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# Preliminary evidence of diurnal rhythms in everyday behaviors associated with positive affect ☆

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ABSTRACT

The authors used the Electronically Activated Recorder (EAR) to track within-day variability in everyday behaviors associated with positive and negative affect across two samples. The EAR is a portable audio recorder that periodically samples snippets of ambient sounds from participants' momentary environments. The recorded sounds are then coded for different behaviors. The study tested whether previous findings regarding diurnal patterns in self-reported mood extend to naturalistically observed behavior. Across both samples, behavior associated with positive affect (i.e., socializing, laughing, and singing) varied according to a sinusoidal 24-h rhythm centered around participants' average waketime while behavior associated with negative affect (i.e., arguing and sighing) did not. Further, there was preliminary evidence that personality traits can moderate these rhythms (e.g., their amplitude).



## 1. Introduction

Mood is an essential feature if not the defining characteristic of ongoing conscious experience. As both philosophers and psychologists have noted, consciousness bereft of mood is rare or nonexistent (DeLancey, 1996; Watson, 2000). Such a constant presence implies an important function, and indeed, mood does more than just provide affective tone (e.g. "the blues" or "rose-colored glasses") to people's moment-to-moment phenomenological worlds.

In daily life, mood acts as a subtle yet pervasive causal agent. Mood states alter the way humans recall autobiographic memories (Miranda & Kihlstrom, 2005), make decisions (Loewenstein & Lerner, 2003), resist or fall prey to persuasion (Schwarz & Clore, 2007), perceive and are perceived by others (Forgas, 2003), and influence how people respond to social situations (Zajonc, 2000). Momentary moods even exert traceable effects on the immune system and the regulation of physical health (Kiecolt-Glaser, McGuire, Robles, & Glaser, 2002; Pressman & Cohen, 2005). Finally, mood dysregulation is a defining feature of many psychiatric disorders and is implicated in their onset, development, and recovery.

As pervasive as mood effects are, humans often remain largely unaware of the factors that are responsible for fluctuations in their moment-to-moment mood (Gilbert, 2006). It is a common experience to find oneself fumbling to understand why one is feeling a certain way. Not only are the causes of mood often beyond conscious access, but mood fluctuations themselves may go unrecognized. Therefore, it is important to develop a more complete understanding of patterns underlying variability in mood.

☆ Portions of the data presented here were used in Mehl, Vazire, Ramirez-Esparza, Slatcher, and Pennebaker (2007) for an analysis of sex differences in daily word use and in Vazire and Mehl (in press) for an analysis of the accuracy of self and other ratings of daily behavior. The analyses and findings reported here do not overlap with those reported in these papers.

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Over the past two decades, emotion researchers have made critical progress in identifying dispositional and contextual influences on everyday affective experiences. This article explores the role of a third component of daily mood fluctuations and their behavioral consequences: rhythmic processes, including both circadian and socio-cultural rhythms. It is well established using forced desynchrony protocols, the gold-standard in chronobiological methodology,[1] that there is a circadian component to self-reported mood (Boivin et al., 1997). More recently, a number of studies have further explored this phenomenon, noting that self-reported positive affect (PA) varies according to a daily rhythm, while self-reported negative affect (NA) does not (Murray, 2007; Murray, Allen, & Trinder, 2002; Thayer, 1997; Watson, Wiese, Vaidya, & Tellegen, 1999; Wood & Magnello, 1992). Some studies (e.g., Murray et al., 2002) have experimentally controlled for social interaction, thus buttressing the argument that the rhythm in PA is endogenous, biologically-driven (i.e., circadian) and not merely diurnal (i.e., a daily pattern with uncertain causation). The disparity in patterns has been linked to different motivational systems regulating PA and NA.

These findings raise a critical question—is the diurnal pattern confined to how people describe their inner mood landscape, or does it also surface in their affect-associated behaviors in the external world? Answering this question is important for at least two reasons. First, from a multiple-method perspective (e.g., Larsen & Prizmic-Larsen, 2006) it is critical to establish whether the evidence of diurnal patterns underlying affect generalizes across methods and replicates if affect is assessed free of self-report. Second, it is of theoretical interest to test the extent to which diurnal fluctuations in experienced affect "spill over" into observable behavior. Affect display is partially under conscious control and often modulated according to social norms (e.g., a churchgoer may feel like laughing during service but decide to suppress it; a student may feel like singing in class but realize it is inappropriate to do so). Finally, studying diurnal rhythms in affect-associated daily behaviors is also in line with Baumeister and his colleagues's recent plea for "affirmative action for action" (p. 401) research in social and personality psychology—a field that currently experiences a dearth of studies that measures "actual behavior" (Baumeister, Vohs, & Funder, 2007).

For the current study, we used the Electronically Activated Recorder or EAR (Mehl, 2007; Mehl, Pennebaker, Crow, Dabbs, & Price, 2001), a relatively novel unobtrusive observation method, to sample affect-associated behavior directly from the natural stream of daily life and independent of self-reports. The EAR tracks participants' real-world behaviors by periodically recording snippets of ambient sounds from their momentary environments. The sampled ambient sounds are then coded for aspects of participant's moment-to-moment social behaviors, interactions, and environments (Mehl, Gosling, & Pennebaker, 2006; Mehl & Pennebaker, 2003; Mehl, Vazire, Ramirez-Esparza, Slatcher, & Pennebaker, 2007).

This study extends prior research on diurnal rhythms in affect in four important ways: First, it subjects the hypothesis of diurnal rhythms in affect to a cross-method validation that is independent of self-reports and based on affect-associated behaviors that are socially important but infrequently studied (e.g., singing, arguing). Second, it tests whether the phenomenon is limited to the experience of affect or can extend to its behavioral expression in daily life. Third, it uses progress in statistical modeling and a theoretically specified mathematical function. Diurnal variability in affect is often studied by using repeated measures ANOVA on between 3 and 10 data points per person per day (e.g., Adan & Sanchez-Turet, 2001; Wood & Magnello, 1992); we directly fit a theoretically predicted sinusoidal curve to fine-grained EAR data consisting of more than 60 data points per person per day. Finally, we explore the idea that personality traits can moderate the identified diurnal patterns. Based on a recent finding that Neuroticism (N) may be associated with a lack of circadian rhythmicity in PA and a blunted amplitude in the core body temperature rhythm (Murray, Allen, Trinder, & Burgess, 2002), we examined whether N would be related to a blunted and Extraversion (E) to an amplified diurnal rhythm of PA-associated behaviors.

## 2. Methods

The data for this study were derived from two EAR projects that examined the personality implications of daily life. For details about Sample 1 see Mehl et al. (2006); for details about Sample 2 see Vazire and Mehl (in press).

### 2.1. Participants

Sample 1 consisted of 96 introductory psychology students at the University of Texas at Austin (47 females, mean age $M = 18.7$) who wore the EAR for approximately 3 days during their waking hours. Of these, 60 participants (29 females, mean age $M = 18.7$) were included in the analyses. Sample 2 consisted of 79 introductory psychology students at the University of Texas at Austin (42 females, $M = 18.7$) who wore the EAR for approximately 5 days during their waking hours. Of these 50 participants (30 females, mean age $M = 18.6$) were included in the analyses. In both studies, participants were excluded if their sleep patterns did not meet our inclusion criteria (see below).

[1] Forced desynchrony protocols place participants in a laboratory-controlled 28-h 'day' without cues to external clock time. The circadian pacemaker is unable to synchronize to this schedule, thus allowing individual circadian rhythms (sleep/wake, temperature, etc.) to proceed according to purely endogenous signals.