

CPDP Project -Checkpoint 03

Devyani Gauri, James Wilkinson, Kaleem Ahmed

Data Science 339
Prof. Jennie Rogers
November 9, 2021

Q.1: Does this code compile and run without significant effort on the part of the reviewer?

Ans.1: Yes, please refer to the ObservableHQ url and the README.

URL: <https://observablehq.com/d/9e5ea60e745071f1>

Q.2: Quantitative Analysis. Does the code answer the questions from the proposal?

Ans.2: Yes, our code answers the questions from the protocol:

a) How are TRRs of different types of force distributed across the time spent in the force? (Refer to severity grading chart (hyperlink [here](#)))

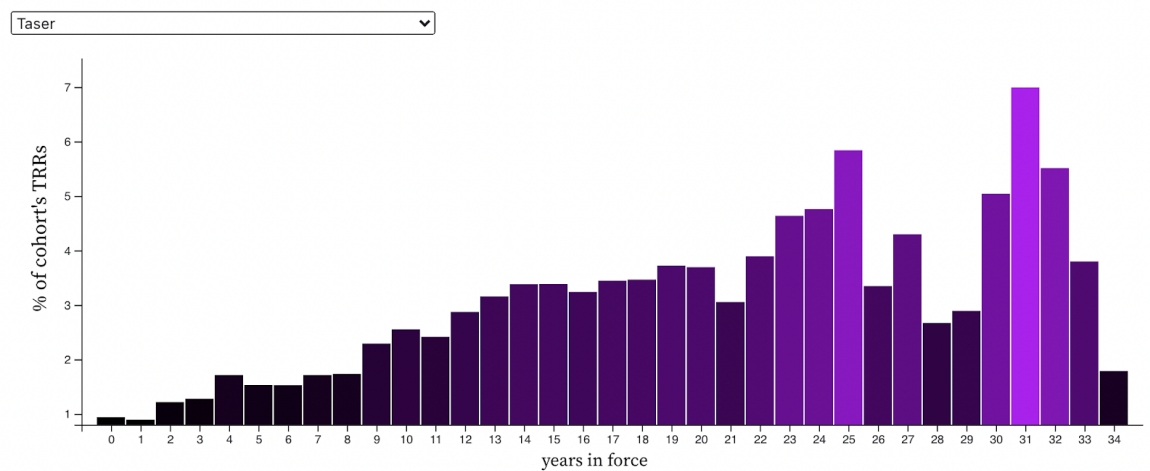
Our bar graph here builds off of our analysis from checkpoint 2. Here we show that time spent in the force has a variable impact on the type of force used. We use the percentage of TRRs for a particular type of force as our defining metric for this graph. We see that less severe types of force such as Member Display stay relatively constant across time (ranging from 22-28%), while moderately severe types of force such as Taser Display, for example, increase exponentially across time in force (increased from 0.2% to 1.6%). Firearm use represented a small portion of TRRs for juniors that have been in the force for less than 2 years (0.2% of TRRs), increasing to a peak amongst officers that have been in the force for 10 years (0.6% of TRRs).

b) How are the TRRs of use of force(per capita) distributed in each unit across an officer's time spent in that unit? (Refer to severity grading chart (hyperlink [here](#)))

We found that officers in units 12, 13 and 22 have a large number of instances of use of force across the amount of time they spend in those units. In units similar to units 30, 36, 80 and 206, officers tend towards excessive use of force early on during their time in that specific unit (shown by a number of spikes) and then the number of TRRs for that unit per capita stop abruptly. We also see that there are a few units (69, 82, 171, 178) that have zero TRRs per capita regarding use of force. We hypothesize that these units don't have officers being assigned to field duty.

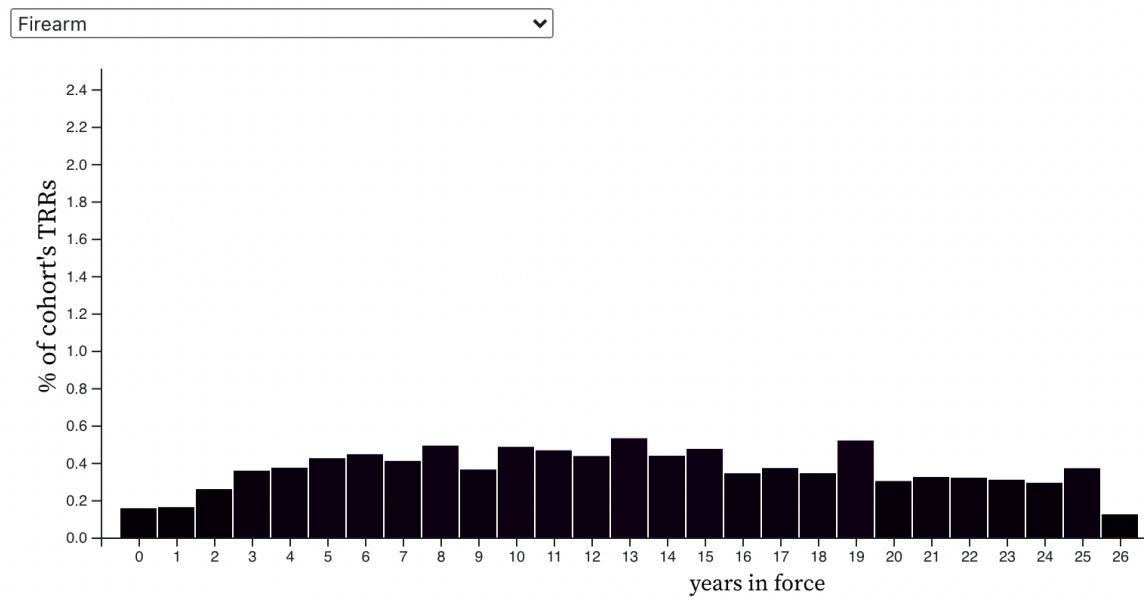
Q.3: Qualitative Analysis: Does the analysis described in the write-up adequately analyze the problem we are investigating? Was it thoughtful and thorough? Does it reveal interesting open questions (optional)?

Ans.3: The bar graph illustrating the percentage of TRRs for each force type across time of employment is striking for a number of reasons. The percentage of TRRs for low severity forces such as verbal commands and member presence stays generally consistent throughout an officer's time of employment. However, we also observe that TRRs are significantly more likely to involve taser use amongst senior officers, with an exponentially increasing curve across time in employment.



We have been interpreting taser use as a more intermediate use-of-force (somewhere between verbal command and firearm). We found a similar trend in checkpoint 2, which we had interpreted as potentially partly going against one of our hypotheses that more severe uses of force become more common with seniority. Within itself, this raises more questions that reverberate across checkpoints: as compared to firearms, why are tasers such a strong outlier (in terms of the bulk of the distribution being around significantly more senior officers)? A good way to approach this would be to break down the usage by geography, as distinct beats are most likely to best isolate unique circumstances. It could be possible that as officers become more senior, they are moved to units that somehow prompt taser use, while more junior officers are assigned to units that preclude taser use in favor of other force types such as verbal commands or holding.

With respect to firearm usage, we see that the officers in their first two years of service have the lowest proportion of TRRs attributed to firearms. The local maximum of this chart is around the 10-year point, telling us that officers that have been in the force for approximately 10 years are mostly likely to have a TRR attributed to firearm usage. Note, the visualisation online contains a much larger peak at the 32-year point, which is caused by noise, and has been removed in the below screenshot of the chart for clarity.



This observation converges with our checkpoint 2 hypothesis where we saw that firearm TRRs were shifted towards more senior officers, even though time to first ever firearm TRR was more prominent in younger officers. We think the phenomenon we see here can also be explained by the same hypothesis that officers that are prone to firearm use are more likely to quit the force early - perhaps because of trauma from the event. However, we notice that there is still a huge spike of the use of firearms later in the career for at least some officers.

Building on this focus on officers within their first ten years of employment, we see the three distinct uses of force - holding, stunning and direct-mechanical represent three sequentially increasing uses of force according to the severity grading chart ([hyperlink here](#)). Viewing these on the interactive visualization shows that while holding is distinctly most prominent amongst officers in their first years of the force, stunning is most prominent for officers in their 5th year of the force, and direct-mechanical is even more distinctly shifted towards officers in their 5th-6th year of the force.

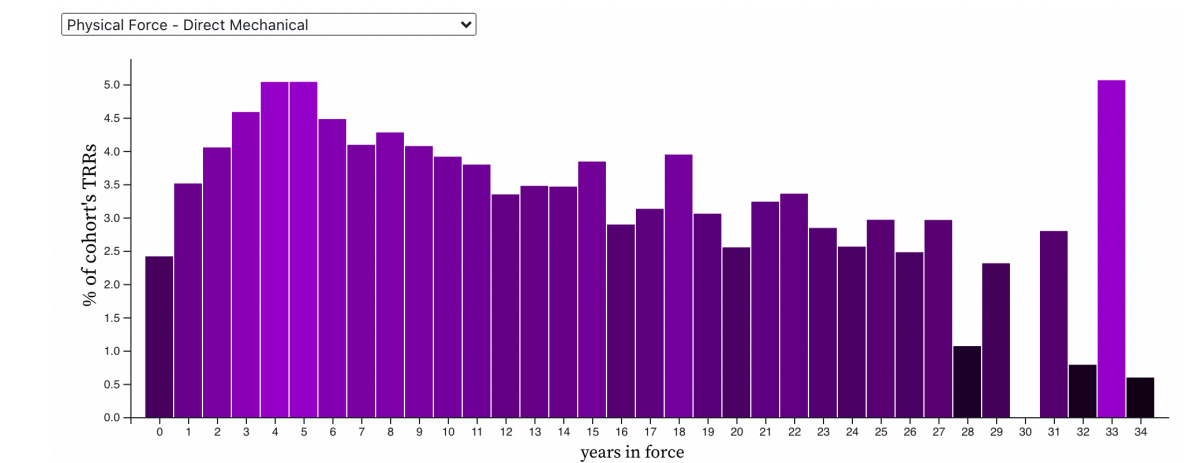
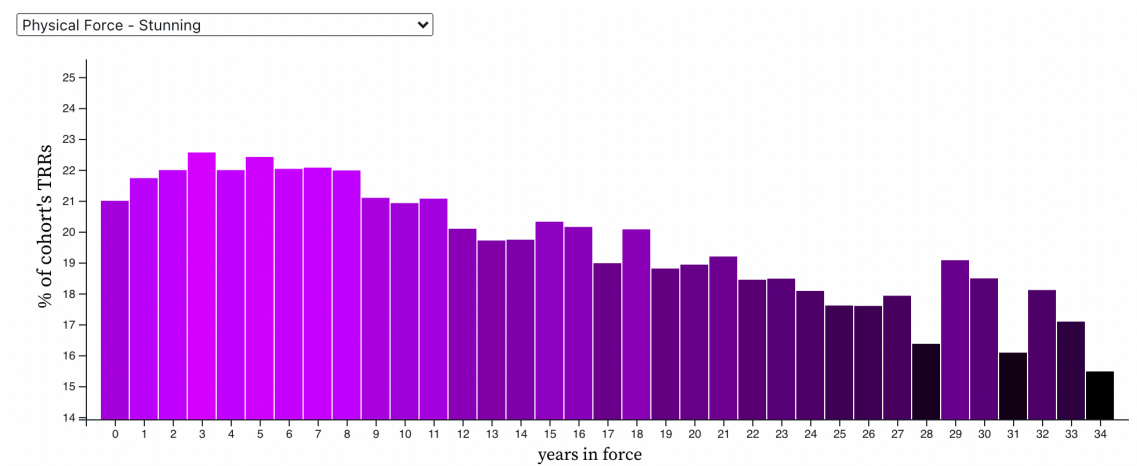
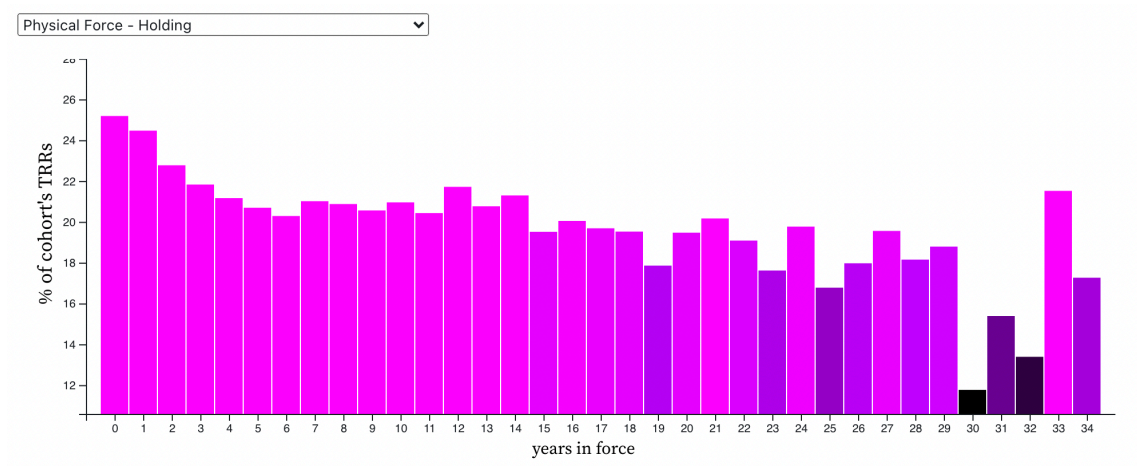
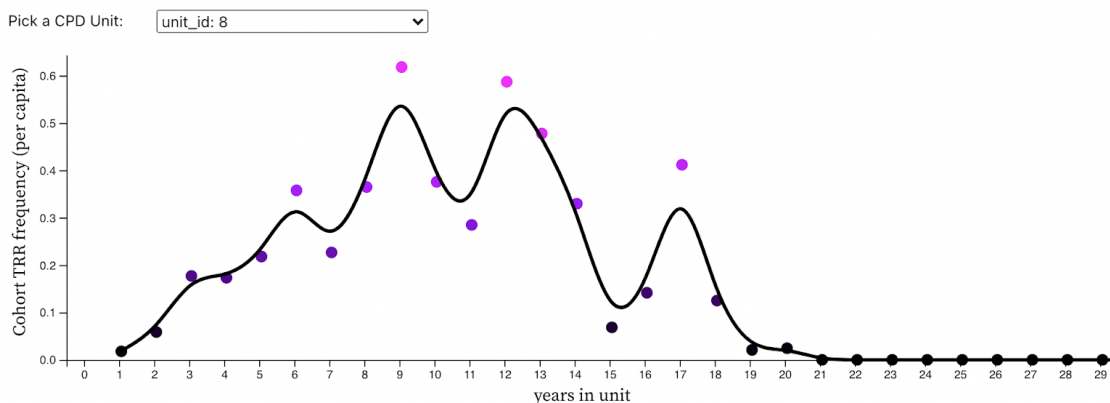


Figure: In the above charts, we view the percentage of TRRs in each cohort that are attributed to holding (top), stunning (middle) and mechanical force (bottom). We notice how the peak of the distribution moves from 0 years in the top chart (representing officers in the 0-1 year of entering the force), to 5 years in the bottom chart.

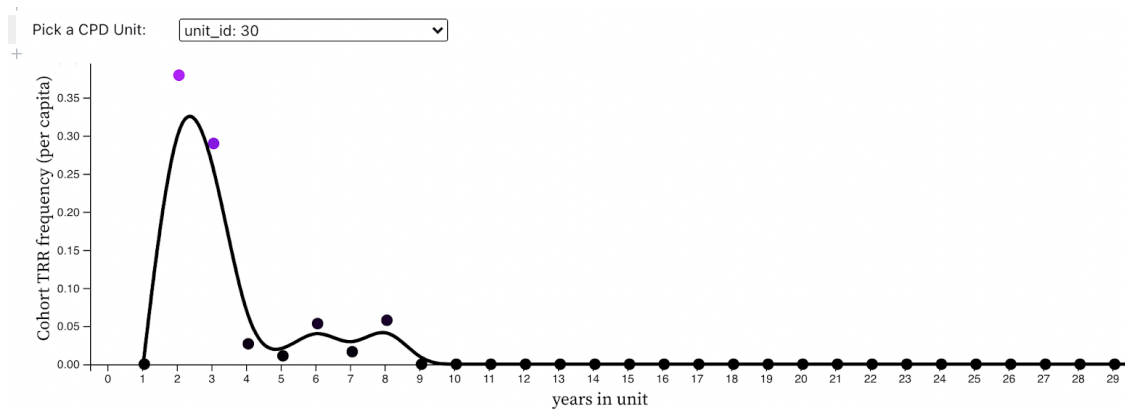
We have reaffirmed our prior conclusions that junior officers (sub-1 year) are less likely to use a higher use of force than more seasoned officers. However, this analysis is showing that TRRs generated by officers in their 5th-10th year of employment are most likely to include more extreme uses of force such as firearms and direct-mechanical, while TRRs are increasingly probable to include taser use for increasingly senior officers.

Building off the idea of peer impact within units and how TRRs change as officers change assigned units, with our second visualization, we wanted to analyze how the time exposure of officers to their peers within a unit affects their use of force (quantified by the number of TRRs per capita for each unit). We found a number of different trends based on visually comparing the graphs for different units.

The most noticeable trend we notice is a uniform increase in TRR frequency as officers progress from entering a unit up until the 5-10 year point. This is consistently found across the vast majority of units, with officers in approximately the 5th-10th years of their time within a unit typically producing the most TRRs per capita.



Another trend we notice is that a few units do have the highest TRR frequencies for the more junior officers (sub 4 years), before phasing out. This shows that some units don't have a high officer retention rate, which could be due to a number of reasons. The most prominent case of this is unit 30, which we note is a recruitment unit. There are also some units with zero TRRs which could be because of the units not having assignments for field work (as mentioned in the quantitative analysis).



With our findings using these visualizations, we have uncovered an interesting array of patterns indicating how officers learn use of force based on the units they are placed in, the peers they interact with and the length of engagement with both. Markedly, we have increased our understanding of how TRRs produced by senior officers are more likely to contain taser use, while junior officers' TRRs are more likely to arise from physically holding a subject. We have also illustrated that junior officers typically have very low numbers of TRRs per capita, and that officers that have been in a unit for 5-10 years are distinctly more likely to give rise to TRRs than senior officers, or junior officers. From this analysis, the case is increasingly building that officers develop poor discipline, and generate more TRRs, after they join the force for the first time. While the story is complex, we are seeing that officers are most problematic around their 5-10th year of service, with both the highest frequencies of TRRs per capita, and the highest likelihood of these TRRs containing stronger uses of force such as firearms and direct-mechanical.