



Identifying Psychological Trauma among Syrian Refugee Children for Early Intervention: Analyzing Digitized Drawings Using Machine Learning

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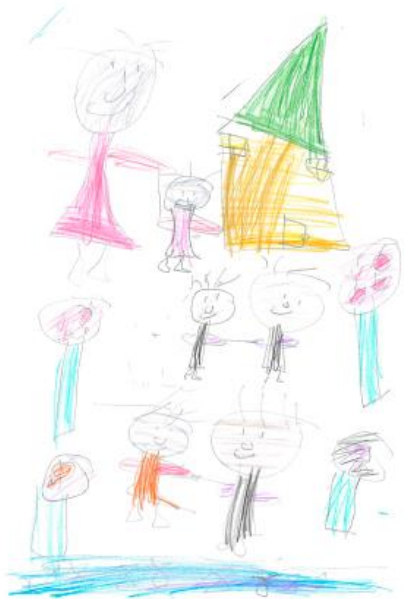
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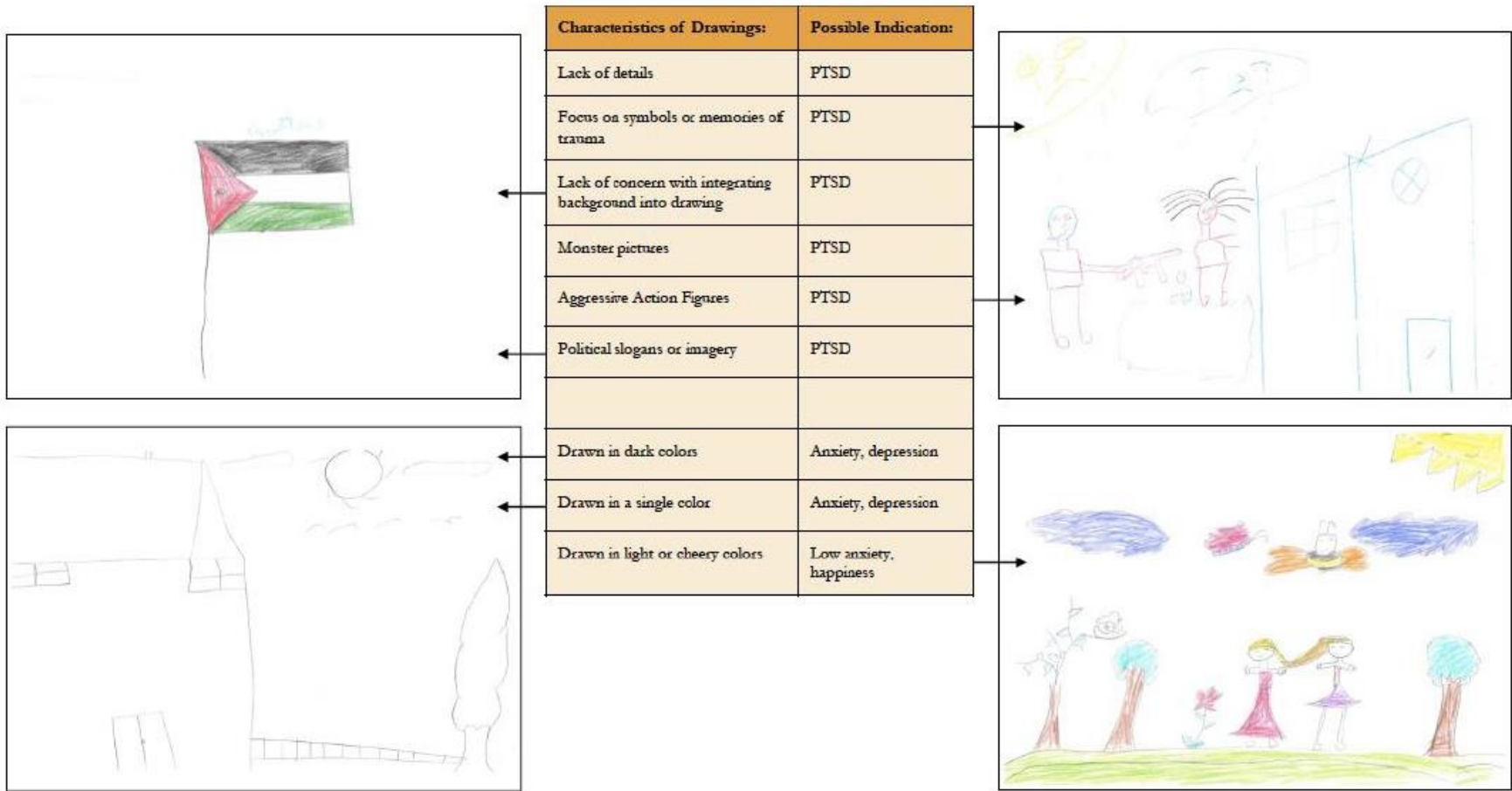


Data and Methodology

- Syrian Civil War: 2011-?
 - 6.6 million refugees, 52% of whom are children
- Objective: To use the quantitative analysis of children's drawings as a non-invasive diagnostic tool to measure psychological trauma of individual refugee children and larger populations.
- Data:
 1. USF Dataset, Jordan, collected 2016
 2. Gender and Adolescence: Global Evidence (GAGE), Jordan, collected 2019
 3. Battlefield deaths in civil war from Syrian Revolution Martyrs Database
- Use conventional & machine-learning econometric tools.
- Children's drawings as indicator of mental health/trauma

Data and Methodology

- Correlating drawing features with aspects of mental health:



Hypotheses and Tests

- 1) Using drawing features from correlations in historical clinical psych literature to create indices of anxiety, depression, and PTSD, what are the effects on children of
 - a) exposure to violence from Syrian civil war
 - b) family's assimilation into Jordanian society
- 2) What drawing features predict exposure to violence?
 - Are these features consistent with historical literature in analysis of children's drawings?

Effects of Exposure to Violence

1) Estimate $y_i = \alpha + \mathbf{X}'\boldsymbol{\tau} + \mathbf{Z}'\boldsymbol{\beta} + \epsilon_i$, where

- y_i is index of anxiety, depression, or PTSD;
- \mathbf{X} is a vector of refugee experiences that includes exposure to violence, assimilation status, or both;
- \mathbf{Z} is vector of characteristics that includes gender, family size, father's occupation, characteristics of city of origin in Syria.

Effects of Exposure to Violence & Reintegration

- Impacts of both violence exposure and reintegration on PTSD:

OLS Regressions on impact of violence and reintegration on Anxiety, Depression and PTSD (USF Data)

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Anxiety	Depression	PTSD	Anxiety	Depression	PTSD	Anxiety	Depression	PTSD
Exposure to Violence	0.021 (0.030)	0.009 (0.044)	0.136*** (0.048)	-	-	-	0.003 (0.028)	-0.018 (0.039)	0.122** (0.048)
Reintegration	-	-	-	-0.112 (0.079)	-0.166*** (0.057)	-0.098** (0.036)	-0.111 (0.080)	-0.167*** (0.059)	-0.087** (0.035)
Observations	1,231	1,231	1,231	1,231	1,231	1,231	1,231	1,231	1,231

OLS Regressions on impact of violence and reintegration on Anxiety, Depression and PTSD (GAGE Data)

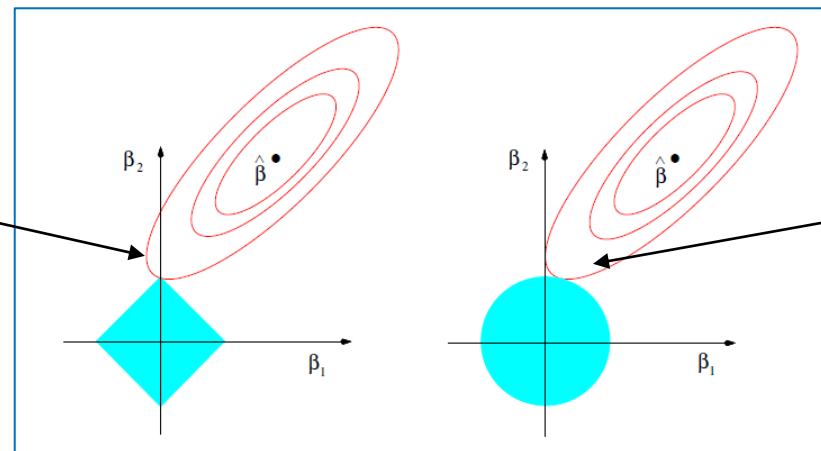
	Anxiety\ Depression		PSTD	Anxiety\ Depression		PSTD	Anxiety\ Depression		PSTD
	(1)	(2)	(3)	(4)	(5)	(6)	(5)	(6)	
	Exposure to Violence	0.098** (0.044)	0.111* (0.064)			0.072 (0.048)	0.105 (0.063)		
Reintegration			-0.187*** (0.051)	-0.044 (0.066)	-0.179*** (0.051)	-0.039 (0.065)			
Observations	1091	1091	1091	1091	1091	1091	1091	1091	

Notes: OLS regressions with Robust standard errors clustered at the governorate/flight-year level in parentheses. *** p < 0.01, ** p < 0.05, * p < 0.10.

Children's Drawings as Predictors of Exposure to Violence

- **LASSO:**
(Least Absolute Shrinkage and Selection Operator)
- Minimizes $\sum_{i=1}^n \left(y_i - \sum_{j=1}^p x_{ij} \beta_j \right)^2 + \lambda \sum_{j=1}^p |\beta_j|$ via changing values of λ across a k -fold ($k = 10$) validation process, calculating mean squared pred. error over λ .

LASSO: (Selection as well as shrinkage)



vs. Ridge Regression:
(Minimizes sum of squared coefficients, just get shrinkage)

Children's Drawings as Predictors of Exposure to Violence

- 2) Use LASSO to estimate $Y_i = \beta_0 + \mathbf{X}'\boldsymbol{\gamma} + \mathbf{D}'\boldsymbol{\beta} + e_i$
- Y_i represents exposure to violence (Syrian Revolution Martyrs Database in year when family fled country);
 - \mathbf{X} is a vector of non-penalized demographic controls
 - \mathbf{D} represents a vector of penalized drawing features obtained from children of Syrian refugee households.
 - LASSO retains “Aggressive Action Figures” in both datasets as strong predictors of exposure to violence, with increases in probability of exposure to violence of 0.164 (USF) and 0.309 (GAGE) respectively.

Summary of Main Findings

- 1) Impact of Exposure to Violence & Reintegration:
 - Drawing-based indices show increases in PTSD of approximately 0.13σ in the USF dataset and 0.11σ in the GAGE dataset from exposure to high levels of battlefield deaths before a child's family fled from Syria to Jordan.
 - Reduction in PTSD and depression from reintegration.
- 2) We find early and preliminary evidence that machine-learning techniques such as LASSO can be used to predict past exposure to violence.
 - With further validation, use as early, inexpensive, non-invasive screening device for trauma among refugee children.