Chapter 27
Defining Ecological Momentary Assessment

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Abstract For research in daily life, multiple terms have been used to describe a quite homogenous set of methodologies. These include, among others, Ecological Momentary Assessment, Ambulatory Assessment, Experience Sampling Method, real-time data capture, and digital phenotyping, just to name a few. Those daily life methods: (i) are characterized by the assessment of data in the real-world; (ii) focus on individuals' momentary states; (iii) are idiographic in focus and therefore enable, in combination with the repeated micro-longitudinal assessments, the examination of within-subject processes; (iv) are multimodal and can integrate psychological, physiological, and behavioural data from e-diaries, smartphone sensing and wearables; (v) allow to reveal and investigate setting- or context-specific relationships, and (vi) have the possibility to run real-time analyses.

For research in daily life, multiple terms have been used to describe a quite homogenous set of methodologies. These include, among others, Ecological Momentary Assessment (EMA; Stone and Shiffman 1994), Ambulatory Assessment (Fahrenberg and Myrtek 1996), Experience Sampling Method (ESM; Csikszentmihalyi and Larson 1987), real-time data capture (Stone et al. 2007), and digital phenotyping (Insel 2018), just to name a few. According to my understanding, which is in line with the definition of the respective international society (SAA: http://www.ambulatory-assessment.org), the different terms highlight more the different origins and ancestors than real distinctions in methodology. For those interested in the history of the development of these terms, we recommend a historical review (Wilhelm et al. 2011) delineating that at the end of the last century, research groups in Germany, the Netherlands and the US started developing innovative methods to assess individual experiences and behaviour in everyday life. Those roots can be differentiated, with ESM characterized by paper–pencil diaries and pagers, EMA using electronic diaries

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(e-diaries) early on, digital phenotyping focusing on passive smartphone sensing, and Ambulatory Assessment having a strong focus on physiological and behavioural monitoring used since decades in internal medicine (e.g. ambulatory blood pressure monitoring) and movement sciences (accelerative devices). However, nowadays most terms are used to describe a broad set of tools to assess affective experiences, cognition, behaviour, and physiological processes in daily life (Mehl and Conner 2012).

Many features distinctly characterize those daily life methods from more traditional assessment approaches like retrospective questionnaires or laboratory-based techniques. They (i) are, first of all, characterized by the assessment of data in the real-world, increasing therewith the ecological validity and generalizability (real-life: Reis 2012); (ii) focus on individuals' momentary or very recent states therewith avoiding retrospective distortions (real-time: Schwarz 2012); (iii) are idiographic in focus and therefore enable, in combination with the repeated micro-longitudinal assessments, the examination of within-subject processes (like dynamics in emotional, behavioural, and psychophysiological systems) (Ebner-Priemer and Trull 2011); (iv) are multimodal and can integrate psychological, physiological, and behavioural data from e-diaries, smartphone sensing and wearables; and (v) allow to reveal and investigate setting- or context-specific relationships (Tost et al. 2019). Finally (vi) the possibility to run real-time analyses on the (scientific) wearables opens new and promising possibilities. These include the use of triggered e-diaries (Ebner-Priemer et al. 2013), which query about symptoms of interest during moments of interest (e.g., whenever a subject uses her lighter, she gets queried about her urge to smoke), to set up early warning systems (e.g., whenever a patient with bipolar disorder shows a decreased numbers of hours slept, more phone calls and more activity a diagnostic session is triggered to clarify an upcoming manic episode), and the use of EMA as an intervention strategy, then labelled as Ecological Momentary Interventions (EMI; Heron and Smyth 2010) or Just-in-Time Adaptive Interventions (JITAI; Nahum-Shani et al. 2015).

The two most often raised concerns regarding EMA are reactivity and compliance. The first refers to participants undergoing EMA altering their behaviour, whereas the latter speculates that EMA poses an immense burden, therefore increasing compliance systematically over time. Fortunately, empirical studies revealed findings regarding both concerns. Systematically manipulating the number of assessments per day (2 vs. 6 vs. 12 times) didn't reveal any signs of reactivity (Stone et al. 2003). In the same vein, studies with demanding time-based designs, like querying e-diary assessments every 15 min or having daily assessments over 12 months (365 days) (Ebner-Priemer et al. 2020), revealed excellent compliance.

Compared to more traditional assessments, like retrospective questionnaires, e-diaries come with a few additional challenges originating from the repeated assessments. Two of those should be highlighted in some detail. First, a so-called time-based design has to be defined, namely a strategy on how often and when assessments should be posed. Normally such a time-based design encompasses the total assessment period (e.g. a week or a month), the number of assessments, as well as the duration between assessments (like every hour). The most often used rule of thumb

is that the sampling frequency should fit the dynamics of the phenomena interest (Ebner-Priemer and Sawitzki 2007). In other words, highly fluctuating phenomena (like affect) should be assessed with a higher sampling frequency, compared to psychological phenomena with lower dynamics (like personality traits). Unfortunately, the dynamic characteristics of most psychological phenomena are unknown. In such cases, starting in a pilot study with an oversampling (a too high sampling frequency) has been recommended. According to current publication guidelines (Trull and Ebner-Priemer 2020) the considerations and decisions regarding the time-based design should be reported in scientific manuscripts. The second challenge is to provide sound e-diary items. Surprisingly, reports on psychometric properties are still rare in this area. This can be partially explained by the fact that traditional theories do not apply. Compared to e.g. personality assessments, e-diary approaches are usually interested in the fluctuations of phenomena in daily life. Accordingly, the within-subject variance is not conceptualized as error, but is the variance of interest. When assessing affect over time, the main interest is not to get an overall estimate of the average affective state of a given person, but to understand how and why affect is fluctuating over time, discovering triggers, antecedents and regulation strategies. Accordingly, reliability must be understood as momentary reliability. Fortunately, theoretical and computational developments have gained tremendous progress during the last years, coming up with sound solutions for calculating momentary psychometric properties for e-diary approaches (Geldhof et al. 2014).

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