FOREWORD

New Methods for Advancing Research on Tobacco Dependence Using Ecological Momentary Assessments

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Received November 18, 2013; accepted November 22, 2013

This special issue presents a series of articles on the use of ecological momentary assessment (EMA; Shiffman, 2009) methods, which involve collecting real-time data in real-time settings, to study tobacco use and dependence. EMA methods have particular utility for understanding tobacco use because they enable microanalyses of use and can shed light on how behavior unfolds over time.

The motivation for this special issue grew out of a workshop on EMA methods and related data-analytic methods, held in connection with the 2012 annual meeting of the Society for Research on Nicotine and Tobacco, sponsored by the Penn State Methodology Center (STL and MEP, organizers). There was great interest and enthusiasm for the methodological issues discussed at the workshop and the identification of important, previously unanswerable questions that can now be addressed using EMA data and new analytic techniques. This inspired us to develop the current special issue of *Nicotine & Tobacco Research* (*NTR*).

This special issue, sponsored by the National Cancer Institute and the Office of Behavioral and Social Science Research at the National Institutes of Health, is devoted to the novel topic of collecting and analyzing data from EMA studies. Our hope is that readers of this issue will recognize the unique light that can be shed on tobacco use, dependence, and treatment by studies using EMA. Perhaps readers who have never collected EMA data will be inspired to do so, and others who have access to existing EMA data will identify new approaches to analyzing the data that address novel, important questions about processes that unfold over the course of a study. In other words, the goal of this special issue is to encourage readers to think broadly and creatively about research questions that can now be answered using EMA methods and analytic approaches illustrated in this special issue.

The response to our request for articles was excellent, and even after rigorous peer review, we had to make many difficult decisions about which manuscripts to include. All of the articles were peer reviewed (and papers by the editors were independently reviewed). We favored articles that (a) advanced the methodology of EMA data collection, (b) presented novel statistical methods that can be applied to analyze EMA data, or (c) illustrated a creative application of EMA data to questions about tobacco use. Several other excellent articles using EMA were not selected to appear in this issue but were accepted for publication in the general pages of *NTR*.

The issue begins with a brief commentary by four individuals from the National Institutes of Health (Ginexi, Riley, Atienza, and Mabry) about how EMA can advance behavioral research related to nicotine and tobacco. Next, Shiffman provides a conceptual overview that places the collection and analysis of EMA data into context, both in history and in relation to various statistical methodologies. The remainder of the issue is comprised of articles that were submitted in response to a call for articles, and includes explanations and demonstrations of data-analytic methods, as well as articles using EMA data to address substantive questions in tobacco science.

The first section begins with an investigation of factors associated with both event- and signal-contingent compliance with an EMA smoking study protocol that was conducted by Schuez and colleagues. This is followed by three articles that incorporate other types of innovative data with EMA. Watkins and colleagues conducted a study in which participants carried smartphones that recorded Global Positioning System (GPS) data and urge ratings. They were then able to understand how tobacco retail outlets, identified via GPS data, influenced EMA reports of urges during a cessation attempt. Wilson and Smyth review the conceptual basis for integrating brain imaging methods with EMA data to gain a better understanding of tobacco dependence and present preliminary evidence for how the combination of EMA and functional magnetic resonance imaging can provide novel insights into understanding and treating tobacco dependence. Finally, Waters, Szeto, Wetter, Cinciripini, and Li use an EMA paradigm to assess attentional bias to smoking cues via the Stroop response time test in real-world settings; these measures were related to craving during the early part of a cessation attempt. These articles illustrate ways in which EMA methods can be used to collect data that are not self-report, and can be integrated with other kinds of data to achieve a deeper understanding of tobacco use.

The second section presents six innovative approaches to analyzing data from EMA studies. Piasecki, Trela, Hedeker, and Mermelstein provide an exemplary demonstration of multilevel modeling for effectively separating within-person variability over time from between-person variability. They found

doi:10.1093/ntr/ntt213

that antecedents of adolescent smoking shifted as individuals progressed to higher levels of tobacco dependence. Three articles present variations of a novel statistical framework, the time-varying effect model (TVEM), for examining how associations between constructs can change as a function of time. Lanza, Vasilenko, Liu, Li, and Piper provide an accessible introduction to this statistical model and demonstrate how both baseline characteristics and time-varying constructs such as negative affect can have effects on urge that vary during the course of a quit attempt and, further, how these time-varying effects can be influenced by treatment. Vasilenko, Lanza, Liu, Yang, Li, and Piper present a generalization of TVEM for estimating time-varying effects on a binary outcome, an essential development given the importance of binary outcomes in smoking research (i.e., smoking or abstinent). The authors found that, over the course of the first 2 weeks of a quit attempt, pharmacotherapies were more effective at reducing smoking during earlier days, whereas the effects of craving and negative affect on smoking strengthened with time. Shiyko, Naab, Shiffman, and Li use TVEM to examine how the effect of negative affect on high smoking urge shifted across a time lag. The magnitude of the effect was strongest for the shortest time lags and diminished over a time lag of about 7 hr. Pugach, Hedeker, and Mermelstein examine positive and negative mood variation and covariation in adolescent smokers using an innovative extension of multilevel models, the bivariate location-scale mixed-effects model. As smoking level increased, both positive and negative moods were more consistent over time within individuals. Within-person association between positive and negative affect was weaker among adolescents who smoked more heavily. Finally, Timms, Rivera, Collins, and Piper present a dynamical systems model to describe smoking as a self-regulatory process. The authors modeled the dynamic relation between daily craving and smoking levels in adults during a quit attempt; a comparison of the estimated processes across treatment conditions suggest new insights into how pharmacological treatment affects individuals. These articles illustrate how novel and sophisticated analytic methods can exploit the richness of EMA data to model more complex associations among variables and how those associations unfold over time.

The future is likely to see more and more sophisticated applications of EMA. As technology advances, novel methodologies are developed, and new products such as electronic cigarettes are developed, tobacco use rates are stagnating. Tobacco science is well-positioned to develop and use EMA methodologies and analytic approaches to better understand the initiation of tobacco use, the development of dependence, and tobacco treatment mechanisms. The ability of EMA to focus on contact in real time, in real-world settings is already being extended to intervention: researchers are developing ecological momentary interventions that can target an intervention based on the patient's current circumstances (e.g., Heron & Smyth, 2010; McTavish, Chih, Shah, & Gustafson, 2012). Such innovations could be used to build on the current knowledge base and further tailor tobacco treatment. These powerful methodologies have the potential to significantly advance tobacco science and subsequently improve public health.

The goals of this special issue are to share our enthusiasm and to acquaint the readership of NTR with the potential for EMA data. EMA data, particularly when analyzed using innovative methodological and analytic techniques, offers researchers the ability to address complex questions regarding the etiology of tobacco use, the development of dependence, withdrawal phenomena, treatment effects, the relapse process, and systems science. We hope you find this issue useful in your own research.

REFERENCES

Heron, K., & Smyth, J. (2010). Ecological momentary interventions: Incorporating mobile technology into psychosocial and health behavior treatments. *British Journal of Health Psychology*, *15*, 1–39.

McTavish, F. M., Chih, M.-Y., Shah, D., & Gustafson, D. H. (2012). How patients recovering from alcoholism use a smartphone intervention. *Journal of Dual Diagnosis*, *8*, 294–304. doi:10.1080/15504263.2012.723312

Shiffman, S. (2009). Ecological momentary assessment (EMA) in studies of substance use. *Psychological Assessment*, *21*, 486–497. PMCID: PMC2846437