# APPENDIX: MEASUREMENT MODELS

**A.1 | MEASURING POLICE LEGITIMACY**

Following Jackson et al. (2022), police legitimacy is measured as a coercive-consensual continuum, which is measured by survey items tapping into the ideas of normative alignment with the police, fear of the police, and duty to obey the police. To measure normative alignment, respondents were asked about the extent to which they agreed that “the police act in accordance with what you believe is right or wrong.” To measure fear of the police, respondents were asked about the extent to which they agreed that “people are afraid of the police.” Both items were measured using a five-point likert scale ranging from (1) never to (5) always. Exact wording can be found in Table A1. All variables were measured in Portuguese and translated into English by me – for the sake of transparency, both the original and the translated versions of all survey items are displayed.

[TABLE A1 ABOUT HERE]

To measure duty to obey, respondents were asked whether they thought they “should obey the police even when you believe they are wrong” (a binary indicator with ‘yes’ or ‘no’ as response alternatives). They were then subsequently asked why they thought they “(*should/should not*) obey the police even when you believe they are wrong,” an open-ended follow-up question. Those open-ended responses were classified based on a supervised machine learning text classification model using a support vector machine model algorithm (Hastie, Tibshirani, & Friedman, [2009](#ref-hastie2009elements)). On previous work, Jackson et al. ([2022](#ref-jackson2020fear)) and Oliveira et al. ([2020](#ref-oliveira2020preditores)) have analyzed the exact same open-ended responses for a different survey[[1]](#footnote-2) and, based on a thematic analysis involving multiple researchers, proposed four categories of duty to obey the police: those who said they should obey the police did so because of a *normatively grounded duty to obey* or based on a *coercive obligation*, whereas those who said they should not did so as a form of *rejection of authority* or as a type of *disobedient protest*.

After removing punctuation and stop words, turning everything into lowercase, and stemming inflected words to their base forms using the R package quanteda (Benoit et al., 2018), I first focused only on those who responded ‘yes’ to the first question (i.e., differentiating between normative and coercive obligation to obey) and used this previous classification to train a machine learning classification model; then I did the same for those who responded ‘no’ (i.e., differentiating between rejection of authority and disobedient protest). With a cross validation rate of 87% for the first and 80% for the second, both models successfully predicted the classes. I then fed the trained models with this study’s data so as to classify the open-ended responses as either “consent”, “coercive”, “rejection of authority”, or “disobedient protest.” The final distribution across all three waves consists of 40% responses in the ‘coercive’ category, 33% in the ‘consent’ category, 19% in the ‘rejection of authority’ category, and 8% in the ‘disobedient protest’ category.

[TABLE A2 ABOUT HERE]

In order to estimate scores of police legitimacy at each time point, I would ideally use a wide dataset and fit a three-trait item response model with trait loadings of the same indicators over time constrained to equality to ensure measurement equivalence. However, such model was too computationally intense and never converged. As an alternative, I estimate a one-trait item response model using pooled data, which is preferrable than estimating three different models at each time point as it imposes measurement equivalence.

As per Jackson et al. ([2022](#ref-jackson2020fear)), the estimated construct is a bipolar continuum ranging from coercive to consensual motivations to comply with the law. Results of the item response model estimated by mPlus 7.11 using maximum likelihood with robust standard errors are displayed in Table A2. Respondents who are normatively aligned with the police will have higher scores (), whereas respondents who perceive the police to be fearful will have lower scores (). Respondents who have a normatively grounded duty to obey the police and those who do not think they should obey as a form of a disobedient protest will also have scores shifted towards the legitimacy end of the continuum ( and , respectively), whereas those who reject the police authority will have lower scores () – in relation to the ‘coercive obligation’ category. Approximately normally distributed trait scores representing police legitimacy at each wave were then extracted and used in subsequent analyses.

**A.2 | SCALING PROPERTIES AND EMPIRICAL DISTINCTIVENESS BETWEEN ALL LATENT CONSTRUCTS**

Table A3 displays all other survey items used in this study, tapping into the ideas of ‘perceived police intrusion, ‘cynicism about police protection’, and ‘perceived police procedural fairness’. All variables were measured in Portuguese and translated into English by me; both the original and the translated versions of all survey items are displayed.

[TABLE A3 ABOUT HERE]

Using only data from the first wave, I first estimate a number of confirmatory factor analysis models to assess the scaling properties of the three constructs and make sure they are empirically distinguishable, contrasting model fit statistics of models with different solutions. All models are estimated by R’s package lavaan using diagonally weighted least squares (all indicators are set as ordinal). I fit five CFA models testing all possible combinations for three potential latent constructs: a one-factor solution where all indicators tap into a single construct; a two-factor model, where items tapping into both procedural fairness and police intrusion load onto a single construct, while items tapping into cynicism about police protection tap into another construct; another two-factor model, where items tapping into both police intrusion and cynicism about police protection load onto a single construct, whereas perceived procedural fairness is a separate construct; yet another two-factor model, in which items tapping into cynicism about police protection and perceived procedural fairness load onto a single construct, while perceived police intrusion is a separate latent variable; and, finally, a three-factor model in which perceived police intrusion, cynicism about police protection, and perceived procedural fairness are each distinct latent constructs.

[TABLE A4 ABOUT HERE]

Table A4 suggests that several combinations have an acceptable model fit, indicating that empirically distinguishing psychological constructs can be challenging. Yet, a three-factor solution clearly has the best model fit. The CFA model with three separate constructs has the highest scores of CFI (.999) and TLI (.997), the lowest score of RMSEA (.021), and is the only model that fails to reject the null hypothesis assuming that the observed covariance matrix is generated by the hypothesized model. While other combinations also have acceptable fit statistics – such as the two-factor solution collapsing perceived procedural fairness and cynicism about police protection – altogether, from a data-driven perspective these results demonstrate that the three constructs are indeed empirically distinguishable. In addition, from a theoretical point of view, considering all the reasons outlined in the rest of the paper, treating perceptions of procedural fairness and cynicism about police protection as two separate constructs is more appropriate. Given all these reasons combined, I treat all three latent constructs as three distinct, albeit correlated variables The three latent constructs are moderately to strongly correlated with each other, with the magnitude of all estimated correlation coefficients ranging from 0.47 to 0.59.

**A.3 | MEASURING ALL LATENT CONSTRUCTS**

[TABLE A5 ABOUT HERE]

I then fit three separate pooled measurement models for polytomous data with logistic function links, each model measuring each latent construct of interest (i.e., perceptions of police intrusion, cynicism about police protection, and perceptions of procedural fairness), as explained in the paper. Empirical indicators (e.g., survey items) are regressed on an estimated latent variable, but with logistic function links as the indicators are categorical variables; in this case, function links are specified as ordinal logistic, as all indicators were measured based on Likert scales. Pooling data across all three waves ensures measurement equivalence as all trait loadings and intercepts are constrained to equality across waves, and therefore such model specifications can capture change over time in latent variables. Factor loadings for the three models are displayed in Table A5. I use trait scores derived from these models throughout the study.

[TABLES A6, A7, A8 ABOUT HERE]

Tables A6, A7 and A8 display correlation matrices between the three derived latent trait scores and scores of police legitimacy (the coercive-consensual continuum) at each time period.

**Table A1.** Survey items used to measure the coercive-consensual continuum

|  |  |
| --- | --- |
| Survey items | Response alternatives |
| The police act in accordance with what you believe is right or wrong (*A polícia do seu bairro age de acordo com o que o(a) sr(a) acha que é certo*) | Never, rarely, sometimes, very often, always (*Nunca, raramente, às vezes, quase sempre, sempre*) |
| People are afraid of the police (*As pessoas sentem medo da polícia*) |
| Do you think you should obey the police even they believe they are wrong? (*O(a) sr(a) acha que deve obedecer a polícia mesmo quando acredita que ela está errada?*) | Yes, no (*Sim, não*) |
| Why do you think you (*should / should not*) obey the police even when you believe they are wrong? (*Por que você acredita que [deve / não deve] obedecer a polícia mesmo quando ela está errada?*) | Normatively grounded duty to obey, coercive obligation to obey, disobedient protest, rejection of authority (based on thematic analysis and a text classification model) |

**Table A2.** Item response model measuring police legitimacy using pooled data

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | *Police legitimacy* | | | | |
| Survey items | Est. | s.e. | | Link function | |
| Act in accordance with what you believe | 1.506 | 0.328 | | Ordinal logistic | |
| People are afraid of the police | -0.601 | 0.101 | |
| Normative duty to obey | 0.511 | 0.087 | | Multinomial logistic (reference: coercive obligation) | |
| Disobedient protest | 0.083 | 0.113 | |
| Rejection of authority | -0.159 | 0.093 | |
| AIC | 24214.01 | |  | |  |
| BIC | 24309.71 | |  | |  |
| N. obs | 2926 | |  | |  |

**Table A3**.Survey items and latent constructs

|  |  |  |  |
| --- | --- | --- | --- |
| **Construct** | **Survey items** | **Response alternatives** | |
| Cynicism about police protection | * How good a job are police in your neighborhood doing in relation to: keeping the streets of my neighborhood peaceful (reverse coded) (*Como o(a) sr(a) avalia o trabalho da polícia no seu bairro em relação a: manter as ruas do bairro tranquilas*) | Very bad, bad, neither good nor bad, good, very good  (*Muito ruim, ruim, nem bom nem ruim, bom* |
| * Police in my neighborhood ensure my safety (reverse coded) (*A polícia do seu bairro garante a sua segurança*) | Never, rarely, sometimes, very often, always  (*Nunca, raramente, às vezes, quase sempre, sempre*) |
| * Laws protect me (reverse coded) (*O(a) sr(a) sente que as leis o/a protegem?*) |
| Perceptions of police intrusion | * Police officers act as if they were above the law in my neighborhood (*Os policiais no seu bairro agem como se estivessem acima da lei*) |  | |
| * Police officers follow and harass people in my neighborhood (*Os policiais no seu bairro perseguem e intimidam as pessoas*) |  | |
| Perceived procedural fairness | The police in your neighborhood: (*A polícia do seu bairro:*) ( |  | |
| * Explain clearly why they pull someone over (*Explica claramente por que revista ou prende as pessoas*) |  | |
| * Make impartial and just decisions (*Toma decisões que são justas e imparciais*) |  | |
| * Pay attention to the information people provide them with (*Dá atenção às informações que as pessoas trazem*) |  | |
| * Treat people with respect (*Trata bem as pessoas*) |  | |

**Table A4.** Contrasting model fit statistics of five CFA models

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | One factor | Two factors | Two factors | Two factors | Three factors |
| Latent constructs | 1) Police Intrusion, Cynicism about Police Protection, and Procedural Fairness collapsed) | 1) Cynicism about Police Protection and Procedural Fairness collapsed;  2) Police Intrusion. | 1) Police Intrusion and Procedural Fairness collapsed;  2) Cynicism about Police Protection | 1) Police Intrusion and Cynicism about Police Protection collapsed;  2) Procedural Fairness | 1) Police Intrusion;  2) Cynicism about Police Protection;  3) Procedural Fairness |
| Estimation | Diagonally weighted least squares | Diagonally weighted least squares | Diagonally weighted least squares | Diagonally weighted least squares | Diagonally weighted least squares |
| Chi-Square | 269.74 | 40.08 | 260.99 | 236.19 | 33.45 |
| (degrees of freedom) | 27 | 26 | 26 | 26 | 24 |
| p-value | p < 0.000 | 0.038 | p < 0.000 | p < 0.000 | 0.095 |
| CFI | 0.968 | 0.998 | 0.969 | 0.973 | 0.999 |
| TLI | 0.958 | 0.997 | 0.957 | 0.954 | 0.998 |
| RMSEA | 0.101 | 0.025 | 0.101 | 0.096 | 0.021 |
| RMSEA CI | [0.090; 0.112] | [0.006; 0.039] | [0.090; 0.112] | [0.084; 0.107] | [0.000; 0.037] |

**Table A5.** Three longitudinal models measuring latent constructs at three points in time

|  |  |  |  |
| --- | --- | --- | --- |
|  | Perceived police intrusion | Cynicism about police protection | Perceived procedural fairness |
|  | Loading | Loading | Loading |
| Act as if above the law | 4.35 |  |  |
| Follow and harass people | 1.44 |  |  |
| Ensure my safety (rev.) |  | 1.00 |  |
| Keep the streets peaceful (rev.) |  | 0.93 |  |
| Laws protect me |  | 0.68 |  | |
| Explain clearly |  |  | 1.00 |
| Make impartial and just decisions |  |  | 1.11 |
| Pay attention to information |  |  | 1.18 |
| Treat people with respect |  |  | 1.09 |
| Estimator | MLR | PML | PML | |
| N. obs | 2929 | 2929 | 2929 | |

**Table A6.** Correlation matrix between key constructs using first wave data

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Perceived police intrusion | Cynicism about police protection | Perceived procedural fairness | Police legitimacy |
| Perceived police intrusion | 1 |  |  |  |
| Cynicism about police protection | .24 | 1 |  |  |
| Perceived procedural fairness | -.29 | -.57 | 1 |  |
| Police legitimacy | -.31 | -.44 | .66 | 1 |

**Table A7.** Correlation matrix between key constructs using second wave data

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Perceived police intrusion | Cynicism about police protection | Perceived procedural fairness | Police legitimacy |
| Perceived police intrusion | 1 |  |  |  |
| Cynicism about police protection | .20 | 1 |  |  |
| Perceived procedural fairness | -.31 | -.57 | 1 |  |
| Police legitimacy | -.32 | -.49 | .65 | 1 |

**Table A8.** Correlation matrix between key constructs using third wave data

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Perceived police intrusion | Cynicism about police protection | Perceived procedural fairness | Police legitimacy |
| Perceived police intrusion | 1 |  |  |  |
| Cynicism about police protection | .30 | 1 |  |  |
| Perceived procedural fairness | -.37 | -.63 | 1 |  |
| Police legitimacy | -.39 | -.53 | .64 | 1 |

**REFERENCES**

Benoit, Kenneth, Kohei Watanabe, Haiyan Wang, Paul Nulty, Adam Obeng, Stefan Muller, and Akitaka Matsuo. 2018. “quanteda: An R Package for the Quantitative Analysis of Textual Data.” *The* *Journal of Open Source Software* 3 (30): 774.

Hastie, Trevor, Robert Tibshirani, and Jerome Friedman. 2009. *The Elements of Statistical Learning: Data Mining, Inference, and Prediction*. Springer Science & Business Media.

Jackson, Jonathan, Krisztián Pósch, Thiago R. Oliveira, Ben Bradford, Silvia M Mendes, Ariadne Lima Natal, and André Zanetic. 2022. “Fear and Legitimacy in São Paulo, Brazil: Police-Citizen Relations in a High Violence, High Fear City.” *Law & Society Review*.

Oliveira, Thiago R., André R. Oliveira, and Sergio Adorno. 2019. “Legitimidade Policial: um Modelo de Mensuração.” *Revista Brasileira de Ciências Sociais* 34 (100).

Oliveira, Thiago R., Andre Zanetic, and Ariadne Natal. 2020. “Preditores e Impactos da Legitimidade Policial: Testando a Teoria da Justeza Procedimental em São Paulo.” *Dados – Revista de Ciências Sociais* 63 (1).

1. Two surveys were fielded using the same questionnaire: a 2015 representative survey of the adult population residing in the city of São Paulo and a three-wave panel survey representative of the adult population residing in eight neighborhoods in the city of São Paulo (see Oliveira et al., [2019](#ref-oliveira2019police); [2020](#ref-oliveira2020preditores)). [↑](#footnote-ref-2)