Exploring Potential Root Causes of Differential Heat Exposure:
Gendered Impacts on Daily Travel Timing

Shelley Hoover, email: shelleyhoover@princeton.edu
School of Public and International Affairs, Princeton University

Center for Policy Research on Energy and the Environment
PRINCETON UNIVERSITY

Overview

It is well-documented that hazards disproportionately impact socially vulnerable populations[1]. However, the underlying causes of inequities that produce socially vulnerable populations are less understood.

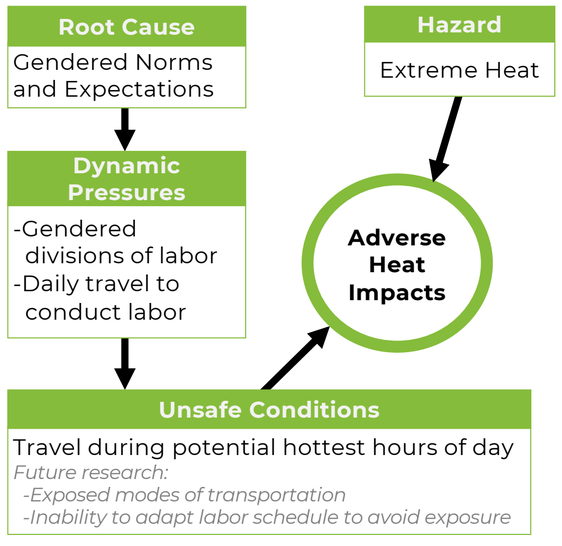
Following the Pressure and Release model, this poster presents an exploratory quantitative analysis into how a root cause, gendered norms and expectations, produces differential dynamic pressures and unsafe conditions across genders. A regression is employed to analyze the gendered patterns of travel during 1-4pm, afternoon hours when daily temperatures frequently peak and are potentially the riskiest time during an extreme heat event[2,3,4]. The analysis considers the impact of travel purpose: whether for work travel, household labor travel, or other reasons; as well as the composition of the household to investigate the potential impact of children in the household or bargaining processes between men and women on travel patterns.

Background

Gender shapes all aspects of social life, including household routines, access to resources, intimate relationships, and employment[5]. While women are frequently identified as disproportionately impacted by hazards; findings on the gendered impacts of extreme heat to date have been mixed[6,7].

Applied Pressure and Release (PAR) Model

The PAR Model is a conceptual framework positing that disasters occur when hazards interact with vulnerable places or populations, which are created through a progression of root causes, dynamic pressures, and unsafe conditions[8]. The PAR model is used to frame a quantitative analysis examining if gendered norms and expectations create specific vulnerabilities to extreme heat through the dynamic pressures of gendered divisions of labor.

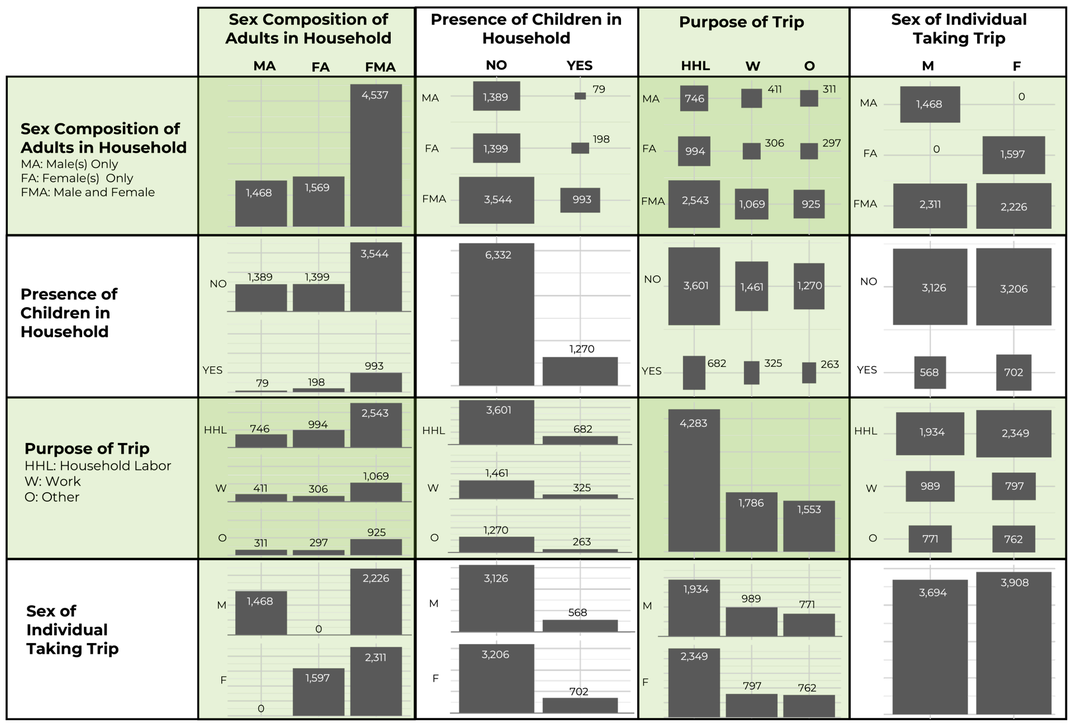


This applied PAR illustrates the theorized process of how rooted gendered norms and expectations results in differential travel timing.

Data & Methods

Variables were derived from the 2022 U.S. Department of Transportation's National Household Travel Survey (NHTS)[9]. Trips taken by adults (18+) during the months of May-September were included, resulting in a final N of 7,602 trips analyzed.

Distribution of Trips by Household Type, Trip Purpose, and Trip Taker Sex



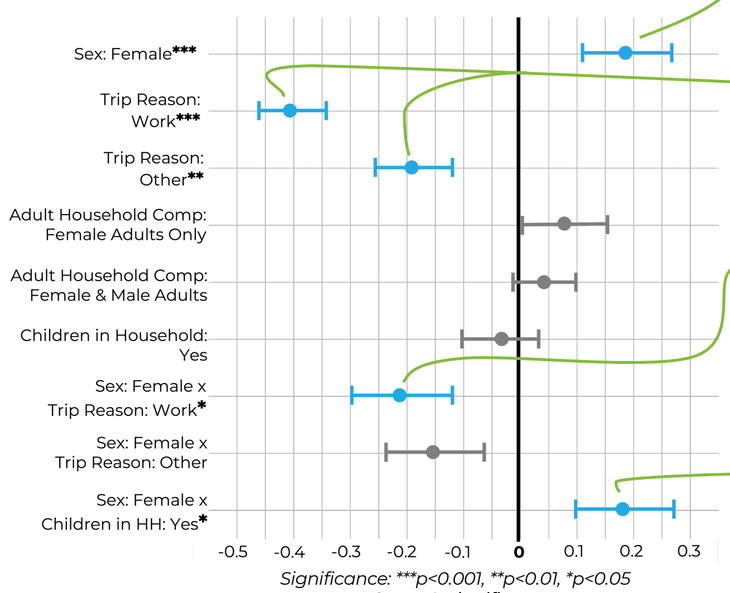
To account for the nested data structure, a binomial generalized linear mixed model (GLMM) is employed to investigate the factors influencing the likelihood of trips occurring between 1pm and 4pm, with households as the random effect. Sex is modeled as an interaction term with the other fixed effects:

$$AFTRIP = \beta_0 + \underbrace{TRIPPU \times SEX + ACOMP \times SEX + CHILD \times SEX}_{\text{Fixed Effects}} + \overbrace{HID}^{\text{Random Effect}} + \varepsilon$$

Results

The random effect results finds significant variation across households (Variance = 1.058, Std. Dev. = 1.028), indicating heterogeneity in trip timing preferences/necessities between households.

GLMM Fixed Effects Results:
Reference Group: Males; Households with Adult Male(s) Only; Household Labor Trips; Households with No Children



*Significance: ***p<0.001, **p<0.01, *p<0.05*
Gray = Insignificant

Overall, women are more likely to travel between 1pm-4pm compared to men.

Household labor trips are more likely to be taken during 1pm-4pm compared to trips taken for work or other purposes.

Men are more likely to travel for work related reasons between 1pm-4pm compared to women.

Women with children in the household are more likely to travel between 1-4pm than men with children in the household.

GLMM Variables

Variable		Value
AFTRIP	Trip taken during 1pm-4pm	Yes/No
HID	Household of Individual	Unique ID
SEX	Sex of individual taking trip	Male/Female
TRIPPU	Purpose of Trip	HHL: Household Labor; W: Work ; O: Other
ACOMP	Sex composition of adults in household	FA: Only female adult(s); MA: Only male adult(s); FMA: Both male and female adult(s)
CHILD	Presence of children in household	Yes/No

Discussion

The GLMM results support the hypothesis that travel timing is gendered. Recognizing the pervasive nature of gendered travel timing supports the need for future research on heat exposure that more meaningfully incorporates gender. For example, existing research has examined the impact of exposed modes of transportation on heat exposure, but focused on work commutes[10,11] or recreational travel[12]. This overlooks travel for household related purposes, which this analysis reveals as gendered.

The analysis did not consider actual heat events, but can inform on policy aimed to mitigate heat exposure. Men were found to travel more during 1-4pm for work-related reasons. Intersections of class may inhibit men from adjusting work schedules for safer travel times.[13] Women were found to travel more for household labor related activities. Women generally have less bargaining power within the household, which may limit their ability to adjust household related travel needs to avoid exposure[14]. This suggests that men may benefit more from workplace-based policies, whereas women may benefit more from policies providing flexibility in unpaid household/childcare expectations.

Finally, I acknowledge that the study's male-female binary is a limitation that significantly oversimplifies gender and omits the experiences of gender minorities.

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