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Leveraging Experience Sampling/Ecological Momentary Assessment for Sociological Investigations of Everyday Life

Christopher R. Browning,[1] Nicolo P. Pinchak,[2] Catherine A. Calder,[3] and Bethany Boettner[4]

[1]Department of Sociology & Institute for Population Research, The Ohio State University, Columbus, Ohio, USA; email: browning.90@osu.edu

[2]Centre for Social Investigation, Nuffield College, and Leverhulme Centre for Demographic Science, University of Oxford, Oxford, United Kingdom

[3]Department of Statistics and Data Sciences & Population Research Center, The University of Texas, Austin, Texas, USA

[4]Institute for Population Research, The Ohio State University, Columbus, Ohio, USA

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Abstract

Experience sampling (ES)—also referred to as ecological momentary assessment (EMA)—is a data collection method that involves asking study participants to report on their thoughts, feelings, behaviors, activities, and environments in (or near) real time. ES/EMA is typically administered using an intensive longitudinal design (repeated assessments within and across days). Although use of ES/EMA is widespread in psychology and health sciences, uptake of the method among sociologists has been limited. We argue that ES/EMA offers key advantages for the investigation of sociologically relevant phenomena, particularly in light of recent disciplinary emphasis on investigating the everyday mechanisms through which social structures and micro (individual and relational) processes are mutually constitutive. We describe extant and potential research applications illustrating the advantages

of ES/EMA regarding enhanced validity, illuminating micro-temporal processes, and the potential for linkage with spatially and temporally referenced data sources. We also consider methodological challenges facing sociological research using ES/EMA.

INTRODUCTION

The micro temporal dynamics of individual, relational, situational, and sociospatial processes are central to a range of sociologically relevant phenomena. For instance, behaviors that communicate racial slights to people of color—racial microaggressions—have been described as both "brief" and "commonplace" (Mendez et al. 2020, Sue et al. 2007), requiring methods that capture the everyday circumstances of such incidents to better understand their origins and how they unfold. Sociological surveys often elicit social network partners by asking respondents about those with whom they interact frequently. Yet, the manifestation of these social ties in the form of actual instances of copresence or communication is rarely observed. Questions regarding the effects of sociospatial contexts such as residential neighborhoods, urban public spaces, workplaces, and educational settings on well-being feature prominently in sociological research; however, measurement of experiences in, or reactions to, such contexts typically relies on standard social survey–based reports. Investigation of responses to contexts based on ecologically valid (reported in situ) data remains rare in current sociological research.

The discipline's relatively recent turn toward enhanced understanding of the multilevel and mechanistic aspects of social phenomena has drawn attention to the promise of capturing socially relevant processes and outcomes in space and time (Palmer et al. 2013, Sharkey & Faber 2014). These developments follow a long tradition of ethnographic work that has produced a wealth of insight into the social context of individual, dyadic, and group processes through participant observation. Although the ethnographic approach has proven remarkably generative in this regard (Anderson 1978, Jones 2009, Leverentz 2022), the method is limited in its ability to capture in-the-moment social dynamics over a large number of participants or beyond a small number of settings. Although quantitative social survey–based research can systematically elicit information from a sample of respondents, it has lacked methods for observing ongoing behavior and experience as it occurs, resulting in lingering concerns regarding reliability, validity, and constraints on the frequency of observation.

Experience sampling (ES)—also referred to as ecological momentary assessment (EMA)—is a data collection method that involves asking study participants to report on their thoughts, feelings, behaviors, activities, and environments in (or near) real time (Bolger & Laurenceau 2013, Csikszentmihalyi & Larson 2014, Shiffman et al. 2008). ES/EMA methods represent a significant opportunity for sociologists to investigate processes that have proved empirically elusive when relying on conventional data collection methodologies. Although use of ES/EMA is widespread within disciplines such as psychology and health sciences, uptake of the method within sociology has been limited. In what follows, we consider recent developments in sociological theory and practice bearing on the relevance of ES/EMA data and describe extant, sociologically oriented research illustrating the benefits of ES/EMA with respect to enhanced validity, illuminating micro-temporal processes, and the potential for linkage with spatially and temporally referenced data sources. We highlight several exemplar domains in which ES/EMA might advance research, including potential applications in criminology, racial disparities, and social network analysis. These subdisciplinary foci are rooted in the authors' research interests; however, we argue that ES/EMA is potentially broadly applicable to areas of sociological inquiry in which intraindividual

variability, covariation, and change and person-context dynamics are central. We also discuss a number of sociologically relevant methodological challenges facing research using ES/EMA.

THE RELEVANCE OF EXPERIENCE SAMPLING/ECOLOGICAL MOMENTARY ASSESSMENT TO MECHANISTIC AND MULTILEVEL APPROACHES IN SOCIOLOGY

James Coleman's (1990) well-known discussion of macro-micro-macro linkages central to sociological theory prompted ongoing reflection on the relevance of relationally embedded individual-level processes in understanding pathways through which social structures yield both individual and, ultimately, collective outcomes. Subsequently, Hedström & Swedberg (1998) articulated the analytical sociology perspective, in which a focus on causal social mechanisms—"constellation(s) of entities and activities that are organized such that they regularly bring about a particular outcome" (Hedström 2005, p. 33)—is critical for effective sociological explanation. In this view, social research must empirically assess the operation of behavioral and interactional dynamics that give rise to system-level outcomes. Failure to probe potential mechanisms limits the capacity to adjudicate among competing causal accounts of a given outcome and relegates generative microlevel processes to a black box. These arguments echo calls among inequality scholars for attention not only to why inequality in important outcomes across race, class, and gender occurs but also to "*how* such variation comes about" (Reskin 2003, p. 8; see also Melamed et al. 2019).

A related development in social science research over the last 3 decades is the increasing emphasis on multilevel conceptualization, measurement, and modeling. Multilevel approaches are particularly relevant for sociology, given the common focus on features of social context as explanans in theoretical models of phenomena that occur at a lower level. An important advantage of multilevel thinking is the recognition that any given individual-level association with an outcome is a potentially "uninterpretable blend" of individual and contextual associations (Raudenbush & Bryk 2002, p. 139). As highlighted in the residential segregation literature, for example, positive individual-level associations between Black racial identification and outcomes such as poor health may be due to the concentration of Black people in racially segregated and often higher-poverty neighborhoods (Do et al. 2017, Robert & Ruel 2006, Wang et al. 2022).

Similarly, disentangling between- and within-individual associations can reveal distinct patterns. Ringwald et al. (2022), for instance, found that the average level of reported conscientiousness was negatively associated with both stress and negative affect. In contrast, days on which more conscientiousness was reported did not result in lower levels of stress and negative affect, indicating that the process by which conscientiousness was emotionally adaptive was not explained by its short-term affect rewards. We argue that ES/EMA offers one strategy for observing macro-micro-macro mechanisms and distinguishing between- and within-individual associations in a sociologically relevant manner. In particular, ES/EMA allows researchers to observe in-the-moment situational, interactional, and intraindividual level processes that may link system-level factors to both individual- and system-level outcomes. We next turn to the history of ES/EMA use in sociology and examine research that has creatively deployed ES/EMA to address sociological questions.

DELIMITING EXPERIENCE SAMPLING AND ECOLOGICAL MOMENTARY ASSESSMENT

ES/EMA has many antecedents and a long history of development. Relevant to sociological interests, the work of Barker and the Kansas School of ecological psychology pioneered the observation of activities in natural behavioral settings on a large scale with the goal of

understanding the environmental inputs to action (Barker & Gump 1964). Whyte (1980) famously used time-lapse photography to systematically document human behavior in urban public spaces. Most germane to the current state of the ES/EMA approach were developments in the late 1970s and 1980s. Specifically, Csikszentmihalyi and colleagues developed the experience sampling method (Csikszentmihalyi & Larson 2014, deVries 1992, Hektner et al. 2007, Larson 2019), which employed pagers to signal moments for subjects to address questions on current or recent mood, activity, interactions, etc. Stone & Shiffman (1994) subsequently introduced the term ecological momentary assessment to the field of behavioral medicine, focusing on the role of repeated, in situ measurement in improving understanding of health conditions, attitudes, behavior, and treatment compliance. Recognizing the prevalence of both terms in the literature, we use the acronym ES/EMA when referring generically to the method.

Shiffman et al. (2008) have described the set of data collection modalities encompassed by EMA as including both respondent self-reports and other ambulatory assessments such as wearable sensors. We focus the following on a consideration of self-report ES/EMA approaches rather than direct observational strategies or the use of wearable sensors. However, we recognize that the utility of ES/EMA may be substantially enhanced when combined with other data collection modalities, particularly passively collected sensor data. A notable example is GPS, which allows ES/EMA responses to be located spatially. Cagney et al. (2020) and Browning et al. (2021) provide overviews of the use of geo-referenced mobility data in sociological and criminological research, respectively, and the potential of these data to shed light on a host of long-standing questions. Although we emphasize the direct benefits of self-report ES/EMA strategies, we note specific research examples of how ES/EMA can be usefully combined with data based on passive sensing technologies. Finally, we consider only those study designs that elicit self-reports in (or near) real time. Accordingly, we do not review daily diary or day reconstruction method (DRM) studies (Kahneman et al. 2004) that draw on end-of-day retrospective reporting on events, feelings, or perceptions; see Cheadle et al. (2020) for a recent exemplar study employing these methods and Lucas et al. (2021) for a discussion of the potentially distinct nature of the data provided by ES/EMA and the DRM.

EXPERIENCE SAMPLING/ECOLOGICAL MOMENTARY ASSESSMENT AS A DATA COLLECTION TOOL FOR SOCIOLOGISTS

Sociology and the Emergence of Experience Sampling

The ES method emerged out of psychology, but the rationale for its initiation and the institutional context in which the method developed point to its relevance for sociological research. In the first published empirical study by Csikszentmihalyi and colleagues (1977) using ES, data on everyday activities, mood, and motivation were collected on 25 adolescents using a wireless pager (or beeper) to signal participants periodically throughout the day. At each signal, participants completed a short-form questionnaire reporting on their activities and mood, resulting in 753 total responses over a week. The authors described ES as combining "the more personalistic approach of psychology with the systemic approach of ethologists and sociologists" (Csikszentmihalyi et al. 1977, p. 282), emphasizing the significance of observing individuals in their everyday environments. A subsequently published study (Prescott & Csikszentmihalyi 1981), an early version of which was cited in Csikszentmihalyi et al. (1977), used the method to investigate personality indicators in an environmental context. The results demonstrated the variable and context-dependent manifestation of personality and the promise of ES for moving psychology away from a trait-oriented to an ecologically embedded understanding of behavioral, cognitive, and affective states.

These early studies highlight the conceptual and methodological compatibility of ES/EMA with sociology. Moreover, the early development of the method would yield large-scale multidisciplinary projects in the 1990s combining ES with survey and other conventional social science data collection modalities with the goal of addressing sociologically significant questions. The Alfred P. Sloan Study of Youth Social Development (SSYSD) (1992–1997) included Csikszentmihalyi and sociologist Barbara Schneider among its leadership and was the basis of two volumes—*Becoming Adult* (Csikszentmihalyi & Schneider 2001) and *The Ambitious Generation* (Schneider & Stevenson 1999)—that employed ES to capture youth experiences in real time. The study recruited a sample of 1,215 youth in grades 6, 8, 10, and 12 from 33 schools. The ES surveys were issued over a weeklong period through wristwatches eight times per day randomly within 2-hour windows between 7:30 am and 10:30 pm. At the time of each survey, the participant completed an ES form that asked about current activities, location, mood, and who the participant was with. The study yielded a range of findings on youth educational experiences and the transition to adulthood.

Arguably the most sociologically ambitious ES/EMA project to emerge during this period was the 500 Family Study (1998–2000). The study sampled 300 families with teenage children and 200 families with kindergarten-age children across seven US cities. Data were collected through traditional social surveys and ES via wristwatches that beeped respondents to complete a survey randomly eight times during waking hours for 7 consecutive days. Surveys inquired about respondents' activities, location, and surroundings and how they felt at that moment. A key feature of the design was the collection of ES data from multiple members of the same family (see also Larson & Richards 1994). The data have been the basis for a number of sociologically oriented publications in addition to the initial volume produced by Schneider & Waite (2005). We consider select findings from these studies below.

Yet, the momentum that developed in the 1990s and early 2000s did not result in widespread subsequent use of ES/EMA among sociologists. For instance, at the time of writing, only two studies employing ES/EMA as a data collection strategy had been published in the *American Sociological Review*—the discipline's flagship journal—and only one of these papers (Offer & Schneider 2007; based on the 500 Family Study) used ES/EMA in the testing of core hypotheses. Considering the *American Journal of Sociology* yields two additional papers, only one of which uses ES/EMA data in hypothesis testing (Sugie 2018a). Although a number of other notable published sociological papers using ES/EMA (discussed below) have emerged since the 500 Family Study, the limited presence of the technique in the discipline's top two journals and in sociological research more generally is striking, given the explosive growth of ES/EMA studies in allied disciplines (Fisher & To 2012, Scollon et al. 2009).

We argue that ES/EMA offers important advantages for sociological research in three key domains: (*a*) enhanced validity, (*b*) illustration of micro-temporal processes through repeated assessment, and (*c*) the potential for linkage to spatially and temporally aligned data on aspects of social context. Below, we highlight sociologically oriented research illustrating the benefits of ES/EMA in these areas. Given the incipient presence of the method in sociology, we also consider emerging projects that feature promising ES/EMA data collection.

Enhanced Validity

Enhanced recall and ecological validity (the latter capturing the extent to which participant self-reports accurately reflect experiences when in their natural environments) are key features of ES/EMA designs and are among the most commonly cited rationales for employing the method (Ram et al. 2017). By administering short surveys to respondents to be filled out in or near real time, ES/EMA captures moments in the stream of daily life as it occurs. Conventional social

survey methods ask respondents to summarize aspects of everyday life over a given prior period (e.g., the past year, the last 30 days), risking the introduction of a range of potential biases to responses. For instance, ES/EMA-based measures of well-being may help avoid the tendency among respondents to retrospectively overemphasize peak moments, to place greater weight on how events were resolved, and to disregard the duration of emotionally significant periods (Hektner et al. 2007). Of particular relevance to sociologists, ES/EMA allows researchers to collect data in the immediate social and spatial contexts in which momentary experiences occur, enhancing ecological validity. Although conventional surveys can provide overall assessments of activities, emotions, perceptions, etc. over set time periods, accurately recalling and reporting on aspects of the social context and settings in which particular events occur—and their intersection with other individual-level momentary states—pose significant challenges for respondents.

As noted, the 500 Family Study represents an important sociological effort to capitalize on the validity benefits of ES to capture aspects of within-family dynamics. The study produced key findings calling into question the validity of standard survey responses about time spent doing housework. For example, Lee & Waite (2005) found significant differences between husbands' and wives' survey- and ES-based reports of time spent doing housework (with the latter being lower). However, ES reports still produced statistically significant and substantial differences in the amount of time spent doing housework between husbands and wives. Notably, husbands' and wives' survey reports of their partner's housework time produced different estimates of the husband's housework. Moreover, using the ES approach, Lee & Waite were able to include mental labor—time spent thinking about different categories of household tasks—among measures of housework time. Subsequent investigation of ES-reported primary and secondary activities (detailed and accurate retrospective reporting of which is likely to be very difficult) demonstrated that mothers spend remarkably more time involved in multitasking than do fathers (Offer & Schneider 2011).

A prominent subsequent example of research leveraging the validity benefits of ES/EMA is the Newark Smartphone Reentry Project (NSRP) (Sugie 2018a). The NSRP provided smartphones to 135 men on parole to understand employment experiences over a 3-month period. In combination with daily diaries, ES was used to capture patterns of job search, work, and work type across days. Sequence analyses revealed a tendency toward irregular, unstable, and highly varied work and a decline in search efforts over time. Like estimates of housework, this foraging approach to employment would likely be obscured by use of conventional survey data collection strategies (Sugie 2018a, p. 1455).

Illuminating Micro-Temporal Processes

A defining feature of ES/EMA is the opportunity for repeated administration of prompts within and across days, resulting in intensive longitudinal data on the intraindividual dynamics of behavior and experience. These data shed light on the short-term consequences of everyday experiences as well as the social and situational processes shaping momentary phenomena. Below, we highlight sociological studies that leverage ES/EMA data to capture microlevel short-term dynamics.

ES/EMA can be used to investigate the intraindividual processes through which sociologically interesting aspects of inequality are manifest. Again, the 500 Family Study provides an opportunity to reveal the micro foundations of intrafamily gender inequality by examining not only differences in the allocation of time to housework (with enhanced validity) but also the emotional reaction to household labor. Offer & Schneider (2011), for instance, found that mothers' multitasking is primarily related to housework and childcare activities and associated with more momentary negative emotion and stress. Fathers' multitasking was less related to housework and childcare and

unrelated to their momentary emotions. For both mothers and fathers, however, multitasking when a spouse or child is present was mostly a positive experience. Offer (2016) found that free time was generally associated with more positive affect and less stress for both working mothers and fathers. When accompanied by the presence of children, however, free time was more beneficial for fathers. In contrast, mothers benefited more from free time in the presence of other adults.

The moderating effects of relational factors (e.g., the presence of children) on the experience of everyday activities highlighted in the 500 Family Study point to the substantial focus on the short-term effect of social context in extant sociologically oriented ES/EMA studies. For instance, beyond the early volumes drawing on the SSYSD (Schneider & Stevenson 1999), these data have been used in more recent research to address the social context of emotional states. Notably, in a study by Lizardo & Collett (2013), adolescents' ES reports were used to investigate the intraindividual social dynamics of embarrassment. They found that adolescents experience embarrassment primarily when in the presence of many nonfamilial others. They also found that male adolescents are more likely to experience embarrassment when in the presence of opposite sex peers. These findings, the authors suggest, have implications for emotions in a host of other social situations, such as when navigating experiences of social mobility, tokenism, and segregation.

Another particularly fruitful line of research focused on momentary social context effects considers well-being among older adults. Goldman & York Cornwell (2023) used ES/EMA data from the Chicago Health and Activity Space in Real-Time (CHART) study to assess how in-the-moment social accompaniment shapes older adults' experiences of stress, pain, and fatigue. The CHART sample included 12,760 EMAs reported by 342 participants, and social accompaniment was assessed with questions about who was with the respondent at the time of their prompt (e.g., nobody, spouse/romantic partner, friend, neighbor, pet). The researchers found that stress and fatigue, but not pain, were significantly less likely to occur when the respondent was in the company of friends or neighbors, even when adjusting for respondent-level measures of social integration (e.g., frequency of interaction with friends, religious and group activity involvement). ES/EMA data from CHART have also been used to study loneliness in the moment among older adults. Compernolle et al. (2021) found that older adults experience greater momentary loneliness when at home or alone compared to when not at home or in the company of others. In addition, the benefits of being outside the home were reduced among respondents who were female, Black, or Hispanic.

Investigation of relational context effects with ES/EMA may also be enhanced by leveraging additional sources of in-the-moment data. In a study assessing momentary well-being among older adults, Ng et al. (2022) drew on data from 272 adults ages 65+ in the Daily Experiences and Well-Being Study (collected from 2016 to 2017). Smartphone-based EMA reports collected over a 5–6-day period were used to assess momentary mood and social encounters (e.g., with spouse, children, and friends). In addition, an electronically activated recorder was used to capture the proportion of time that the respondent spent talking within 3-hour windows. Ng et al. found that married respondents engaged in more conversations than did divorced respondents but that contact with friends was more strongly associated with conversation engagement among divorced respondents. In addition, conversation was associated with a more positive mood for all respondents, but especially so among those who are widowed. This study illustrates not only the effective use of ES/EMA to elucidate the immediate social context of well-being experiences but also the potential for integrating ES/EMA data with additional novel data sources. We next turn to emerging literature combining ES/EMA with space-time data on context.

Capturing Context: Linkage with Space-Time Data

Although a number of studies use survey or ES/EMA-reported location context data, rapidly expanding temporally and spatially referenced data sources (administrative, survey, and found data; Connelly et al. 2016) present sociologists with a unique opportunity to broaden the investigation of contextual influences on ES/EMA-measured processes and outcomes. Smartphone-based ES/EMA applications are increasingly incorporating the capacity to locate responses through collecting logged spatial coordinates, through either regular collection of GPS coordinates or one-time measures attached to an ES/EMA response (Boettner et al. 2019, Cai et al. 2022, Kirchner & Shiffman 2016, Mennis et al. 2018, Sugie & Lens 2017).

Early ES/EMA studies considered the role of survey-reported spatial context, broadly defined, in shaping momentary outcomes. For instance, Hunter & Csikszentmihalyi (2003) used the SSYSD to examine youths' level of interested engagement (versus boredom) with everyday activities. The authors found that youth from wealthier residential contexts (captured with a survey item on the respondents' residential context) experienced higher levels of boredom with daily activities than did those from more economically disadvantaged areas (see also Shernoff & Csikszentmihalyi 2001). More recent studies have used ES/EMA-reported features of location to investigate experiences of racism. The Spaces and People in Neighborhoods (SPIN) project collected ES/EMA and survey data on 65 disadvantaged Black adolescents to investigate the self-reported contexts in which experiences of racism occur. Ortega-Williams et al. (2022) found that respondents experienced more racism and less social support when at school, walking on streets, and in stores (among other locations). Moreover, daily experiences of racism were associated with reduced daily feelings of safety, while daily experiences of social support were associated with greater daily feelings of safety and less stress. Wilson et al. (2023) also investigated everyday perceptions of racism, drawing on ES/EMA data collected from a sample of 25 Black adolescents ages 14–19 who had witnessed violence in the previous 3 months. Respondents were prompted to respond to ES/EMA surveys three times per day over a 2-week period, asking about their current location, who they were with, their emotional state, and experiences of racism. Wilson et al. found that momentary perceptions of racial discrimination were associated with reduced feelings of safety, while momentary perceptions of social support were positively associated with momentary safety. Momentary support was also negatively associated with momentary symptoms of posttraumatic stress.

An emerging approach combines ES/EMA methodology with GPS-derived mobility and activity space data to understand contextual effects on well-being. In a recent study, Browning et al. (2024) linked GPS on mobility to ES/EMA reports of safety in the moment among urban youth from the Adolescent Health and Development in Context study. The authors found evidence that youth experienced reduced safety when in neighborhoods with higher levels of violent crime, and they also found that Black youths reported lower in-the-moment safety when in predominantly white neighborhoods. Booth et al. (2022) drew on SPIN data (which also included the collection of GPS data on the everyday locations of participants) to understand their daily exposures and marijuana use over a monthlong period. The authors were specifically interested in how adolescents' daily perceptions of collective efficacy—defined as the perceived capacity of locals to achieve shared goals and enforce social norms—shape daily marijuana use and whether this association is mediated by daily stress. These researchers found that days with heightened in-the-moment perceptions of collective efficacy were associated with reduced marijuana use, but only when a high proportion of ES/EMA-reported collective efficacy perceptions were within the spatial boundary of the neighborhood. In contrast, heightened perceptions of collective efficacy reported largely from outside the neighborhood of residence were associated with more marijuana use. These associations of collective efficacy were partially mediated by EMA-reported daily levels of stress,

which calls attention to how disadvantaged minority youth may face adversity when encountering social control beyond their neighborhood.

Extant studies have also used ES/EMA methodology to understand the consequences of everyday mobility among adults. For instance, using ES/EMA and GPS-tied data collected from 270 adults in the Human Mobility Project pilot study, Palmer et al. (2013) found that men feel less happy in the moment when away from home, but momentary happiness among women is not related to how far they are from home. York Cornwell & Goldman (2020) drew on ES/EMA and GPS data from respondents in the Real-Time Neighborhoods and Social Life Study to understand the in-the-moment dynamics of pain and fatigue among older adults living in New York City. Data were collected from 62 adults ages 55 and above who were provided a smartphone that tracked GPS locations and that collected ES/EMA surveys over the course of a week. Results indicated that respondents were more likely to experience pain and fatigue when at locations they perceived to have more disorder, such as locations involving drug and alcohol use, broken windows, vacant buildings, litter or graffiti, or people yelling. This association was particularly evident when respondents were outdoors and was observed net of a host of controls for respondents' home neighborhood features, time of day and day of week indicators, concentrated disadvantage at the EMA location, and temporally lagged EMA reports of pain and fatigue.

Finally, ES/EMA methodologies have been utilized in tandem with space-time data to study populations that have traditionally been difficult to sample (Sugie 2018b). Research has demonstrated the feasibility of issuing smartphones and EMA surveys to study individuals experiencing homelessness (Semborski et al. 2022), drug addiction (Freedman et al. 2006), and reentry following incarceration (Sugie 2018b). In a rare example combining EMA and GPS, Sugie & Lens (2017) used data from the NSRP to examine the association between mobility patterns and employment among men recently released from prison. They proposed that, because the areas that parolees reside in tend to be void of suitable work opportunities, opportunities in parolees' broader mobility patterns will be more strongly associated with employment outcomes. To test this hypothesis, respondents' smartphones tracked their GPS locations, and daily EMA surveys asked about employment on that day. These data were used to create respondent-level measures of employment outcomes and employment opportunities in respondents' neighborhoods and broader daytime locations. Of these opportunity measures, Sugie & Lens found that only the daytime location–based measure was associated with faster progression to job attainment and the portion of days spent working.

Extant sociological research leveraging the benefits of ES/EMA with respect to enhanced validity, illuminating micro-temporal processes, and linkage with passively collected GPS data has yielded rich findings on the social context and consequences of everyday experiences and behaviors. This emerging body of sociologically oriented ES/EMA research points to the still largely untapped potential of these methods for addressing long-standing questions of sociological concern.

FUTURE DIRECTIONS

Given the incipient nature of sociological research using ES/EMA, we offer several potential applications of the method to address sociologically relevant questions in the areas of crime, race, and social networks. We then turn to a discussion of methodological challenges facing sociological research using ES/EMA.

Neighborhood Social Processes and Adolescent Risk

Decades of research have investigated the role of collective efficacy—"a group's shared belief in its conjoint capabilities to organize and execute the courses of action required to produce

given levels of attainments"—in generating beneficial outcomes (Bandura 1997, p. 477). Although widely applied to organizational settings (Bryk & Schneider 2002), the concept has received considerable attention in the urban sociological and criminological literatures. Sampson et al.'s (1997) classic study demonstrated a negative effect of community-level collective efficacy (measured as the aggregate of resident reports on the level of trustworthiness and willingness to intervene on behalf of shared goals characterizing the neighborhood as a whole) on violent crime rates. A number of subsequent studies have offered additional evidence corroborating the protective effect of collective efficacy (Kirk & Matsuda 2011, Morenoff et al. 2001, Odgers et al. 2009).

Largely absent from the empirical literature, however, are efforts to identify the on-the-ground mechanisms through which collective efficacy influences crime and other risky behaviors among youth. At least three possibilities have been offered. First, neighborhood collective efficacy may influence a variety of communal socialization practices (e.g., through the prosocial activities of local organizations and institutions) (Sharkey et al. 2017), resulting in beneficial developmental effects on local youth. Second, in high-collective-efficacy communities, neighborhood residents are entrusted to enforce local prosocial norms. To the extent that intervention norms influence the supervision activities of neighborhood residents, collective efficacy may operate situationally to influence the social control activities of local adults (e.g., through breaking up groups of misbehaving youth, calling the police, or otherwise intervening directly in the behavior of youth in public space). Third, cues that influence expectations regarding local norms may lead youth to "feel an added layer of supervision" when in a high-collective-efficacy space, resulting in a deterrent effect through youth perceptions of the immediate informal social control environment (Fagan et al. 2014, p. 1499).

Measuring situational mechanisms is challenging when relying on conventional social survey techniques alone. ES could be effectively deployed in the context of daily spatial routines to disentangle the effects of individual (ES/EMA-based) youth perceptions of a given informal social control environment from adult willingness to intervene in the same public space (adjusted for prior youth socialization and associated predispositions toward offending). Recent advances in geofencing—triggering of ES/EMA prompts when study participants are detected to enter a particular predetermined polygon—allow for more precise targeting of prompts to time spent in public space (Booth 2024, Shevchenko & Reips 2023). ES/EMA might also be used to identify spatial heterogeneity in intervention willingness (Carter et al. 2024) or youth perceptions of informal social control environments to better understand the substantial variation in crime observed within neighborhoods characterized by concentrated disadvantage and other forms of structural disadvantage (Leech & Adams 2023).

Racial Microaggressions

The social structural origins, experience, and consequences of racial discrimination are clearly topics central to sociology (Burt et al. 2012, Daniels et al. 2023, Owens 2022). More recently, experiences of "brief and commonplace daily verbal, behavioral, or environmental indignities" (Sue et al. 2007, p. 271) communicating racially derogatory slights and insults—or racial microaggressions—have drawn attention as a potential chronic contributor to racial disparities in health and well-being (Cheadle et al. 2020). Although the term has been the subject of controversy and critique due to conceptual ambiguity and the potentially diminishing implications of the term micro (Domínguez & Embrick 2020), everyday racially devaluing experiences and the coping strategies they induce have nevertheless been an important focus of research on inequality (Clark et al. 2006; Hicken et al. 2013, 2018).

Despite the temporally and spatially circumscribed (event-based) nature of racial microaggressions, measurement strategies have relied largely on traditional social survey constructs asking respondents about the occurrence of discriminatory experiences and the cognitive, emotional, and behavioral preparation engaged in to preemptively to combat the consequences of such experiences (Hicken et al. 2013, Williams et al. 1997). A limited number of studies have applied ES/EMA to document the daily experience of microaggressions in epidemiological research. Data from the Postpartum Mothers Mobile Study, for instance, found that Black participants report approximately two experiences of racism a day (Mendez et al. 2019; see also Cheadle et al. 2020). These data indicate the high frequency of microaggressions and the potential for chronic exposure to racist slights and insults to contribute to ongoing stress and its health consequences (see also Nam et al. 2021).

ES/EMA-based research into the situational contexts in which microaggressions occur and their social structural backdrop could add significant insight into the mechanisms of consequential everyday racism. As noted above, Ortega-Williams et al. (2022) demonstrated variability in the experience of racism across location types, pointing to the need for sociologically informed hypotheses regarding the social and spatial organization of microaggression experiences in everyday life. ES/EMA in combination with location sensing could capture the spatial (e.g., neighborhood), organizational (e.g., school, workplace), and network context in which microaggressions occur and their immediate and longer-term mental health consequences. Although a challenging design to implement given the variability in the frequency with which respondents will experience microaggressions (Ram et al. 2017), an event-contingent EMA reporting schedule (asking respondents to initiate EMAs in the immediate aftermath of a microaggression experience) in combination with random prompts capturing typical experiences could offer novel insight into the context and consequences of racial microaggressions.

Social Networks

The study of social network structure, dynamics, and influence is a mainstay of sociological research and now represents a rapidly growing cross-disciplinary focus (Chapman et al. 2022, Naud et al. 2020, Rivera et al. 2010). Although ties between individuals in a network are measured in a variety of ways (Bierstetel & Slatcher 2020, Vanden Abeele et al. 2020), large-scale social survey research has typically relied on a network name generator approach whereby a respondent's ego-centric ties are elicited using reference to one or more types of interaction, e.g., "who are the people with whom you discussed an important personal matter?" (Burt 1984, Perry et al. 2018). Other name generators focus on the strength of a relational tie, the frequency of interaction, levels of social support, and so on. Where possible, such data can also be aggregated to generate sociocentric networks capturing all ties among members of a group (An et al. 2022, Valente 2010). Although a voluminous literature has been based on such data, yielding a range of important findings, the approach nevertheless generates a network snapshot (or series of snapshots in longitudinal survey–based network studies) with limited information on the actual dynamics and context of social interactions. Indeed, examination of individuals' positions within networks over time reveals considerable variation between and even within years (Moody et al. 2011).

Integration of ES/EMA data with traditional survey-based name generators holds the potential to illuminate network dynamics in novel ways. ES/EMA could be integrated with a name generator approach to assess the correspondence of named network partners on a survey (e.g., capturing frequent interaction partners) with instances of copresence or communication with those ties in real time. ES/EMA data could also be used to systematically capture the network sources of occurrences of social support, conflict, reciprocity, and their short-term consequences on a day-to-day

basis. The integration of personal network and ES/EMA data is rare, and the limited number of published studies that have combined these methods have been conducted outside of sociology (Harlow & Cantor 1995, Langener et al. 2023, Stadel et al. 2023). However, the Adolescent Health and Development in Context study (Boettner et al. 2019) collected both network name generator and ES/EMA data on the presence of named network partners from a sample of 1,405 youth in Columbus, Ohio. At the start of the study week, youth were asked to report the names of network partners with whom they routinely interact as well as characteristics of those network partners (age, race, sex, education, behavior, etc.). Youth were then provided smartphones for a weeklong period, and ES/EMA surveys were issued randomly during nonschool daytime hours up to five times a day. ES/EMA items asked whether the respondent was with any of the named network partners at the time of the prompt (in addition to other questions on mood, activity, behavior, and aspects of the social context). These data offer the opportunity to consider not only network partner copresence and interactional dynamics in real time but also the ES/EMA-facilitated measurement of other situational contexts of such interactions.

ES/EMA also provides an opportunity to move beyond the constraints of name generators in investigating consequential everyday network interactions. A growing literature calls into question the extent to which data produced by name generators accurately reflect respondent's social ties given recall limitations and biases of reporters (Brands 2013). Reliance on name generators may also artificially limit the reported network to the type of interaction targeted or may result in the omission of ties that may be theoretically relevant but are not interpreted to meet a given name generator criteria. Torres's (2019) discussion of elastic ties—relations similar to strong ties on dimensions such as time spent together and social support but considered neither strong nor weak by reporters—is informative in this regard. Similarly, Desmond (2012, p. 1296) finds that disposable ties—"brittle and fleeting" associations that nevertheless may serve as sources of resources and support—are common among the urban poor. Small's (2009) discussion of the social support role that mothers who frequent childcare centers play in each other's lives (despite sometimes quite limited familiarity beyond center interaction) also highlights the complex nature of network support, particularly among economically disadvantaged populations. These qualitative studies point to the potential of ES/EMA-based approaches for generating novel, systematic, on-the-ground information about the prevalence and functioning of social ties in everyday life.

METHODOLOGICAL CONSIDERATIONS

While incorporating the ES/EMA data collection modality into observational studies has tremendous potential for increasing the ecological validity of empirical findings and uncovering mechanisms underlying sociological phenomena, it is no methodological panacea. A robust literature has emerged in psychology and health sciences addressing concerns that arise when employing ES/EMA, including issues related to design, fielding, and analysis (see Burke et al. 2017, Heron et al. 2017, Smyth et al. 2021, Stone et al. 2023). Although substantial progress has been made, it is nevertheless the case that routine statistical challenges associated with gaining insight from observational data—ranging from sampling bias to missing data to unmeasured confounding—can be amplified in the ES/EMA setting. Below we highlight a number of methodological challenges of particular relevance to sociologists.

Important considerations in ES/EMA study design are the number, temporal coverage, and sampling frequency of prompts. For optimal ecological validity and avoidance of recall bias, ES/EMA prompts should be frequent and ask study participants about their experience/exposure in the moment or in the very recent past. When exposures of interest are infrequent and the burden of responding to prompts is nontrivial, however, designs that ask about specific windows of

time (e.g., within the last 2 hours, since the last prompt) may better capture within- and across-individual variation in exposure (e.g., Scott et al. 2017). Ideally, the number of prompts and time sampling scheme (i.e., schedule of prompts) should reflect the temporal variability of the phenomena being studied, but a priori knowledge of this variability is often not available (Ram et al. 2017).

As discussed above, ES/EMA can allow for empirical investigations of mechanisms underlying individual- and system-level outcomes. By definition, mechanisms are inherently causal relationships between variables. Therefore, qualified conclusions about causality are incompatible with mechanistic hypotheses and analyses. Ideally, traditional mediation analyses looking to distinguish direct and indirect relationships between an exposure and outcome should be avoided. Instead, mediation analyses should be conducted within a formal causal framework in which a target causal effect/estimand is defined and its identifiability is established by checking appropriate versions of the assumptions of consistency (no unmeasured confounders), conditional independence, and positivity (Imai et al. 2010, Nguyen et al. 2022) for longitudinal settings (VanderWeele & Tchetgen Tchetgen 2017, Zheng & Van Der Laan 2017).

Participant burden in ES/EMA studies is typically significant, and therefore sampled individuals who are willing to participate in a study may not be representative of the target population. This form of selection bias is a threat to the external validity of such studies. Relatedly, within-individual missing data resulting from participants not responding to ES/EMA prompts in systematic ways (e.g., when engaging in particular types of activities, at certain times of day, while at particular locations, or while engaged in particular types of activities)—a form of sampling bias—are often a major concern. In studies administered on mobile devices, systematic missingness in ES/EMA responses can occur due to technical challenges (e.g., when Internet or GPS connectivity is not available at particular locations, when a drained battery prevents prompt delivery). Even when a missing-at-random assumption is reasonable, the high dimensionality of data collected as part of longitudinal ES/EMA designs can make standard adjustment methods (e.g., multiple imputation) computationally challenging to implement (Stone & Shiffman 2002). Moreover, the mechanism underlying the missingness may better be classified as missing not at random, a setting in which it may be difficult to provide valid inferences (see Stone et al. 2023). Keeping ES/EMA survey length to a minimum, balancing validity concerns with adequate time windows in which to complete surveys, and ensuring sufficient incentives for EMA completion may aid in addressing missing data (Wen et al. 2017, Wrzus & Neubauer 2023).

The structure of ES/EMA data is well suited to multilevel models for repeated measures, where individual-specific random intercepts and slopes are shrunk toward corresponding overall parameters of primary interest. Ram et al. (2017) make an important point about the appropriateness of multilevel modeling assumptions in ES/EMA studies by considering potential violations of assumptions that may threaten the ecological validity of inferences. In the setting in which the effect of a time-varying exposure on an outcome is of interest, the ES/EMA prompt schedule is implicitly mapping the prompt measurements to what is known as an equivalent time samples design in the quasi-experiment setting (Campbell & Stanley 1963). Unlike experimental settings involving repeated measures, in which treatment at each time point for each individual is random, the timing of repeated measures is what is typically random in the ES/EMA setting. Whether this randomization allows for generalization across time and individuals—an implicit goal for multilevel inferences on population parameters—is questionable. For example, consider a binary exposure and an ES/EMA response that are measured at a fixed number of time points, randomized across individuals within a window of time. From the observed data, individuals who happen by chance to not have an observed exposure cannot be distinguished from individuals who are never exposed. Intuitively, those in the latter group should not contribute to inferences on an

overall exposure effect. Yet, in the multilevel modeling framework, individuals for whom exposure is never observed are treated identically to those who are never exposed, which is inconsistent with the pursuit of ecological validity. Similar challenges to pooling across time exist as well.

A final methodological challenge in ES/EMA studies is the impact of design decisions—particularly those that deviate from a simple random sample (e.g., stratification)—on measurement of context as an inherent feature of a place or setting. In probability designs, study participants represent others in a target population in ways that are known by design, that may become knowable as part of the study (e.g., group membership information collected via survey), or that remain unknown. Only when population representation is known or knowable do probabilistic principles—such as weighting and statistical model fitting—allow for valid inferences about population quantities and associations. In ES/EMA studies, particularly those in sociology, the representativeness of collected data with respect to a context not explicitly considered in the original design is often complex. For example, consider ES/EMA-based reports of perceived safety as individuals go about their daily routines. How representative is a participant's perception of their safety at a particular location of the typical level of in-the-moment safety experienced by the population of individuals who visit that location over time? Without knowing how the original study design impacts the representativeness of the reports with respect to this location-specific population of safety perceptions, it is not possible to draw valid population-level inferences for the context itself. Alternative sampling designs or supplementary data collection efforts for sensitivity analyses to address representation are possible strategies to improve the reliability of inferences.

CONCLUSION

Use of ES/EMA across the social and health sciences has increased rapidly over the last 3 decades. Yet, despite the influence of sociology on the origins and early development of ES/EMA, current use of the technique among sociologists remains limited. We argue that the technique offers opportunities for enhanced measurement of social processes across macro-micro (individual and relational)-macro links and is compatible with contemporary sociological interest in mechanistic and multilevel approaches. Extant and potential sociological applications of ES/EMA highlight the benefits of the approach with respect to enhanced validity, illuminating micro-temporal processes, and the potential for linkage with a wide range of spatially and temporally referenced data sources.

We can only speculate as to the reasons for the method's comparatively limited popularity within sociology. Although the near ubiquity of smartphones and the increasing availability of vendor-provided apps (e.g., Onnela et al. 2021) for designing and administering ES/EMA studies have increased researcher access to the methodology, resource constraints remain a concern for interested investigators. Traditional reliance on large-scale probability samples among sociologists compounds cost-related barriers when compared with typical samples employed in psychology and many ES/EMA designs within the health sciences. A number of methodological issues, including potential threats to ecological validity, causal inference, participant burden, missing data, and design considerations, pose ongoing challenges for effective use of ES/EMA as well. These and other challenges present potential obstacles to widespread adoption of the method within sociology. In turn, the relative absence of research using ES/EMA within sociology has led to a lack of sociological influence over the direction of methodological work on the technique (although see Sugie 2018b). For instance, although many studies outside of sociology employ ES/EMA to capture aspects of the immediate setting or social environment, this measurement domain has been relatively neglected in ES/EMA-related methodological work (Langener et al. 2023).

We point to research areas of sociological interest that might benefit from adoption of ES/EMA technology, highlighting the capacity of the method to yield intensive (repeated),

real-time, ecologically valid information on phenomena that occur at fine-grained timescales as well as the spatial and social settings in which they occur. Although our research examples are selective with respect to the subfields addressed, we view ES/EMA as having potentially widespread application within sociology. Moreover, increased use of the technique can serve as an alternative to reliance on administrative, found (e.g., large-scale cell phone usage data), or other big data sources (over which investigators have comparatively little control) to investigate everyday life.

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