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Where Does Stress Happen? Ecological Momentary Assessment of Daily Stressors Using a Mobile Phone App

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BACKGROUND

1. Daily stress in various environments

- Daily stressor refers to quotidian adversity and the friction that exist in daily life. Daily stress contributes to myriad negative health outcomes (Wright et al., 2020).

- Daily stress occurs in various environments, such as stress at the workplace, at home, while driving, in grocery stores, and in city environments (Matheson et al., 2006; Quinn et al., 2010; Scott-Parker et al., 2018). The home and the workplace are the two most common spaces where people encounter daily stress.

- Most studies that examined stress in various environments have focused on identifying stressors in such environments, rather than collecting data about stress as it happens in free living conditions dynamically. Therefore, which daily stress types vary by location, and which stress types are generated regardless of the location remain unknown. As such, stress interventions rarely account for the environment in which stress occurs.

- In addition, the onset of the COVID-19 pandemic have forced many people to work at home, introducing new stressors and challenges to maintaining a work-life balance (Galanti et al., 2021; Hayes et al., 2020), compelling us to further explore the relationship between geographical location and daily stress perception.

2. Ecological momentary assessment (EMA)

- Initial studies of daily stressors have relied primarily on self-administered checklists. Stress is measured at a single point, subjecting to recall bias, leading to overestimating emotionally salient stressors (Larson & Csikszentmihalyi, 2014).

- Ecological momentary assessment (EMA) allows for the collection of cognitive appraisals of daily stress in the moment it occurs within real-life environments, reducing recall bias and allows for the measurement of phenomenon as they are experienced in free-living conditions (Kou et al., 2020; Fernández-Castro et al., 2021).

- In this study, we combined **app-based EMA** with the parallel measurement of the **geospatial location**, opening the possibility of a better capture of where stress happens and spreads in various environments.

METHOD

Data collection

1. Participants (33)
   - 25 individuals in the Arizona state, U.S. (2018).
   - 8 individuals in the Indiana state, U.S. (2020).
2. Recruitment
   - Community flyers and posts in community Facebook groups.
3. Data collection processes
   - Participants utilized a mobile phone-based EMA app to record stressors as they went about their daily lives.
   - If they were in a situation that was unsafe to use their phones (e.g., driving a car), they were asked to proceed to the nearest safe location before recording their experience.
   - If participants did not experience stress during a day of their study period, they were asked to log an event on their phones before they went to bed for the evening indicating that they had not experienced stress but were still active participants in the study.
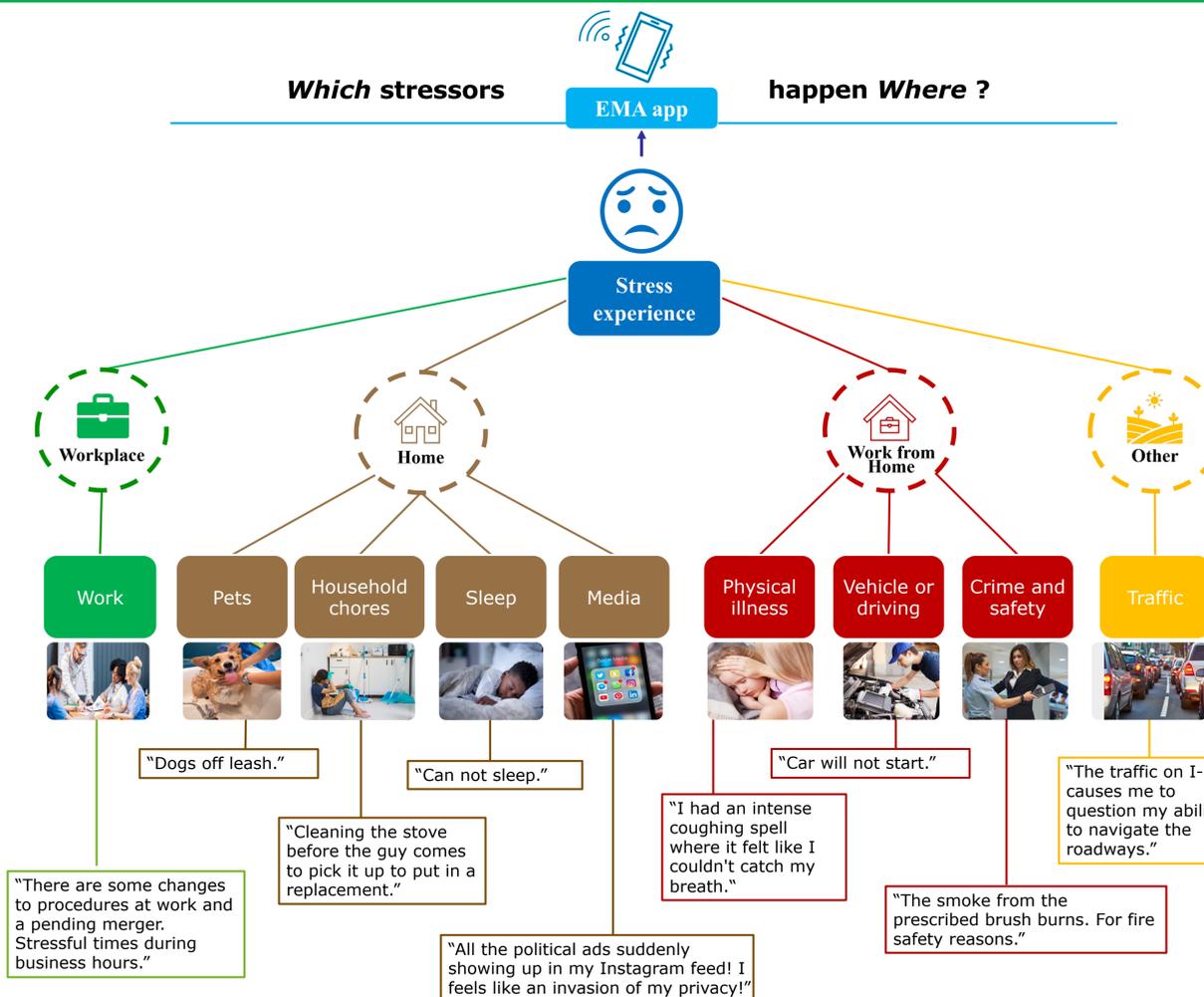
Instruments

1. In a pre-test survey, study participants provided their home and work address.

2. A buffer with a 0.1-mile (528 feet, 0.16 km) radius was created around each participants' home and work addresses. We then identified stressors that occurred within these buffers or outside of these buffers.

3. When study participants determined that they experienced a stressor, they opened the app and were asked to "Briefly describe what is causing you stress." An open-ended text box was provided for participants to describe their stressful experiences.

4. The app automatically collected the GPS coordinates of the participant each time they logged a stressful experience.

Analysis

1. Determine where each stressor occurred.
   - We geocoded each stressor location based on the coordinates recorded by the EMA app and compared them to the coordinates of each participant's self-reported home and work addresses.
2. Analyze stressor themes thematically.
   - A three-person thematic analysis coding team discussed participants' records to determine important areas of inquiry for analysis.
   - Each coder coded the data and manually developed a codebook of stressor themes experienced by study participants.
   - The three coders discussed their coding of stressors to reach consensus on themes.
3. Identify how frequently each stressor theme emerged among participants.
   - A series of chi-square tests were performed to assess if stressor themes were mentioned more or less frequently by location.

RESULTS

Which stressors   happen *Where* ?

"There are some changes to procedures at work and a pending merger. Stressful times during business hours."

"Dogs off leash."

"Cleaning the stove before the guy comes to pick it up to put in a replacement."

"Can not sleep."

"All the political ads suddenly showing up in my Instagram feed! I feels like an invasion of my privacy!"

"I had an intense coughing spell where it felt like I couldn't catch my breath."

"Car will not start."

"The smoke from the prescribed brush burns. For fire safety reasons."

"The traffic on I-17 causes me to question my ability to navigate the roadways."

Top ten frequent stressors

1. Work
2. Time
3. Psychological issues
4. Physical Illness
5. Pets
6. Social interaction
7. Mistakes
8. Technology or device
9. Finance
10. Sleep

The final list of stressor themes contained 27 unique stressors.

Nine daily stressors differed by location

Stressor Themes	Location proportion (%)			
	Home	Work	Work at Home	Other
Work stress	24.8	41.3*	22.3	11.6
Pets	57.9*	15.8	7.9	18.4
Household chores	68.2*	0.00	22.7	9.1
Physical Illness	34.0	4.3	40.4*	21.3
Sleep	57.1*	3.6	39.3	0.0
Vehicle or driving	10.0	15.0	40.0*	35.0
Traffic	11.8	17.6	29.4	41.2*
Crime and safety	26.3	21.1	52.6*	0.00
Media	54.5*	4.5	40.9	0.00

Results of chi-square test for relationships between stressors and locations.
* Location where this stressor occurs most frequently among the four locations.

DISCUSSION AND CONCLUSION

1. Experiences of daily stressors differ by location.

   - Work-related stress was shown to occur most frequently at the workplace.
   - Stress about pets, household chores, sleep and media were strongly associated with the home space. Past studies on home-related stress have primarily focused on marriage and parenting which are demonstrated not limited to the home setting (Camisasca et al., 2016; Berge et al., 2017).
   - Physical illness, vehicle or driving, and crime and safety stressors were reported more frequently in "work from home" environments. These three stressors have not often appeared in previous studies on the stress of working from home (Galanti et al., 2021; Weinert et al., 2015).
   - Traffic-related stress was experienced more common in "other" environments.

2. In terms of the COVID-19 related shift of many individuals to working from home, we provide early evidence that stressors experienced in the home by those who work from home may be different than those who work elsewhere.

3. EMA allows for geospatial analysis of self-reported stressors, enhancing the ability to determine when and where stress happens.

4. Study findings begin a body of research that should identify elements of the built and natural environment that play a role in stress, allow for more targeted interventions aimed at reducing stress and promoting health.

LIMITATION AND FUTURE RESEARCH

1. As a preliminary study, we limited the possible space categories for collecting GPS coordinates to four: home, work, work at home, and other. Future research could configure GPS coordinates for various common places, such as hospitals, grocery stores, parks, schools, gymnasiums, and so on, providing a comprehensive picture of the relationship between stress and spatio-temporal effects.

2. The enormous potential of smartphone-based EMA could be further explored. Additional data such as time, photos of stressful environments, voice or video, and more should be collected and analyzed to paint a complete picture about the relationships between location and stress.

3. Interventions targeted at specific geospatial locations can be created to address common stressors in various environments.

Plain-text & voice Accessible QR code