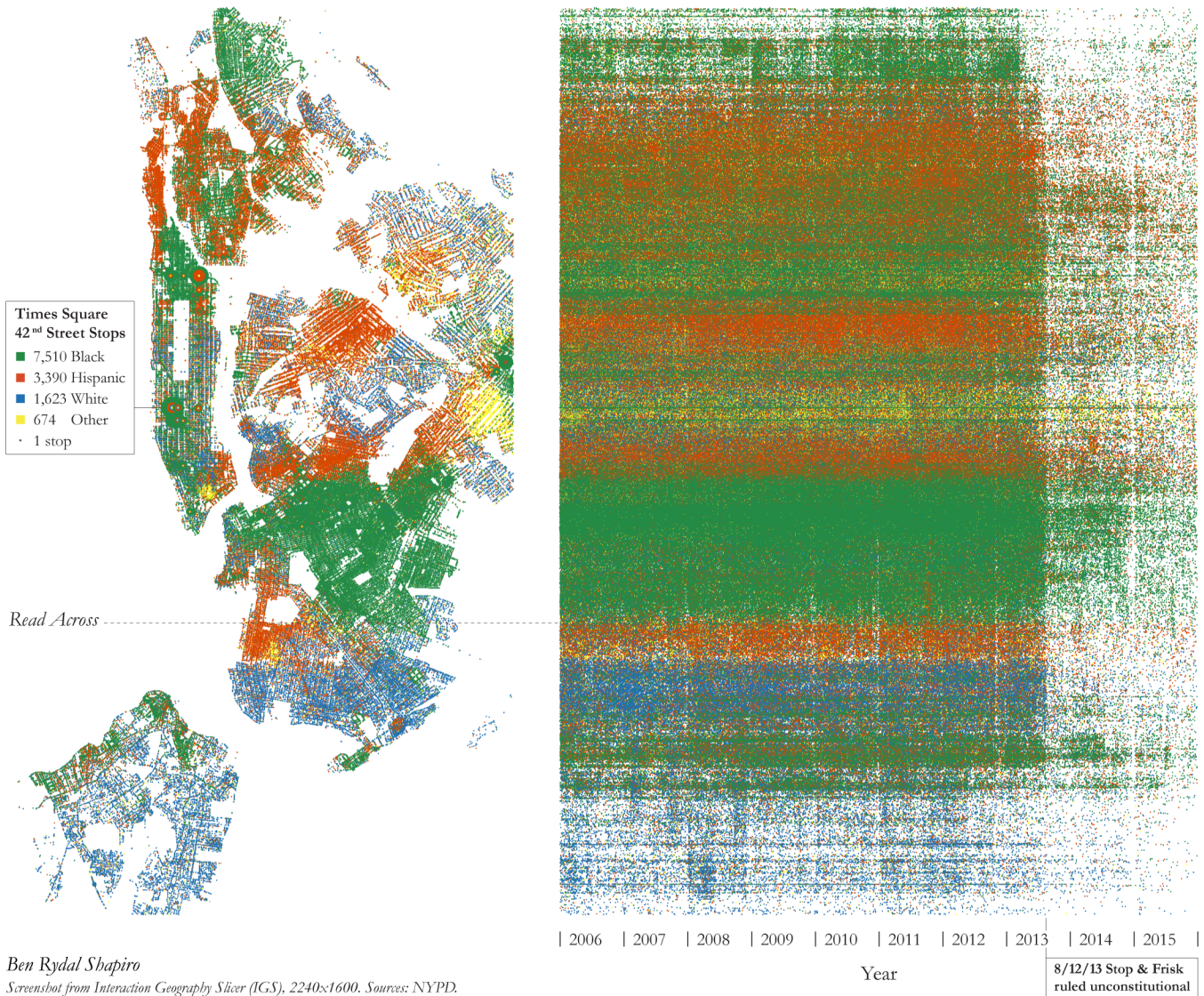
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# Using the Interaction Geography Slicer to Visualize New York City Stop & Frisk

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Ben Rydal Shapiro  
Screenshot from Interaction Geography Slicer (IGS), 2240x1600. Sources: NYPD.

Figure 1: Screenshot with legend and keys from Interaction Geography Slicer (IGS) showing recorded stops in New York City from 2006-2015. The right view extends stops on map horizontally over time. Data from NYPD. Copyright © Ben Rydal Shapiro. Reprinted by Permission.

## ABSTRACT

This paper adapts and uses a dynamic visualization environment called the Interaction Geography Slicer (IGS) developed by the 1<sup>st</sup> author to visualize data about New York City's Stop & Frisk Program. Findings and discussion focus on how this environment provides new ways to view, interact with and query large-scale data sets over space and through time to support analyses of and public discussion about New York City's Stop & Frisk Program.

**Keywords:** Interaction geography slicer, new york city, stop and frisk, crime, space-time visualization, data visualization, statistics, information visualization-art-statistics collaborations.

**Index Terms:** H.5.m. [Information interfaces and presentation]; J.5 [Arts and Humanity]: Architecture; I.3.m. [Computer Graphics]: Miscellaneous.

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## 1 INTRODUCTION

*“It worked very well in New York... it brought the crime rate WAY DOWN” – Donald Trump*

*“It was ineffective” – Hillary Clinton*

*“The argument is that it is a form of racial profiling” – Lester Holt*

The three statements above were made during the inaugural 2016 presidential debate by Donald Trump, Hillary Clinton, and moderator Lester Holt, respectively. These statements reflect different views regarding the effectiveness and future use of “stop, question and frisk” policing tactics that allow police officers to stop civilians whom police officers deem reasonably suspicious and subsequently, frisk, search, or detain them, even through the use of physical force. The central premise of this article is that important (and controversial) political and social issues that occur “in place,” such as stop and frisk, can benefit from new, spatiotemporal ways of viewing, analyzing and discussing them.

This paper adapts and uses a dynamic visualization environment called the Interaction Geography Slicer (IGS) developed by the 1<sup>st</sup> author to visualize data about New York City’s Stop & Frisk Program. Findings and discussion focus on how this environment provides new ways to view, interact with and query large-scale data sets over space and through time to support analyses of and public discussion about New York City’s Stop and Frisk Program.

We begin by reviewing relevant historical, statistical and visualization research concerning New York City’s Stop & Frisk Program as well as concepts and methods from space-time visualization research that inform this work. Subsequently, we discuss how to read Figure 1 that opens this paper and demonstrate what it reveals about stop and frisk that is otherwise concealed, obscured, or overlooked in more conventional representations of the phenomenon. We then use a second figure that visualizes New York City felony data at precisely the same spatial, temporal and symbolic (e.g. dot size) scales to conduct a comparative analysis that we suggest advances stop and frisk research. We continue by discussing a third figure that visualizes data along New York City’s Broadway Street to further define the types of interactive and comparative capabilities of the IGS. We conclude by discussing inherent limitations and next steps in this work.

## 2 RELEVANT WORK

### 2.1 New York City’s Stop & Frisk Program

Stop, question and frisk or “stop and frisk” policing tactics originated nearly 50 years ago in a Supreme Court case called *Terry vs. Ohio* (1968) [22]. This case laid the groundwork for police officers in many cities to stop and search civilians deemed, however arbitrarily, suspicious [6]. In the 2000s, New York City used stop and frisk policing tactics aggressively and in dramatic fashion. For example, data from the New York Police Department (NYPD) documents the rapid rise in stops from approximately 100,000 stops in 2002 to just over 685,000 stops in 2011. However, this general trend experienced a relatively abrupt turnaround in 2013 when a federal judge ruled that New York’s Stop & Frisk Program utilized indirect racial profiling that violated the constitutional rights of minorities throughout the city [16]. This ruling did not end New York’s Stop and Frisk Program (police officers still stopped roughly 23,000 civilians in 2015) but it did highlight the effectiveness of broad policy-level reform.

Empirical research concerning stop and frisk in New York City has grown considerably primarily due to the release of detailed publicly available data from the NYPD on all individual reported

(by police) stops since 2003 [28]. This data describes each reported stop in New York City including characteristics such as the location of each stop (typically precise to the street level), time of the stop (typically precise to the minute) purpose of the stop, information about the person stopped (e.g. race, age, gender) and police actions during a stop such as searching, using physical force, or arresting suspects [21, 33].

In one strand of research, statisticians utilize this data to document the incidence and distribution of stop and frisk practices. Many statisticians show that police disproportionately stop ethnic minorities and particularly persons of African American and Hispanic decent [13, 15, 33]. For example, of the approximately 685,724 reported stops that occurred in New York City in 2011, 53% (350,743) were Black, 34% (223,740) were Latino and 9% (61,805) were white [27]. Others illustrate how, despite wide acknowledgement that particular geographic areas of New York are targeted due to higher crime rates, (a) there is very little empirical research studying the relation between stop and frisk and crime, (b) the research that has been conducted rarely shows any statistical correlation between stop and frisk and crime, and (c) nearly all of this research uses spatial units at the police precinct or census block level that are too large to adequately conduct comparative analyses between stop and frisk and crime [15, 18, 21, 34, 35]. Still other statisticians demonstrate particular ways stop and frisk tactics influence neighborhood-police relationships. For instance, some study how policing tactics change in certain neighborhoods following homicides (e.g. violent crimes), finding that stops in non-white neighborhoods (particularly majority Black and Hispanic neighborhoods with high crime) increase dramatically after a homicide causing people to experience “the fear and shock that come with extreme violence” [21]. In contrast, there is no evidence that stops in white neighborhoods increase following a homicide [21].

In a separate strand of research, many visualization researchers, designers and artists utilize a variety of techniques to visualize and describe data about New York’s Stop & Frisk Program. Some utilize interactive maps to visualize and layer the location of stops and particular stop events such as gun recoveries [19]. Others utilize interactive graphics that include maps and timelines to show the fluctuation and uneven racial distribution of stops [6, 12]. Still others provide highly interactive and engaging ways for people to visually interact and draw their own conclusions from complex stop and frisk data [32].

Together, we suggest these two strands of research inform a number of important starting points relevant to this paper:

*Starting Point 1:* Statistical and visualization research and design concerning the use and effectiveness of New York’s Stop & Frisk Program is still in its infancy. Much of the research we have described reflects initial efforts to explore trends in only very recently available data in order to begin to make sense of an extremely complex and controversial issue.

*Starting Point 2:* Like many controversial issues, there is a significant need for the production of more powerful “artifacts” to better inform public discussion. For instance, many leading and influential public figures continue to state with complete confidence that stop and frisk tactics inherently reduce crime ignoring empirical research that does not show any correlation between (a) stop and frisk and (b) crime. Put differently, there is a significant need for tools and analytic processes that use information visualization and the arts to make statistical analyses and questioning about this issue more accessible to public figures and the general public [14].

*Starting Point 3:* There are a number of specific research and design needs. First, there is a significant need to advance existing spatial analysis and visualization of New York City stop and frisk data and to do so not only at the census block or police precinct

level but also at the street level [6, 11, 21]. Second, there is also a significant need to begin to account for the spatiotemporal dimension of stop and frisk data [45]. In other words, almost no work currently explores stop and frisk as it occurs in space and through time simultaneously. Third, future research and design must develop ways to analyze and visualize stop and frisk data over more than a single or a few years as is typically the case in most existing work due to technical limitations (e.g. to make data processing “manageable”) [45]. Finally, future research and design should support more dynamic ways to make comparisons between stop and frisk data and crime data.

## 2.2 Space-Time Visualization Research

This paper also draws from an established body of visualization research and design concerning space-time visualization, which seeks to describe and understand phenomena (e.g. movement, information or traffic flows) over space and through time simultaneously [1, 2, 3, 4, 5, 24, 29, 36].

In particular, the dynamic visualization environment introduced in this paper, the Interaction Geography Slicer (IGS), is adapted from other work that is developing and using the IGS to study the relation between people’s “interaction geographies” and learning in museums and other built environments [37, 38, 39]. This work and thus this paper also draws from a geographical perspective called “time geography” [17] and related work concerning the use and advancement of a 3D representational system called the “space-time cube”, which is often used to visualize physical movement (e.g. traffic flows) both over a 2D map and as it extends upwards over time in 3D [5, 20]. In addition, this paper also draws from research that advances the usability of the space-time cube for expert and non-expert users [8, 9, 10, 25, 30, 43].

## 3 VISUALIZING NEW YORK CITY STOP & FRISK, 2006-2015

### 3.1 How to Read Figure 1

Figure 1 that opens this paper is a screenshot from the IGS. It shows recorded stops from 2006-2015 (10 years total) on a map of New York City and also their occurrence over “space-time” [17] across a timeline. Data is from the New York City Police Department [28] and records stops precise to the street intersection and minute of occurrence from 2006-2015. Stops without recorded spatial or temporal coordinates are not shown.

The right part of the figure or the “space-time view” extends stops on the map across a timeline, preserving vertical location on the map with the Y-axis. Put differently, the space-time view “stretches” stops shown on the map horizontally to their precise occurrence in time across the timeline while preserving one spatial dimension. Thus, a reader should use the two views (map and space-time) together by looking across horizontally from one view to the other.

Color designates race. Green is Black, red-orange is Hispanic, blue is White, and yellow is Other. These racial categories and color choices reflect particular aesthetic and analytic decisions and can be changed or expanded within the IGS to encompass different colors or more racial categories.

Both map and space-time views use proportional symbol mapping where symbol or dot size represents the number of stops at a location on the map or in space-time (e.g. the larger the dot the more stops). In the figure, symbols are perceptually scaled (e.g. increase in size), which adjusts the area of symbols to account for underestimation that occurs when the area of the symbol proportionally corresponds to increases in the size of the data (e.g. absolute scaling) [40]. Furthermore and quite importantly, many symbols/dots only show the racial category that was stopped the most at a location on the map or in space-time (e.g. the other three racial categories are not shown). In cases

with an equivalent number of stops of two or more racial categories at a location, dots for each category are plotted adjacent to one another as a single dot. In addition, for locations where the number of stops exceeds 1600, dots for each racial category are plotted on top of one another in descending order (largest on the bottom) so that a dot for each racial category is shown at that location. This technique is most recognizable at locations with many thousands of stops (often subway stations) shown by large, superimposed dots of multiple racial categories. For instance, we have highlighted Times Square 42<sup>nd</sup> Street Station as one example wherein a large green circle encloses a smaller red-orange circle that encloses even smaller blue and yellow circles. These patterns indicate that the number of stops at Times Square 42<sup>nd</sup> Street Station exceeded 1600 during the observation period (2006-2015) and that Black civilians were stopped most (green circle), followed by Hispanics, Whites and, finally, Other civilians. This set of algorithms was selected after numerous tests demonstrating that they appropriately balanced aesthetic (dot overcrowding) and functional considerations along with distinct challenges in this data set (e.g. repeated stops at the same street location and heavily skewed data) to communicate the spatial distribution and sequential organization of stops at this spatial and temporal scale.

Like any set of techniques, the conventions depicted in Figure 1 have limitations and provide only one way to view these data. Later in this paper, we discuss these limitations in more detail as well as ways the IGS addresses these limitations directly by, for example, providing ways to “slice” space and time to provide different views of the data and utilizing algorithms to plot repeated stops in different types of ways (e.g. utilizing absolute scaling of symbols as opposed to perceptual scaling).

### 3.2 Figure 1 Discussion & Findings

We suggest that an initial overview reading of Figure 1 [41, 42] contributes a fundamentally new view of New York City’s Stop & Frisk program. The map view depicts a full 10 years of reported stop data, something rarely found in previous research. Likewise, the map view complements and extends existing stop and frisk research by highlighting the uneven racial distribution of stops across the city not just at a neighborhood or police precinct level, but also at particular street level locations and landmarks across New York City. For example, there are an extremely high number of recorded stops at particular subway stations. The space-time view, in contrast, presents a more powerful and fundamentally new view of stops/policing activity across New York City. The space-time view possesses a “graphical weight” that does not and cannot exist in the map view. Put another way, the space-time view has a graphical density, color concentration and color distribution that foregrounds the uneven racial distribution of stops over space and through time.

Once the space-time view is digested and understood, the figure offers deeper levels of reading. Most notably, the space-time view reveals the dramatic fall or “decay” of stops after years of aggressive stop and frisk policing tactics in New York, following the ruling by a federal judge on 8/12/13 that New York’s Stop & Frisk Program violated the constitutional rights of minorities. This dramatic fall is not visible in the map view, but is clearly evident as it unfolds after 8/12/13 on the timeline.

Furthermore, the space-time view provides more detail as to how stops are potentially distributed across different neighborhoods and geographic areas. Since the racial distribution of stops in this data is so uneven and concentrated in particular geographic areas, the space-time view creates dense strips or bands of stops of the same color/racial category. For example, the density and concentration of Blacks stopped in Brooklyn (the geographic region that appears in green above the horizontal line drawn on Figure 1) is apparent in the map view. However, the



space-time view makes the magnitude of these stops more apparent by revealing an incredibly thick and dense strip of green. Likewise, the space-time view highlights many dense strips of Hispanic stops occurring in predominantly Hispanic neighborhoods.

In addition, the space-time review reveals phenomena that are not visible using the map view. These phenomena include: 1) vertical “white lines” or blank spaces many of which indicate a cyclical cessation of stops during the holiday season (e.g. December/Christmas/the New Year), 2) “blotches” of stops that appear or bleed through dense bands of stops indicating potential times of intense policing activity often of Blacks and Hispanics, 3) the uneven “fall” of stops after the court ruling with some areas of the city even experiencing a subsequent and brief increase in stops after the dramatic fall, and 4) extremely straight, “horizontal lines” indicating a high density and even or uneven sequential organization of stops at particular locations. We encourage readers to draw their own findings from Figure 1.

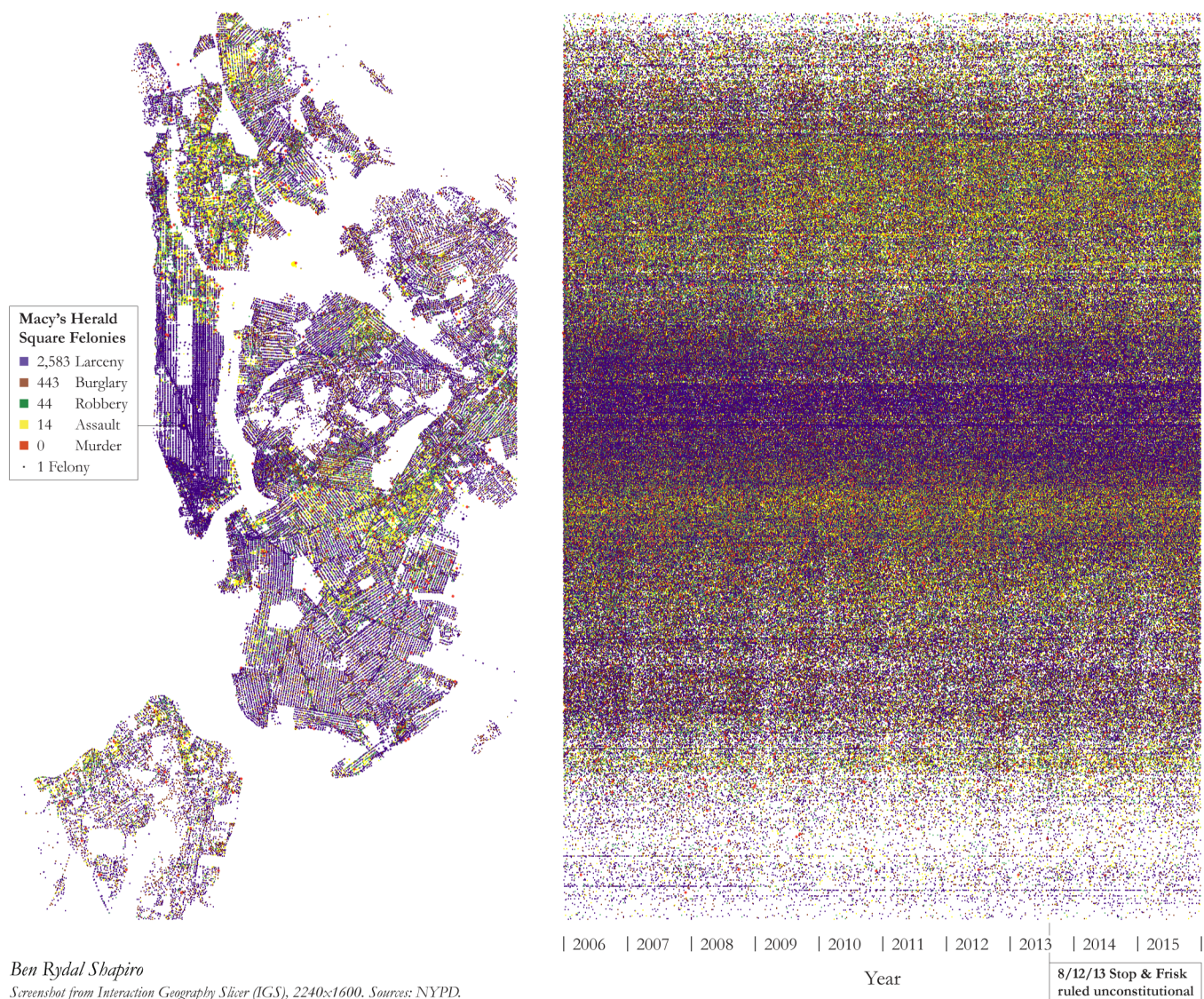
In summary, Figure 1 introduces one way in which the IGS visualizes data from New York City’s Stop & Frisk Program at one spatial and temporal scale. We suggest the figure shows stops in a new and provocative way and identifies segments of space and time of potential interest for stop and frisk research. Equally important, like any visualization, Figure 1 has limitations that necessitate other ways to view, interact with and query this data.

#### 4 COMPARING NEW YORK CITY FELONIES, 2006-2015

##### 4.1 How to Read Figure 2

Figure 2 shows a screenshot from the IGS that maps New York City felonies over space and time using exactly the same scales and dot conventions as Figure 1. Rape is not included because it is not coded at the street level and grand larceny/grand larceny with a motor vehicle is combined into a single felony category of larceny. Additionally, murders are enlarged slightly.

### NEW YORK CITY FELONIES, 2006-2015



Ben Rydal Shapiro  
 Screenshot from Interaction Geography Slicer (IGS), 2240x1600. Sources: NYPD.

Figure 2: Screenshot with title, legend and keys from Interaction Geography Slicer (IGS) showing recorded felonies in New York City at the same scales and dot conventions as stops shown in Figure 1. Data from NYPD. Copyright © Ben Rydal Shapiro. Reprinted by Permission.

## 4.2 Figure 2 Discussion & Findings

We suggest that an overview reading of Figure 2 in comparison to Figure 1 leads to two striking and important realizations. First, there are far fewer and less concentrated felonies at particular places in comparison to stops shown in Figure 1. This finding is documented in existing literature [6, 13, 18, 44], but these figures make it visible in new ways. Second, the space-time view reveals what appears to be very little change in the consistency of felonies over 10 years. Most importantly, this visual “wall” of felonies persists through the dramatic rise and fall of New York Stop and Frisk and its unconstitutional ruling. This does not mean that stop and frisk is having no effect on reported felonies—as numerous reports show, the number of felonies has decreased slightly over these 10 years [33, 34, 35]. However, the figures provide a stark and vivid contrast to statements from those who predicted (and still claim) that felonies would rise dramatically and immediately following the reduction of stop and frisk policing tactics in New York City. Thus, Figure 2 contributes to stop and frisk research by further challenging statements that claim stop and frisk policing tactics influence crime in a direct or cause-and-effect way.

Figure 2 also supports deeper levels of reading. First, the figure reveals the distribution of felonies in a particular manner. For example, the figure shows a large amount of grand larceny occurring in Manhattan. This is striking in both the map and space-time views. Second, cyclical patterns of reported felony activity are visible in the space-time view as white spaces or “waves” that indicate cessations in reported felony activity at particular times each year. This is documented in existing research but is shown in a new way. As with Figure 1, we encourage readers to draw their own findings and questions from Figure 2.

In summary, Figure 2 provides a valuable and striking comparison to Figure 1. We suggest this comparison supports public discussion about the complex relationship between stop and frisk policing tactics and felony activity in New York City. However, as with Figure 1 there are many inherent limitations that specifically highlight the need for additional ways to interact with, view or query these data (e.g. most dots only show felonies that occur the most at a location, yellow emphasizes assaults, and small yearly decreases in felonies are not adequately shown).

## 5 BROADWAY STOPS & MURDERS, 2006-2015

The prior two visualizations highlight patterns of stops and felonies across the entire New York City area between 2006 and 2015. However, the IGS can also be used to visualize spatiotemporal patterns of stop and felony data at scales and in ways that, to our knowledge, do not exist in current research. As one such example, consider Figure 3 (on the following page), which arrays stop and frisk as well as felony data along Broadway Street, one of the oldest North-South thoroughfares in New York City. Although Broadway Street is perhaps best known as the epicenter of America’s theater industry, the street itself stretches the length of Manhattan and intersects, across its 13-mile pathway through Manhattan, a wide range of neighbourhoods that vary in racial and socioeconomic composition. As described next, Figure 3 reveals some of the novel dynamic and comparative possibilities of the IGS that we use to, for example, show how Broadway Street varies considerably with respect to the use of stop and frisk tactics and with regard to incidents of murder.

### 5.1 How to Read Figure 3

Figure 3, titled “*Broadway Stops & Murders, 2006-2015*”, is a screenshot from the IGS that shows all recorded stops and murders that occurred along Broadway Street in Manhattan from 2006-2015. Each black dot indicates a murder. Colored dots

indicate stops using the same color choices but different dot/symbol scaling as Figure 1. The map view shows felonies occurring across Manhattan in grey and highlights in color all stops and murders that occurred along Broadway Street. The space-time view shows only stops and murders that occurred along Broadway Street (e.g. it does not show all felonies across Manhattan in grey).

### 5.2 Figure 3 Discussion & Findings

Several conclusions can be drawn about the dynamic visualization and analytic possibilities of the IGS by considering Figure 3: *Broadway Stops & Murders, 2006-2015*. First, the figure shows how one can use the IGS to dynamically “slice” regions of space to highlight phenomena by, in this case, drawing (with one’s cursor/mouse) over the map. Put differently, the figure shows how we have highlighted phenomena along Broadway Street by “drawing the street” to reveal phenomena in both the map and space-time views that occur along/near Broadway Street. Thus, this example shows how the IGS provides not only a way to perform the types of street level spatiotemporal analysis that many stop and frisk researchers call for, but how it also provides new ways to interact with and determine the boundaries of spatial regions in ways that draw from and extend existing space-time visualization research. Moreover, one can also draw shapes in the space-time view to define and highlight phenomena across different types of temporal regions (not shown in the figure). In addition, the IGS supports many more conventional and computationally less expensive (e.g. faster) ways of slicing regions of space and data through the use of circular and rectangular shapes (e.g. one can select circular and square regions on the map and in space-time to highlight phenomena). Likewise, future development aims to support the import of standard geographic shapefiles and census tracts to highlight data.

Second, the figure illustrates (in comparison to previous figures) how one can use the IGS to dynamically “zoom” to select and reveal phenomena in both the map and space-time views (e.g. both views adapt to one another). In this case, we have zoomed on to Manhattan in the map view to reveal phenomena across the Manhattan region (e.g. as opposed to all of New York City as shown in Figures 1 and 2). Though the figure maintains a temporal scale of 10 years to allow comparisons to be made to Figures 1 and 2, temporal zooming down to the minute for this data set is possible within the IGS.

Third, the figure also shows one way to “layer” stop and felony data in the IGS. In this case, recorded murders are layered on top of recorded stops. However, the IGS supports a variety of interactive ways to layer and toggle between different types of stop and felony data.

*Broadway Stops & Murders, 2006-2015* contributes to stop and frisk research in a variety of ways. First, the figure continues to reveal and emphasize that ethnic minorities and particularly persons of African American and Hispanic descent are stopped at an extremely high rate. In this case, over 80% of recorded stops along Broadway Street are of Blacks and Hispanics.

Second, the figure aims to make visible and support public discussion about an important question in stop and frisk research. Namely, how does police activity respond to violent crime in particular geographic areas for different races [21]? Put simply, the figure aims to provide an artifact to support broader public discussion and consideration about this research question.

Third, the figure affords observations that on one hand further public discussion about stop and frisk but on the other hand indicate the need for more comparative forms of visual analysis (e.g. of other streets in New York City) as well as more powerful forms of statistical analysis.



## BROADWAY STOPS & MURDERS, 2006-2015

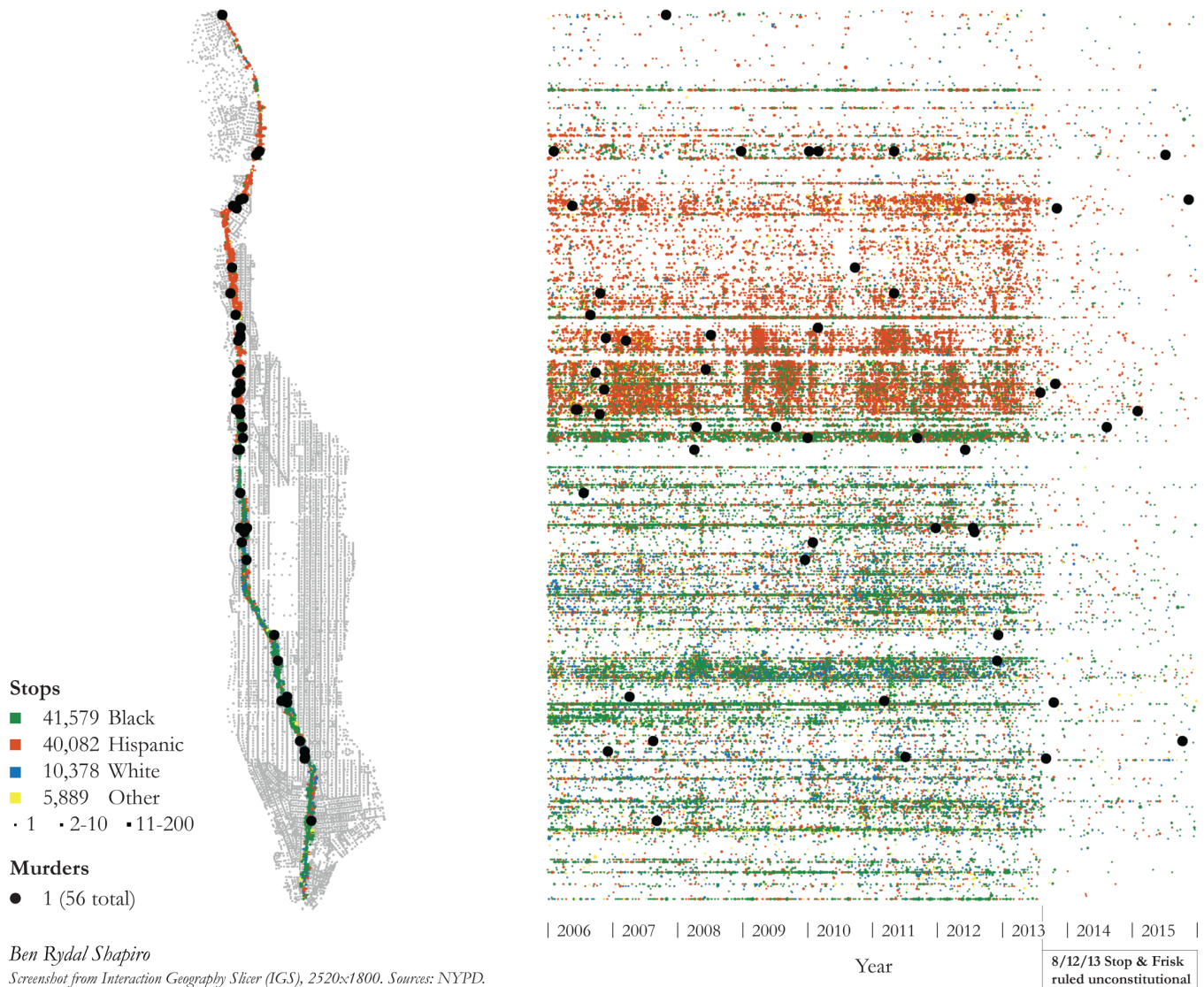


Figure 3: Screenshot with title, legend and keys from Interaction Geography Slicer (IGS) showing stops and murders along Broadway Street in Manhattan, New York. Data from NYPD. Copyright © Ben Rydal Shapiro. Reprinted by Permission.

For example, some observations the figure makes visible include: (a) continuous and discontinuous lines of stops in the space-time view, primarily of Blacks and Hispanics, that correspond with particular locations along Broadway Street, (b) variation in the distribution of murders along Broadway Street across both space and space-time (e.g. only a single murder occurs in 2014) and (c) locations and regions of space and time for further analysis and comparison to other streets in New York City.

To review, Figure 3 demonstrates some of the dynamic visualization and analytic possibilities of the IGS that provide new ways to view, interact with and query stop and felony data. In doing so, the figure (a) provides an artifact to support public discussion about New York City’s Stop and Frisk Program, (b) makes visible and supports public discussion about stop and frisk research and (c) raises new questions relevant to stop and frisk and criminal research such as what are productive spatiotemporal units of analysis to study “micro-geographic hot spots” of policing or felony activity [21, 45]?

## 6 CONTRIBUTIONS

In summary, this paper makes three primary contributions. First, it adapts and uses the IGS to illustrate new, spatiotemporal ways to view, interact with and query large-scale data sets to support public discussion about New York City’s Stop & Frisk Program. In doing so, this paper shows how with further development the IGS may be applied to other types of large-scale data sets and particularly ones concerning important political and social issues that occur “in place.”

Second, this paper contributes to collaborations across the disciplines of information visualization, art and statistics. The authors of this paper are from each of these fields and such collaborations are necessary to this work. Likewise, the figures in this paper are informed by and integrate each of these disciplines. For example, the figures synthesize (a) techniques of space and time flattening from information visualization, (b) compositional and color choices inspired by artists including Mark Rothko and Piet Mondrian (e.g. Hispanic stops in Figure 1 are shown in red-orange as opposed to orange to suggest that New York City is

“bleeding”) and (c) specific questions and findings raised by statisticians concerning policing activity and crime.

Finally, this work exemplifies the value of many open-source programming languages and libraries designed by/for visual artists and designers. The version of the IGS used in this paper is written in Java and draws from the Processing Programming Language [31] created by Ben Fry, Casey Reas and a vibrant community of many other generous and hard working contributors, as well as the Unfolding Maps Library [26] created by Till Nagel and a team of similarly generous and hard working contributors.

## 7 LIMITATIONS

There are several limitations of this work. First, each figure described in this paper embodies particular computational and aesthetic choices that show selected phenomena in certain ways while hiding others [23]. Figures 1 and 2 in particular, utilize algorithms that often show the highest number of stops or felonies of a racial or felony category at each space and space-time location. As a result, for example, Figure 1 does not adequately communicate that police do stop White citizens in Brooklyn and does not compare stops to neighborhood demographics. Instead, it shows that police stop far more Black citizens in Brooklyn than other races. Likewise, felony assaults in Figure 2 appear more numerous than they actually are due to the color choice of yellow. Moreover, all figures in this paper show “fixed” views from the IGS that are intentionally oriented in a particular manner. In other words, rotating the map view (an operation possible within the IGS) would change the types of patterns visible in the space-time view. Throughout this paper, we have discussed how these limitations necessitate the need for multiple views of the same data and how the IGS can provide such views by utilizing different algorithms to scale symbols, slice space, time and data, layer or toggle data, change colors and expand data categories and zoom space and time. Nevertheless, it is important to understand the inherent limitations and particular goals of the static figures shown in this paper.

Second, there are a number of limitations with respect to the original data sets from the NYPD. For example, numerous researchers have demonstrated the issues and limitations with police reporting of stops (e.g. many stops go unreported). Likewise, both data sets aggregate phenomena to the street intersection and sometimes aggregate phenomena from a larger geographic region to particular street intersections. For example, as the NYPD describes [28], felony offenses occurring within the jurisdiction of the Department of Correction are located at Riker’s Island (e.g. this creates a line of felony assaults (yellow) in the upper right part of the space-time view in Figure 2). Thus, the figures in this paper make the structure of the original data sets quite visible—this is on one hand a strength of the IGS but on the other hand, a limitation and caution against interpretation or explanation that makes conjectures about human action at scales below the spatial resolution of the original data.

Third, our processing of the original data sets (retrieved from the NYPD in September, 2016) resulted in certain limitations. For instance, we eliminated all data points without a space or time coordinate. Moreover, we defined what constituted Broadway Street as a geographic region (e.g. no shapefile currently existed) by testing (via drawing) whether all points in the original data set were located within a certain number of pixels from Broadway Street (e.g. at a particular map scale) and as a result, intentionally included points/phenomena that were near to Broadway Street. These decisions served the purposes of this paper and could be easily adjusted in future research.

Fourth, the figures in this paper are limited by the resolution of the screens and prints through which they are shown. Higher

resolution screens or prints afford more precise readings (e.g. the IGS adapts to resolution).

Finally, interpretation of the figures in this paper is limited by prior knowledge of the geography and social and political landscape of New York City. Readers who live in or know New York City are able to read and interpret the figures included in this paper in more nuanced and informed ways than those persons without this prior knowledge.

## 8 NEXT STEPS

With further development and support, this work will be made publicly available to support further public discussion and analysis of New York City’s Stop & Frisk Program. Current and future development aims to refine the ways of reading, using and performing analyses with these data using the IGS. For example, additional user group test cases are necessary to better understand how people read and make sense of the complex, spatiotemporal visualizations depicted in this paper and to build supports that aid in interpretation and reduction of misinterpretations. Likewise, current and future work includes optimizing the IGS to, for instance, advance the speed, fluidity and precision of spatial “slicing” of stop and felony data.

## 9 CONCLUSION

We began this paper with three statements from the inaugural 2016 presidential debate that illustrated different views regarding the effectiveness and future use of “stop, question and frisk” policing tactics. Subsequently, we adapted and used the Interaction Geography Slicer (IGS) to visualize data about New York City’s Stop & Frisk Program. In doing so, this paper demonstrated how the IGS provides new ways to view, interact with and query large-scale data sets over space and through time to support analyses of and public discussion about New York City’s Stop and Frisk Program. Throughout this paper, we have highlighted particular contributions of this work and equally important, particular limitations of this work. We hope to have demonstrated that important (and controversial) political and social issues that occur “in place,” such as stop and frisk, can benefit from new, spatiotemporal ways of viewing, analyzing and discussing them. Finally, it is our hope that the previous pages make evident the value of and new possibilities for collaborations across the disciplines of information visualization, the arts and statistics.

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