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USING INTENSIVE REPEATED MEASURES DESIGNS TO STUDY FAMILY PROCESSES: EMOTIONAL INERTIA AND INTERPERSONAL EMOTION PERCEPTION IN DAILY LIFE

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The current article illustrates how intensive repeated measures designs can be used to study family processes. Interpersonal processes are of key importance in family research, but rarely studied as such. In the present article, we provide an example of how intensive longitudinal data provides insight into family processes. The example we use focuses on how spouses' emotional dynamics are associated with their perception of the partner's daily emotions. Parents from 172 families rated their own and their partner's emotional states six times a day during one week. Variables of interest were inferred from repeated measurements of momentary experience within individuals and dyads over time. Multilevel analyses revealed that mothers who featured less changeability in their emotions provided more accurate reports of their partners' emotions. This example illustrates how over time processes within individuals and dyads can be accessed using intensive repeated measures designs and analyzed in a multilevel analytic framework.

Key words: Emotion dynamics; Emotional inertia; Family processes; Repeated measures; Multilevel Modeling.

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A Systems Theory perspective on the family and family processes emphasizes the importance of considering individual factors alongside interpersonal and contextual factors (e.g., Stanton, 2013), a call that is difficult to answer in quantitative family research. Assessing psychological characteristics and processes of families is particularly challenging when subjective and other covert variables are of interest. Such information can only be assessed from individuals, and is subject to bias due to each individuals' personal characteristics and experiences (Kenny & Acitelli, 2001). Moreover, family relationships become observable via their effects on individuals (Berscheid, 1999), and assessing these effects entails combining assessments from all individuals of interest. Finally, investigation of psychological processes, or of characteristics referring to behaviors in psychological processes, focus on phenomena that unfold within individuals over time, and couple- or family-processes unfold within couples or families over time. As a result, studying couple- and family-processes require methodological approaches that capture the over-time dynamics of experiences and behaviors of multiple members of the dyad or family simultaneously, and analytic approaches that allow for integration of these data are necessary.

Over the past two decades, intensive repeated measures designs based on ambulatory as-

sessment procedures — daily diaries, ecological momentary assessments (EMA), experience sampling methods (ESM) — have become a well-established tool to study everyday life processes. Collecting intensive repeated measures makes it possible to assess dynamic processes in real time (Repetti, Reynolds, & Sears, 2015), and this is immediately relevant for the study of two core components of family processes: i) individual responses and change across time within the family context, and ii) correspondence between and interconnection of these responses and changes. Studying how these two dynamic levels in the family process relate and mutually affect each other can provide unique insight into the interpersonal dimension of individual experience and behavior (Schoebi & Randall, in press). In the current article, we illustrate how interpersonal extensions of ambulatory assessment designs can be used to illuminate the interplay between individual process characteristics and interpersonal processes over time and in the natural family environment.

The example we use focuses on emotional processes in parental dyads. Emotions play a key role in many family processes. Specifically, they organize cognitions and behaviors of family members, and therefore their interactions (Keltner & Haidt, 2001). As a result, family relationships are characterized by a unique degree of emotional connection between family members (e.g., Prager & Roberts, 2004; Reis, 2012), and emotions provide a unique point of access to understand the dynamics of family interactions. In the remainder of the introduction, we first address methodological issues in studying interpersonal emotion dynamics, and make a case for using intensive repeated measures designs. We then discuss the relevance of emotional dynamics for individual adjustment, and its implications for the interpersonal realm.

How to Capture Emotional Dynamics in Daily Life?

Emotional experience is dynamic and fluctuates as a function of external changes. Various self-report approaches to assess emotions have been used in the past, capturing affective experience generally (e.g., Goldberg, 1993) or retrospectively over the past weeks (e.g., Watson, Clark, & Tellegen, 1988), but these approaches do not capture the dynamics of emotional experiences. Although some approaches include direct assessments of emotional dynamics, doubts remain regarding the accuracy of generalized or retrospective assessments (Robinson & Clore, 2002). To more accurately capture emotional changes intensive repeated measures designs are well suited (Ebner-Priemer, Eid, Kleindienst, Stabenow, & Trull, 2009). Intensive sampling of momentary self-reports of emotional states provides the researcher with serial data on affective experience in the natural environment (Shiffman, Stone, & Hufford, 2008). These data bear at least two major advantages: minimized bias by keeping emotional reports close in time to their actual experience (Schwarz, 2012), and the possibility to assess change and changeability in emotional states. In particular, assessing affect variables in a real world setting captures the contribution of the rich situational variability to which individuals are exposed to in daily life (Moskowitz, Russell, Sadikaj, & Sutton, 2009). This strengthens the study of context-sensitive microprocesses such as emotions (Shiffman et al., 2008).

Examining the temporal dynamics of emotions provides insight into the core processes underlying individual well-being and psychological distress, and several recent studies have documented an association between low emotional changeability, so-called *emotional inertia*, and psychological maladjustment (Koval & Kuppens, 2012; Kuppens, Allen, & Sheeber, 2010; Kuppens et al., 2012; Rottenberg, 2005). Emotional changeability can have various facets: it may reflect flexibility, reactivity or more generally (in)stability. While these terms cannot be used inter-

changeably, neither the literature to which we refer here nor our own data allow for strong conclusions about whether emotional changes actually happen as adaptive or maladaptive responses to events or changes in their environment. Nevertheless, because some changeability can be considered a prerequisite for emotions to be adaptive, very low changeability should interfere with adaptive responding. At the same time, high emotional changeability need not be adaptive. Investigating the implications of emotional inertia for interpersonal adaptation requires a methodological approach that combines a between-person framework with a within-person design. Emotional inertia needs to be assessed as a within-person phenomenon, and individual differences in emotional inertia are reflected at the between-person level. Similarly, interpersonal adaptation refers to processes that can be assessed at the within-dyad level, unfolding within dyads across time and situations (see also Gable, Gosnell, & Prok, 2012). Momentary data series can be collected from two interaction partners simultaneously, allowing us to assess the degree of accuracy between partner perceptions of emotions and the emotional self-report of the partner (see also Wilhelm & Perrez, 2004). Assessing these processes within each dyad allows for the examination of differences in interpersonal adaptation across dyads, which may vary as a function of emotional inertia at the between-subject level, as we shall propose hereafter. In this way, the current approach allows us to examine how individual emotional dynamics (e.g., emotional inertia) relate to interpersonal emotion processes, as reflected by the degree of accuracy in tracking the partner's emotion fluctuations over time.

Emotional Inertia and Psychological Maladjustment

Emotions are supposed to guide our everyday behavior in an adaptive way (Planalp, Fitness, & Fehr, 2006). To serve the function of preparing an individual for adaptive responses, emotions need to be reactive to relevant events and changing contexts (Ekman, 1992; Keltner & Gross, 1999; Planalp et al., 2006). For instance, negative emotions such as anger or fear drive us to abandon or confront the source of threat, whereas positive emotions such as love or joy facilitate approach behaviors. A lack of emotional flexibility may thus compromise an individual's capacity to respond adaptively across varying conditions and demands. High levels of emotional inertia may reflect this adaptive deficit. Moderate levels of emotional inertia, by contrast, reflect an emotional dynamic that is potentially more susceptible to external changes (Kuppens et al., 2010), whereas very low levels of emotional inertia, or in other words, very high emotional changeability may point to emotional instability or hyperreactivity and also undermine adaptive behavior (Ebner-Priemer et al., 2007; Tolpin, Gunthert, Cohen, & O'Neill, 2004).

A slow changing emotional dynamic, as reflected by high levels of emotional inertia, may adversely affect individual and interpersonal adaptation. On the individual level, emotional inertia has been related to psychological maladjustment, and studies have documented links with psychological dysfunctions such as depression, neuroticism, low self-esteem, and fear of negative evaluation (Koval & Kuppens, 2012; Kuppens et al., 2010; Rottenberg, 2005), and high levels of emotional inertia can be considered an antecedent or even risk factor of clinical depression in adolescence (Kuppens et al., 2012).

On an interpersonal level, emotional changeability is equally essential for interpersonal adaptation since emotions play an important role in structuring and shaping interpersonal interactions (Niedenthal & Brauer, 2012). For example, adaptive responding to the disclosures of an interaction partner is a key ingredient of relationship functioning and a building block for a sense of

intimacy (Reis & Clark, 2013). Interaction partners adjust their behaviors in response to each other's emotional signals, responding with similar or complementary emotions, in presumable accordance with the demands of the situation (Keltner & Haidt, 2001). A high level of emotional inertia may deprive an individual from responding in a context-sensitive manner to the needs and emotions of the other person. One central mechanism in this process of emotional reciprocity is the perception of the interaction partners' emotional state.

PSYCHOLOGICAL MALADJUSTMENT AND INTERPERSONAL PERCEPTION

Although emotional inertia is thought to undermine context-sensitive responding, this does not necessarily translate into a lack of accuracy in tracking others' emotions. In contrast, emotionally inert individuals may even track their partners' emotions more closely than their less inert counterparts. Although this assumption may seem counterintuitive at first glance, there is growing evidence suggesting a link between sensitivity in perceiving emotional and behavioral changes in close others and psychological maladjustment. Many psychological disorders are characterized by inflexibility on an affective, cognitive, and behavioral level (e.g., Kashdan & Rottenberg, 2010), but when it comes to recognizing emotional and behavioral changes in close others, psychological maladjusted individuals seem to be highly sensitive (e.g., Harkness, Jacobson, Sinclair, Chan, & Sabbagh, 2012). Several studies suggest that psychologically maladjusted individuals are particularly vigilant when exposed to socially threatening situations. Individuals with elevated depressive symptoms, for instance, perceive and overestimate drops in their partners' commitment and increases in negative behavior more readily than non-depressed individuals (Overall & Hammond, 2013). Given that such sensitivity is particularly activated in socially threatening situations, it may reflect insecure attachment, and indeed, individuals with a highly anxious attachment style are particularly accurate in inferring their partners' thoughts during discussions of relationship threatening topics (Simpson et al., 2011). Similarly, Harkness et al. (2012) found dysphoric individuals to be more accurate in decoding peoples' emotional states than non-dysphoric individuals during interactions where relationship goals were at stake.

Studies examining the effects of accuracy in intimate relationships are more inconsistent, documenting both positive and negative effects. Whether a situation evokes threat appears to be an important factor (Ickes & Simpson, 2001). In nonthreatening contexts, accuracy tends to be related to positive relationship outcomes. Accuracy heightens intimate partners' mutual understanding and thus contributes to effective support provision and feelings of closeness between them (Simpson, Ickes, & Oriña, 2003; Verhofstadt, Buysse, Ickes, Davis, & Devoldre, 2008). However, accuracy in relationship-threatening situations deprives individuals of protecting themselves from the hurtful thoughts and emotions that their partners may harbor (Simpson, Ickes, & Blackstone, 1995). Indeed, when situations implicate threat for a relationship greater accuracy tends to be associated with less satisfaction, stability and feelings of closeness (Simpson, Ickes, & Grich, 1999; Simpson, Ickes, & Oriña, 2001).

Maladjusted individuals are characterized by high levels of emotional inertia in daily life except when a stressful event is about to happen. Koval and Kuppens (2012) examined the impact of social stress anticipation on emotional inertia. Emotional inertia was assessed with an intensive repeated measures design over two days, involving several momentary emotional self-reports per day, before and after an experimental manipulation. The manipulation involved anticipating to the participants that they would have to complete a Trier Social Stress Test (TSST) at a later time. This social stress anticipation changed the emotional dynamics of psychological maladjusted individuals

causing their inertia levels to drop. The authors suggest that this drop may be due short-lived, ineffective coping attempts leading temporarily to more fluctuations in their emotional dynamics, respectively a decrease in their emotional inertia levels. These results also imply that psychological maladjusted individuals are particularly vigilant in anticipatory stressful situations.

PSYCHOLOGICAL MALADJUSTMENT AND INTERPERSONAL DISTRESS

Interpersonal distress is substantially linked with psychological maladjustment, and with affect-related pathology or maladjustment in particular. Neuroticism, for example, is a powerful predictor of relationship distress and dissolution (Karney & Bradbury, 1995). A high level of neuroticism is associated with greater exposure to interpersonal conflicts in daily life and particularly high displays of anger and depression in response to conflict (Bolger & Zuckerman, 1995). Conversely, relationship distress is also a reliable precursor of psychological maladjustment. In fact, Whisman and Uebelacker (2009) found evidence for relationship dysfunction to be both a predictor and consequence of depressive symptoms. In their two-year longitudinal study, baseline depressive symptoms were found to predict subsequent relationship dysfunction to the same extent as baseline relationship dysfunction predicted subsequent depressive symptoms. Psychological maladjustment involving self-regulation problems may go along with insecurities and draw individuals closer to their social partners, as evidenced by increased emotional susceptibility to and connection with the partner's emotions (Meuwly, Bodenmann, & Coyne, 2012; Schoebi, 2008), possibly as an attempt to access others as external regulators (Randall & Schoebi, 2015). This may result in behavioral excesses regarding external regulation attempts such as reassurance seeking, typically observed in depressed individuals (e.g., Joiner & Metalsky, 2001) and in association with insecure attachment styles (Shaver, Schachner, & Mikulincer, 2005).

Taken together, the association between psychological maladjustment and relationship distress is well established. Relationship outcomes are influenced by the way spouses talk and respond to each other (Fincham & Beach, 1999), and a driving force behind those mutual responses may be the accuracy in perceiving one partner's emotions (e.g., Overall & Hammond, 2013).

THE CURRENT STUDY

Investigating interpersonal processes among individuals in families involves specific requirements that have to be met by an appropriate methodological approach. Family processes essentially emerge within persons and dyads or families across multiple situations. Studying links between individuals' psychological processes and interpersonal processes are of pivotal importance in clinical family psychology, and these phenomena therefore need to be captured appropriately and accurately. In the current article, we demonstrate how intensive repeated measures designs using electronic self-report procedures, applied to all members of a dyad or family, provide a useful way to access interpersonal processes in family relationships. We illustrate this case with a study on the relationship between emotional inertia, an emotion dynamic characterized by low changeability of emotional experience within an individual, and interpersonal perceptions of emotions, a process which occurs within dyads. Using this example of emotional inertia and interpersonal emotion perception, we exemplify the investigation of individual and interpersonal adaptation processes based on an intensive repeated measures design.

To this end, couples' recorded their momentary emotional experience and the perception of their partner's emotions six times a day over seven consecutive days. We used a multilevel analytic approach. Multilevel analysis is a powerful tool to examine repeated measures data, as it allows us to examine variability and covariances that exist within persons, dyads or families, as distinct from variability and covariances that emerge between couples or families in a single comprehensive analytic framework, while allowing for examining how differences between individuals, dyads and families relate to how variables unfold within individuals, dyads or families.

The concepts we use for our example reflect dynamics or processes that occur or unfold *within individuals*, and we assess them at the within-individual or within-dyad level: emotional inertia was operationalized as individuals' first order autocorrelation across repeated emotion reports, or in other words, the extent to which one's current affective state predicts one's subsequent affective state. Accuracy in perceiving or tracking the partner's emotions was assessed by examining the extent to which perception of partner emotions predicted the partner's self-reported emotion fluctuations across repeated measures. Differences in emotional dynamics exist *between individuals*, and we used this between-person variability in emotional inertia as a predictor of the within-dyad process of perceiving or tracking the partner's emotions.

METHOD

Participants

The sample consisted of 172 committed and mostly married (96.5%) parents of adolescent children. Families were recruited by means of flyers distributed in public schools and with ads in local newspapers in different French and German speaking regions of Switzerland.

The sample comprised German-speaking (74%) and French-speaking families (26%). The average age was 46.2 years (SD = 5.3) for men and 44.2 years (SD = 4.8) for women. Children's age ranged from 9.6 to 18.5 years, having a mean age of 14.6 years (SD = 1.3). Couples' average relationship duration was 19.1 years (SD = 4.9).

Most husbands were employed full-time (86%), whereas most wives were employed part-time (67.6%). Overall, the couples can be described as stable, and with above-average education (52% men and 21.8% of women holding a University degree).

Procedure

All materials were provided in the participant's preferred language (French or German). Materials were first developed in German and a translation into French was tested, corrected and validated via back-translation. All families' were visited in their home by a research assistant who provided detailed instructions on the use of the handheld computers and explained the reporting plan, all questions and items. Participants completed a practice trial to familiarize themselves with the electronic diaries and open questions were clarified. The reporting period started the next day and lasted seven consecutive days.

On each day of assessment, participants started the computer after waking up and provided their first report. Once started, computers prompted participants to report based on a pro-

grammed reporting schedule by means of acoustic signals at five occasions throughout the day, each of them randomly timed within a two-hour time window. Except for the first report of the day, all assessment times were synchronized between couples to ensure concurrent responses of both spouses. Participants carried the handheld computers with them and were instructed to report as soon as possible after the acoustic signal. If participants failed to report immediately, they could report retrospectively with a maximum delay of two hours. Participants were instructed not to discuss their reports with their partners. Thus, each of the 344 participants provided a series of 42 reports (six reports on each of seven days).

Measures

Emotional state. At each report, participants rated their current emotional state, responding to the question "how do you feel right now?" The reports were provided by means of four bipolar 6-point scales, anchored by affect labels with opposite valence: *angry-calm* (ärgerlich-friedlich; fâché-paisible), *sad/depressed-upbeat/content* (traurig/bedrückt-fröhlich/heiter; triste/déprimé-joyeux), *anxious-confident* (besorgt/ängstlich-zuversichtlich; soucieux/angoissé-confiant), and *burdened-unburdened* (belastet/unbelastet; préoccupé/sans souci). The ratings were averaged to form a general measure of the perceived valence of the current emotional state. Evaluation of the reliability of change across time of the scale (following Wilhelm & Schoebi, 2007) yielded an acceptable score of $R_C = .71$, and the reliability of between-person differences was estimated at $R = .97$.

Perceived partner emotions. Participants not only rated their own emotional states, but also reported on the perceived or assumed emotional state of their intimate partner ("How do you think [name partner] is feeling right now?") based on the identical items used for reporting the own emotional state. Partner emotion ratings were also averaged to form an overall measure "partner affect." For perceptions of partner emotions, it appeared that differential change in emotional tones were tracked with some sensitivity, which might have contributed to a rather moderate reliability of change $R_C = .65$. The between-person reliability was satisfactory ($R = .80$).

Data Analysis

The data featured multiple sources of non-independence: individuals provided series of repeated measurements (Level 1), and fathers and mothers belonged to a dyad, and thus likely sharing not only children and a home, but also past and present experiences, values, interests, friends, and other aspects of their daily life context (Level 2). Ignoring non-independence in these data would yield biased significance tests. Multilevel Modeling takes into account this nested data structure, and its extensions for dyads and families offers a key advantage to studying family processes, as it allows to flexibly model variance that occurs within individuals and dyads or families (at Level 1) and variance that occurs between individuals, dyads or families (Level 2). Here, we follow the general approach proposed by Laurenceau and Bolger (2005). We examined emotional inertia and accuracy in partner perceptions at Level 1, to test the association between individual differences in partner perceptions of emotions and emotional inertia as between- and within-person association at Level 2.

We first set up a model to estimate emotional inertia. As mentioned earlier, we operationalized emotional inertia as the degree of the first-order autocorrelation among reports on the

own emotional state within each person. This coefficient reflects the extent to which the current emotional state is a function of the emotional state report at the previous measurement (a lagged emotional state effect; *t*-1). To capture only within-person covariance, we centered the lagged emotional state predictor variable around the person's mean across all of his or her emotional self-reports. The within-person model for the measurement of emotional inertia can thus be expressed with the following Equation 1:

$$\text{EMOTION}_{ti} = \pi_{0i} + \pi_{1i}^{*}(\text{EMOLAG}_{ti}) + e_{ti} \tag{1}$$

EMOTION_{ti} denotes the momentary emotional state of person *i* at time *t*, which is predicted by an intercept π_{0i} capturing the mean emotional state of person *i,* and the slope π_{1i} of the lagged emotional state (EMOLAG_{ti}), which represents the extent to which the previous emotional state predicts the current emotional state. The error term e_{ti} captures the residual variance at Level 1.

We allowed each individual to have its own intercept and its own estimate of the autocorrelation parameter π_{1i}, by estimating random variance components u_{0i} and u_{1i}. Equations 2 display the Level 2 model:

$$\pi_{0i} = b_{00} + u_{0i}$$
$$\pi_{1i} = b_{10} + u_{1i} \tag{2}$$

In this model, individual *i*'s intercept (π_{0i}) and inertia (π_{1i}) estimates are expressed by the overall intercept of the samples' mean emotional state (b_{00}) and inertia estimate (b_{10}), and a residual term (u_{0i}, u_{1i}) capturing the individual's deviation of the sample estimate. The residual u_{1i} for the inertia parameter (π_{1i}) thus reflects individual differences in emotional inertia, and we used a *z*-score of this parameter as a Level 2 predictor in the subsequent model to examine perceptions of partner emotions.

Because the first model presented here served to compute an emotional inertia estimate significance tests were not of primary interest. For reasons of parsimony, we did not incorporate the dyadic structure of the data. In contrast, the model examining perceptions of partner emotions served to test our hypothesis. We therefore set up a dyadic model, specifying the dyad at Level 2 and repeated measures at Level 1, with each of the partner obtaining a separate set of parameters, and therefore, being nested within the equation. This multiple intercept approach was used by Raudenbush, Brennan, and Barnett (1995), and is more generally described in Laurenceau and Bolger (2005), or in Kenny, Kashy, and Cook (2006).

The Level 1 of the model modeled each individuals degree of accuracy in interpersonal emotion perception — or the degree of correspondence between the perception of the partner's emotional states and partners own self-reports — across all repeated measures. The equation examined to what extent people differ in their degree of accuracy and was formulated as follows:

$$\text{EMOTION}_{ti} = \pi_{1i}^{*}(\text{FATHER}_{ti}) + \pi_{2i}^{*}(\text{MOTHER}_{ti}) + \pi_{3i}^{*}(\text{MO\_PERC\_FA}_{ti}) + \pi_{4i}^{*}(\text{FA\_PERC\_MO}_{ti}) + e_{ti} \tag{3}$$

EMOTION_{ti} reflects the emotional state of a particular father or mother of dyad *i* at time *t*. An intercept is estimated for the father (π_{1i}) and the mother (π_{2i}), capturing the father's or mother's average emotional state. The estimate for parameter π_{3i} reflects the extent to which the mother's perception of the father's emotional state covaries with the father's self-reported emotional state, and likewise, the estimate for parameter π_{4i} expresses the extent to which the father's perception of the mother's emotional state converges with the mother's self-reported emotional state. The estimate for e_{ti} captures the residual variance.

For illustration purposes, we also tested whether accuracy in partner reports of emotion varied as a function of individual differences in emotional inertia at the between person Level 2. This part of the model essentially captures accuracy as the extent to which the average partner emotion report of the perceiver corresponds to the partner's average self-report (a between-person accuracy estimate). A coefficient for this accuracy estimate emerges from a between-person comparison and it therefore does not directly reflect a process that occurs within a dyad. The within-person level of analysis, by contrast, allows a more fine-grained analysis that more closely reflects a dyadic process as it derives the accuracy estimate from both partners' emotion reports across the repeated measurements.

The model capturing the between-person associations can be expressed with the following equations:

$$\begin{aligned}
\pi_{1i} &= b_{10} + b_{11}^{*}(\text{MEAN_PERC_MF}_i) + b_{12}^{*}(\text{EMO_MOTHER}_i) + b_{13}^{*}(\text{INERTIA_MOTHER}_i) \\
\pi_{2i} &= b_{20} + b_{21}^{*}(\text{MEAN_PERC_FM}_i) + b_{22}^{*}(\text{EMO_FATHER}_i) + b_{23}^{*}(\text{INERTIA_FATHE}R_i) \\
\pi_{3i} &= b_{30} + b_{31}^{*}(\text{EMO_MOTHER}_i) + b_{32}(\text{INERTIA_MOTHER}_i) + u_{\text{M}i} \\
\pi_{4i} &= b_{40} + b_{41}^{*}(\text{EMO_FATHER}_i) + b_{42}^{*}(\text{INERTIA_FATHER}_i) + u_{\text{F}i}
\end{aligned} \tag{4}$$

The equations for π_{1i} and π_{2i} represent the between-person dimension of the model. The estimates for b_{11} and b_{21} capture the sample estimate for the association between an individuals' average perception of the partner's emotional state, and the partner's average self-reported emotional state. Specifically, b_{11} reflects the extent to which the mother's average perception of the father's emotions predicts father's average emotional self-report whereas b_{21} captures the equivalent parameters for the father's perceptions (between-person accuracy estimates). The estimates for b_{12} and b_{22} control for the effects of the perceiver's own emotional state and the partner's self-reported emotional state. The estimates for b_{13} and b_{23} reflect the extent to which the perceiver's inertia was associated with the partner's average emotion report. To be specific, however, because the perception of the partner's emotional state was included in the model (b_{11}, b_{21}), the now residualized outcome reflects the discrepancy between the average partner perception and the average self-reported emotional state, and therefore, the estimates for b_{13} and b_{23} actually tell us whether the perceiver's inertia was associated with overperception (for negative coefficients) or underperception (for positive coefficients) of the partner's emotional state, on average.

The equations for π_{3i} and π_{4i} represent the within-person part of the model and examine individual differences in tracking the partner's emotional states. The estimates for b_{32} and b_{42} capture the association of the perceiver's emotional inertia with the accuracy with which the perceptions of the partner's emotional state describe the partner's self-reported emotional state. These coefficients reflect whether accuracy in tracking the partner's emotion over time varied as a function of emotional inertia, thus responding to our example research question at the within-person level. Again, these coefficients are controlled for the perceiver's average emotional state, as reflected by the coefficients b_{31} and b_{41}.

In a final step, we included a multiplicative interaction term between the perceiver's emotional inertia and the average perception of the partner's emotional state in the Level 2 to examine our research question at the between-person level. To this end, the Level 2 equations as shown in Equations 4 are extended as follows:

$$\begin{aligned}
\pi_{1i} &= b_{10} + b_{11}^{*}(\text{MEAN_PERC_MF}_i) + b_{12}^{*}(\text{EMO_MOTHER}_i) + b_{13}^{*}(\text{INERTIA_MOTHER}_i) \\
&+ b_{14}^{*}(\text{MO_PERC} \times \text{INERTIA}_i)
\end{aligned}$$

$$\pi_{2i} = b_{20} + b_{21}^{*}(\text{MEAN\_PERC\_FM}_i) + b_{22}^{*}(\text{EMO\_FATHER}_i) + b_{23}^{*}(\text{INERTIA\_FATHER}_i) + b_{24}^{*}(\text{FA\_PERC} \times \text{INERTIA}_i)$$
$$\pi_{3i} = b_{30} + b_{31}^{*}(\text{EMO\_MOTHER}_i) + b_{32}^{*}(\text{INERTIA\_MOTHER}_i) + u_{\text{M}i}$$
$$\pi_{4i} = b_{40} + b_{41}^{*}(\text{EMO\_FATHER}_i) + b_{42}^{*}(\text{INERTIA\_FATHER}_i) + u_{\text{F}i} \quad (5)$$

The estimates for the newly added parameters b_{14} and b_{24} represent multiplicative interaction terms between the perceiver's average partner emotion report, and his or her inertia, indicating whether between-person accuracy varied as a function of emotional inertia. These coefficients thus represent the equivalent of the coefficients b_{32} and b_{42} (moderator effects of inertia in perceiving the partners emotions) but at the between-person level. In the models examining perceptions of partner emotions, we adjusted for linear time trends and first order autocorrelation (not shown in the equations above, and not reported in the tables for parsimony reasons).

Results

Preliminary Analysis: Emotional Inertia between Participants

We first modeled emotional inertia as described above, and examined between-person variance components of inertia estimates to gauge whether participants actually differed from one another in their levels of emotional inertia. The results suggested that participants varied significantly in their emotional inertia, χ^2 (343, N = 344) = 666.86, p < .001. It thus made sense for the variance component capturing between-person variability in emotional inertia to be used as a between-person variable in further models.

Emotional Inertia and Perception Accuracy of Emotions in Dyads

At the within-person level, the dyadic data revealed that mothers were particularly accurate in tracking emotional changes in their partners' when they were emotional inert. Although both mothers (b = .18, p < .001) and fathers (b = .24, p < .001) were accurate in tracking each other's emotions over time, emotional inertia moderated this effect in women: mothers estimates of their spouse's emotions were more accurate when they were emotionally inert (b = .06, p < .001). This pattern of findings did not emerge for fathers' perceptions of mothers' emotions (b = .03, p = .12) (Table 1).

Taken together, although both parents were able to predict the emotions of their partners' accurately, women's accuracy varied as a function of their emotional inertia. They tracked their partner's emotional changes more closely when they were more emotionally inert.

At the between-person level, the match between perceivers' average perception of their partners' emotions and partners' average emotional self-report provided significant results for fathers and mothers. Both mothers (b = .10, p < .001) and fathers (b = .14, p < .001) were generally accurate in perceiving their partners' emotions. Emotional inertia did not moderate accuracy neither in women (b = .00, p = .83) nor in men (b = –.00, p = .95). The residualized outcomes in mothers perception of fathers average emotions indicated that mothers with high levels of emo-

tional inertia tended to underperceive their partners' emotional states (b = .02, p < .05) as compared to women with low levels of emotional inertia, who overestimated their partners' emotions.

TABLE 1
Correspondence between perceived and self-reported emotional states of family members, as moderated by emotional inertia

Predictor	*b*	*SE*	*p*	95% CI
Within-person				
Fathers perception of mothers emotional states	.24	.020	< .001	[0.20, 0.28]
Moderator effect inertia fathers	.03	.016	.12	[–0.01, 0.06]
Mothers perception of fathers emotional states	.18	.016	< .001	[0.15, 0.22]
Moderator effect inertia mothers	.06	.013	< .001	[0.03, 0.08]
Between-person				
Fathers perception of mothers emotional states	.14	.026	< .001	[0.09, 0.19]
Moderator effect inertia fathers	–.00	.011	.95	[–0.02, 0.02]
Mothers perception of fathers emotional states	.10	.027	< .001	[0.05, 0.15]
Moderator effect inertia mothers	.00	.013	.83	[–0.02, 0.03]

Note. N = 172 families.

DISCUSSION

The goal of this article was to illustrate how family processes and individual functioning can be studied empirically as they evolve over time in families' natural environments. Repeated measurements allowed us to gain insights into dyadic processes without relying on generalized or retrospective self-report measures, and therefore, on the individual's ability to accurately infer and aggregate their emotional dynamics. Whenever a dynamic phenomenon is of interest, several assessments are required to model change for each individual. Repeated measures designs provide a solid foundation for studying processes which unfold within individuals, dyads or families over time and across contexts. It allows us to collect data on process variables, namely variables that change within the realm of interpersonal interactions across hours and days. Ambulatory or other momentary assessments measure emotion, behavior and cognitions as experienced in daily life and are therefore less prone to retrospective recall biases (Bolger, Davis, & Rafaeli, 2003). Repeated measures provide the means for a more differentiated way of thinking about family processes, because distinct sources of variability can be studied. This is of particular importance given that associations found between two variables at the between-person level are not necessarily true for the same two variables at the within-person level (Hamaker, 2012), as our example also underscores. Taken together, to adequately address processes which evolve within individuals, dyads or families, there is no way around repeated measures designs. Bolger and Laurenceau (2013) provide a more extensive discussion and introduction to using intensive repeated measures designs.

Our illustration involved individual process characteristics and interpersonal processes in couples, using the example of emotional inertia and its relationship to interpersonal perception of emotional states. We gained access to these individual and interpersonal processes by means of an intensive repeated measures design with an electronic self-report measure simultaneously in both

partners' six times a day during one week. We used a multilevel technique to analyze within-person and within-dyad processes, and links between these processes at the between- and within-person level. To apply a multilevel analysis, the structure of the data requires to include multiple, preferably theoretically meaningful levels, which means that measurements that have characteristics in common and are therefore considered as interdependent are regarded as nested within another unit (Nezlek, 2011). In repeated measurements, the repeated self-reports of a person share variance because the data points are nested within the same person, thus constituting two different levels of analysis (Nezlek, 2012). Between members of a family, there is additional covariance because they belong to the same social unit. Here, we used dyadic extensions of multilevel models to investigate between- and within-person differences while taking into account the non-independence of dyadic data. This approach incorporates a distinct set of parameters for each individual of the dyad in a single, dyadic equation. Alternatively, we could have used a model with three levels (measurements, individuals, dyads), where the clustering at the dyad level would have captured similarity in partners' data. Our approach of choice, however, allows for more straightforward modeling of interpersonal processes if partners are distinguishable (such as is the case with husbands and wives; see Bolger & Laurenceau, 2013, or Kenny et al., 2006, for a more detailed discussion).

We expected individuals with high levels of emotional inertia to perceive others' emotional states with more accuracy. This assumption was based on studies which imply that emotional inertia is a characteristic feature of the emotional dynamics of maladjusted individuals, and findings indicating an association between psychological maladjustment and sensitivity in perceiving emotional and behavioral changes in close others. Testing this assumption, we chose an example that uses a within-person dynamic (emotional inertia), assessed based on intensive repeated reports on emotional experience, as a predictor for a within-dyad association (the over time association between emotion perceptions and partner's emotion reports). In other words, we assessed the individual emotion process evolving over time of each person and used this assessment to characterize the person. We then used this characteristic and related it to an evolving, transactional dyadic process. Our expectation was partially confirmed for women, but not for men.

On the between-person level, mothers and fathers perception of their partners' average emotional states matched their partners' average emotional self-reports. Emotional inertia did not moderate accuracy. The results, however, suggested that inertia in women was associated with more negative discrepancies of partner perceptions from the partners' self-reported emotional states. On the within-person level, we found that both, fathers and mothers predicted their partners' emotions over time with significant accuracy, but inert women were even more accurate in tracking their partner's emotional changes over time. That is, women's, but not men's accuracy in partner perceptions varied as a function of their level of emotional inertia. These results emphasize the aforementioned importance to consider both, between- and within-person processes in the analysis since they may well yield different results.

Emotional Inertia and Intimate Relationships

Emotions are a key variable in family functioning (Berscheid, 1999). To provide an adaptive benefit, emotions should change in accordance with significant events in the environment. Too many or strong fluctuations may reflect a dynamic characterized by over-reactivity or insta-

bility, but very few emotional changes over time may also undermine individual and interpersonal adaptation. The latter phenomenon, termed emotional inertia, has received little empirical attention in relationship and family research, although the study of emotional dynamics may be particularly important in the context of intimate relationships, affecting the quality and stability of relationships (Karney & Bradbury, 1995). Given the link between psychological maladjustment and interpersonal distress (Bolger & Zuckerman, 1995; Karney & Bradbury, 1995) the investigation of how individuals' vulnerabilities are associated with interpersonal processes is necessary to shed light on the mechanisms behind this link. Individuals with high levels of emotional inertia seem to be especially alert or even vigilant to close others' emotional states. Indeed, closer tracking of the partner's thoughts and feelings reflects negative relationship outcomes in situations that pose a threat to a relationship, such as less relationship satisfaction, stability and feelings of closeness in intimate relationships (Simpson et al., 1999, 2001).

Increased vigilance in inert individuals may be motivated by a desire to detect potentially threatening interpersonal situations in their intimate relationships, perhaps compensating for a maladaptive emotion system. The close attention of maladjusted individuals to others' emotions, and compromised emotion regulation skills (Campbell-Sills & Barlow, 2007), may impair interpersonal adjustment in intimate relationships. These speculations await further empirical work on relationship and family processes. Moreover, demonstrating a linkage with prospective change in relationship outcomes is necessary to support conclusions about implications for relationship functioning. A first step in this direction may focus on interpersonal behaviors linked to interpersonal emotion perceptions.

Limitations

The current study is subject to several limitations. Our participants were individuals in stable relationships and do therefore not represent the entire population very well. In particular, our results are based on a non-clinical sample and studying dysfunctional families, or individuals with psychopathologies related to emotional inertia (Kuppens et al., 2010), may have yielded different results.

We focused exclusively on processes involving the subjective experience of the own self-reported emotions, and perceptions of the partner's emotional states. Despite the many advantages of an ambulatory assessment approach, it should be emphasized that self-report measures do not allow a direct analysis of behavioral processes and are therefore no substitute for observational behavior (Bradbury, Fincham, & Beach, 2000). Systematic observation permits capturing behavioral responses between dyads and family members. An ambulatory assessment approach permits to capture subjective reports of experiences over long periods of time, whereas a systematic observation allows detecting microprocesses during a rather short period of time, involving the expressive component of emotions.

Although subjective experience and perceptions, not accessible by observational approaches, were of interest, an integration of results obtained from different methodological approaches could further improve future studies. Combined methods could provide refined assessments of individuals' emotional dynamics, for example, and emotion perceptions and other aspects of interpersonal sensitivity could be studied in the same individuals both in daily life and in the lab. Combining different methodological approaches has the advantage that interpersonal and family processes can be examined from different perspectives and thus offer a more complete understanding of a

phenomenon (Laurenceau & Bolger, 2005). However, it is important to be aware that both methods, ambulatory assessment and observational studies, do only provide a snapshot of the emotional episodes an individual experiences in daily life.

CONCLUSIONS

All these processes evolve as we live our daily lives, navigating interactions in our families and our lives outside the family. We believe that capturing and assessing these phenomena adequately requires capturing the immediate experiences in these different circumstances across hours and days. In the current article, we provided an example based on emotion processes, because emotions are central to family processes and family functioning. The way we perceive each other's emotions influences the way we talk and respond to each other (Keltner & Haidt, 2001), and how we track and perceive our partners may be influenced by our own emotional dynamics and adjustments, as the current findings suggest. Nevertheless, the types of methods and analyses exemplified can be used for a wide range of couple- or family-processes, and may advance research on family functioning in significant ways.

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