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# A general framework for capturing interpersonal emotion dynamics: associations with psychological and relational adjustment

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## A general framework for capturing interpersonal emotion dynamics: associations with psychological and relational adjustment

Emotions are fundamentally dynamic in nature as they alert us to important changes in the environment, and motivate us to cope with them (Kuppens, 2015; Scherer, 2009). The characteristics of these emotional changes over time provide crucial information about people's mental well-being and adjustment and even about the risk for the occurrence and progress of psychopathology (Houben, Van Den Noortgate, & Kuppens, 2015; Wichers, Wigman, & Myin-Germeys, 2015). For instance, the persistence of people's emotional experience over time prospectively predicts the onset of depressive disorder in adolescence (Kuppens, et al., 2012).

In addition, emotions mainly occur and change in the context of social interactions and relationships (Schoebi & Randall, 2015; Tiedens & Leach, 2004). They regulate social interaction, and social processes in turn regulate the emerging emotions (Frijda & Mesquita, 1994). Over the last years, there have been calls for including social relations in the study of emotional processes (Fischer & Van Kleef, 2010; Parkinson & Manstead, 2015), resulting in a significant increase of research explicitly focusing on interpersonal emotion dynamics, the ways in which emotions emerge and change in interactions between people and can become interwoven over time (Butler, 2015; Lichtwarck-Aschoff, Kunnen, & van Geert, 2009; see also Chapter 1 for a conceptual review). This increase was further spurred by the growing availability of technologies and statistical techniques that allow for dyadic, multilevel, and overtime data collection and analysis (see Chapter 4). Yet, the precise nature and correlates of interpersonal emotion dynamics remain poorly understood (see also Butler, 2015; Schoebi & Randall, 2015 and Chapter 10). How can we make sense of complex interpersonal emotion patterns, and how are they related to psychological and relational adjustment?

The aim of the current chapter is help fill this gap, by providing an overview of research on interpersonal emotion dynamics, the processes that underlie these dynamics, and how these dynamics can contribute to (mal)adjustment. We propose a taxonomy that acts as a structuring framework, identifying four key characteristics of interpersonal emotion dynamics: emotional covariation, emotional influencing, emotional variability, and emotional inertia. We synthesize research findings relating these characteristics to psychological and relational adjustment; and in doing so, identify gaps in our existing knowledge of interpersonal emotion dynamics. In line with current research practices, we focus on how emotions interact between individuals in a close relationship (e.g. couples, adult-caregivers, close friends), as such relationships are principal contexts for emotion experience, expression, and regulation and are central for people's adjustment (Berscheid & Ammazzalorso, 2001; Reis, Collins, & Berscheid, 2000; see Chapter 7 for an explicit focus on families, Chapter 8 for young adult romantic and peer relationships, and Chapter 9 for intimate relationships). However, we think that the proposed concepts have applicability beyond the dyad to social relationships involving more people.

## Taxonomy of Four Fundamental Interpersonal Emotion Dynamic Characteristics

We introduce a novel taxonomy[1] to capture some important characteristics of interpersonal emotional dynamics. Although these dynamics can be investigated in multiple ways, the taxonomy focuses on four elementary aspects, that stem from two distinctions.

[1] Note that the taxonomy suggested here partly mirrors a framework that Kuppens & Verduyn (2015) have proposed to grasp intrapersonal emotion dynamics. In this taxonomy, two distinctions are made that in combination result in four elementary characteristics of intra-individual emotion trajectories. A first distinction is drawn between a focus on single versus multiple emotions and a second distinction is made between two facets of emotional change, the degree of variability and time-dependency. These two distinctions result in four intrapersonal dynamic features: emotional covariation, emotional cross-lags, emotional variability, and emotional inertia. Like we propose here for the interpersonal case, these characteristics have been shown to be essential for individual well-being (e.g., Houben et al., 2015; Pe, et al., 2015).

As a first organizing principle, we distinguish on studying the specific dynamics that occur between individuals, and the dynamics that characterize an interpersonal system as a whole. When individuals interact, the nature of their interaction is determined by each person's individual qualities and by the unique interplay between these qualities (Reis et al., 2000). This interplay can be studied in isolation, focusing on the interpersonal connections only. For instance, one can examine how angry expressions of one partner elicit responses in the other partner during a fight. However, the whole picture can be looked at as well, taking both the individual qualities and the interpersonal connections into account. For our example above, this would mean that also partners' intra-individual changes in anger (due to for instance intrapersonal regulation processes) are considered and how they combine with the interpersonal connections into an emotional state of the couple. Thus, one then focuses on how the global level of negativity that is present in the couple changes across the interaction, which results from interactions between both partners' intra-individual changes in anger and the interpersonal reciprocity in anger taking place. In this case, a systems perspective approach[2] is adopted, in which the dyadic partners are conceived as one single interpersonal system which is irreducible to the constituent partners and has properties on its own such as the state of the system being dependent on its past state, states to which the system often recurs, et cetera (e.g., Lewis, 2000; Steenbeek & van Geert, 2005; see also Chapter 3 for a dynamic system approach to interpersonal emotion processes).

As a second organizing principle, we distinguish between time-dependency and time-independency of emotional change. A time-dependent perspective investigates how strongly an emotional state carries over from one moment to the subsequent moment and thus

[2] System theories (e.g. general system theory; Von Bertalanffy, 1950) focus on the study of complex systems and its characteristics, emphasizing the interactions between constituting elements which all together form one system with its own patterns of self-stabilization and organization. For instance, clinical family system theories (e.g. Minuchin, 1974) have promoted such a system view of the family, and developmental and relational researchers commonly approach human development and relationships from such a system perspective (e.g., Gottman, Swanson, & Swanson, 2002; Hollenstein, 2015; Lewis, Lamey, & Douglas, 1999; Reis et al., 2000).

considers sequential relations, whereas time-independency does not take the temporal order of emotional states into account. For our angry fight example, a time-dependent perspective means that one investigates how anger between the partners/within the couple carries over from one moment to the next. For dynamics that occur between individuals, this means focusing on how much one person's change in anger predicts the partner's subsequent change in anger. For dynamics that characterize the interpersonal system as a whole, this means capturing the change in the couple's anger, or how long the couple maintains an angry state, resulting from each partner sustaining their own and their partner's anger during the fight.

From a time-independent stance, one focuses on how the anger of the partners relate to each other over time or on the dispersion of anger for the whole interpersonal system. Here, the temporal order of experienced anger in each party does not matter. For instance, whether both partners are experiencing a constant, moderate level of angriness during the first half of the fight and then a more extreme, elevated level at the end of the fight, or whether they constantly switch between these moderate and extreme levels can lead to the same results. Here, dynamics that occur between individuals capture how much partners' changes in anger during the fight fluctuate together. If one shows an increase in his/her anger, is the other one's anger increasing as well? Dynamics that characterize the interpersonal system as a whole capture the extremity of the anger experienced by the couple during the fight. How much does each partner's own anger change over the fight, and how much does this change go together with a change in the partner's anger?

Together, these distinctions result in four key characteristics of interpersonal emotion dynamics, graphically illustrated in Figure 1: (1) emotional covariation, or how emotions of different individuals covary across time, (2) emotional influencing, or how individuals' emotions at one moment predict other people's emotions at the next moment, (3) emotional variability, indicating how much the emotional state of the interpersonal system fluctuates

across time, and (4) emotional inertia, representing the carryover of the emotional state of the interpersonal system from one moment to the next. In the following sections, we discuss each of the four characteristics separately, focusing on definitions, potential underlying processes and relations with well-being, and relevant existing research.

<Insert Figure 5.1 here>

## Emotional Covariation

Interpersonal emotional covariation reflects the strength with which different individuals' emotions covary across time (Butler, 2011). It is sometimes referred to as synchrony or emotional similarity (e.g., Anderson, Keltner, & John, 2003; Papp, Pendry, Simon, & Adam, 2013) and can be operationalized as the concurrent covariation of people's emotions over time. For instance, in one study, spouses' moods and cortisol levels were assessed 4 times a day for 3 consecutive days, and covariation was assessed by slopes in a multilevel model predicting participants' own cortisol level and mood by their partner's concurrent cortisol level and mood. The spouses showed positive covariation of both cortisol and negative mood during daily live, but not of positive mood, meaning that partners' negative emotions concurrently increased and decreased throughout the days. In principle it is also possible that people show negative covariation, with increases in one person's emotion coinciding with decreases in another person's emotion. Up to now such inverse linkages have been mainly reported in studies investigating physiological linkages in close relationships (for an overview, see Timmons, Margolin, & Saxbe, 2015).

Concurrent covariation can arise due to two processes. First, in case of measurements across longer timescales (e.g., experience sampling), covariation may be the resultant of individuals influencing each other on shorter timescales and thus reflect time-dependency rather than time-independency. Emotional influencing will be discussed in the corresponding section below. Second, emotional covariation can be explained in terms of emotional

similarity, with people having shared environments or experiences that they interpret in similar fashion, or corresponding diurnal affective rhythms (Anderson et al., 2003; Gonzaga, Campos, & Bradbury, 2007). Emotional similarity is especially expected to occur in close relationships with high physical proximity (e.g., families living together), mutual care and interdependence of activities, cognitions, goals, and behaviors (Fitzsimons, Finkel, & vanDellen, 2015; Wegner, Guiliano, & Hertel, 1985). Indeed, people in close relationships become increasingly emotionally similar over time, termed emotional convergence, and this convergence positively predicts relationship quality and longevity (Anderson et al., 2003).

The emotional convergence hypothesis explicitly states that it is adaptive for people in a close relationship to evidence emotional similarity, because of three primary reasons (Anderson, Keltner, Tiedens, & Leach, 2004). First, emotional similarity helps people to coordinate their behaviors and thoughts, and thus to respond together to environmental demands. Second, it enables people to better understand each other and therefore facilitates their interactions. Finally, it increases their closeness as they feel validated in their emotional experiences. This line of research suggests that positive emotional covariation goes together with smoother interactions between close relationship partners, and thus positively relates to relational adjustment. It has indeed been shown that people prefer to interact with persons that are experiencing similar emotions (Gibbons, 1986), that they feel more satisfied when they do (Locke & Horowitz, 1990) and that their negative emotions in stressful situations decline, compared to when they interact with persons that are experiencing dissimilar emotions (Townsend, Kim, & Mesquita, 2014). Additionally, emotional similarity has been related to more relationship satisfaction, closeness, and stability (Townsend, Kim, & Mesquita, 2014). Nevertheless, in daily life, emotional covariation in romantic partners is sometimes negatively related to adjustment indicators (e.g., relationship satisfaction; Saxbe & Repetti, 2010 and

attachment; Butner, Diamond, & Hicks, 2007). Here, emotional covariation probably does not only reflect emotional similarity processes, however, but also emotional influencing.

## Emotional Influencing

Interpersonal emotional influencing refers to one individual's emotions predicting another individual's emotions over time, and is also known as *emotion transmission* (Larson, & Almeida, 1999), *susceptibility* (Randall & Schoebi, 2015), *cross-lagged covariation* (Butler, 2011), *crossover* (Westman, 2001), or emotion transfer (Parkinson, 2011). It is usually operationalized as the extent to which the (change in the) emotional experience of one person predicts the (change in the) emotional experience of another person at a subsequent time point, for instance by cross-correlations (e.g., Feldman, 2003) or prospective change models, and thus explicitly incorporates the process of one person's emotions feeding into another person's emotions across time (Larson & Almeida, 1999) [3]. For instance, people tend to bring home workplace-related stress, which impacts their partners' mood negatively (Westman, 2001; see also Chapter 7 for a review). Interpersonal influencing can result in augmentation, with emotions reinforcing each other across time or showing positive feedback loops (a change in one predicts a similar change in the other), or in blunting, with emotions counteracting each other across time or showing negative feedback loops (Pe & Kuppens, 2012; Reed, Barnard, & Butler, 2015).

Regarding the processes underlying emotional influencing, people can catch others' emotions through mirroring or mimicry processes (Hatfield et al., 1994) or the emotion of others can be evaluated and change one's own emotion through social appraisal (Parkinson & Simons, 2009). Also, people often share their emotions with others, which elicits similar

[3] It must be noted however that correlational findings cannot speak directly to the underlying mechanisms, and it is not possible to directly exclude if the change in a receiver's emotions following the sender's emotions has nothing to do with this sender's prior emotion. For instance, in certain cases cross-lagged associations can also result from person responding to a shared stimulus with different response times.

emotions in the listener (Rimé, 2009). Another possibility are coordination processes. For instance, during parent-child interactions, parents are sensitive to micro-shifts in their child's affective state and behavior and match their own (Feldman, 2007), which benefits the child's emotional development and regulatory capacities (Tronick, 1989). Coordination is not only considered fundamental for child development, but also for regulating and facilitating communication and relationships in adults (Feldman, 2007; Vallacher, Nowak, & Zochowski, 2005). For instance, when people are motivated to have a smooth and pleasant interaction with someone else, they adjust their own emotional state to the apparent state of this person (Erber, Therriault, & Wegner, 1996; Huntsinger, Lun, Sinclair, & Clore, 2009). Finally, emotional influencing can result from conscious or unconscious regulation processes (Zaki & Williams, 2013). For instance, people can explicitly try to reduce the stress their partner experiences in a certain situation by distracting him or her, or do it unconsciously.

Because emotional influencing can be indicative of different processes, it is difficult to make overall predictions about its associations with individual and relational adjustment. It is often seen, however, as a defining characteristic of intimate relationships (Butler, 2011; Schoebi & Randall, 2015). Emotional influencing indeed suggests closeness or interdependence between persons, with individuals being able to impact each other (Kelley, et al., 1983). Whether it goes together with more or less well-being might therefore be a function of which emotions or outcomes people end up experiencing due to this interdependence (Fitzsimons et al., 2015; Kelley, 1979). When influencing helps people to regulate their emotions better than they would do on their own, a positive association between emotional influencing and adjustment is expected, with the opposite being true for poorer emotion regulation. Imagine a patient who experiences a lot of anxiety when sitting in the waiting room before a painful treatment. If this patient's partner is present, the couple can start showing negative feedback loops between their emotions, resulting in the patient's negative

emotions being reduced. However, the couple can also show positive feedback loops, reinforcing each other's anxiety, with the patient ending up with even stronger negative emotions than when waiting alone. These feedback loops pertain to the concepts of coregulation and co-dysregulation (Butler & Randall, 2013; Reed et al., 2015; see also Chapter 3). Coregulation refers to an oscillating, bidirectionally linked and mutually dampening emotional influencing pattern, governed by negative feedback loops, that contributes to each person's emotional stability (Butler & Randall, 2013; Field, 1985; Sbarra & Hazan, 2008). Co-dysregulation on the other hand, refers to a positive feedback process in which partners' emotions are mutually amplifying, away from emotional stability (Reed et al, 2015). Thus, people can facilitate each other in regulating their emotions efficiently or on the contrary, hamper each other's emotion regulation. Thus, augmentation between negative emotions might be associated with maladjustment, whereas blunting of opposite-valence emotions could play a buffering role. Additionally, for psychological adjustment, it could matter if emotional influence is reciprocal (as in co-regulation) or if one person is more dependent and consistently accommodates the other's emotions, receiving worse outcomes as a result.

Research on emotional influencing and adjustment indeed reveals mixed findings. In daily life, mainly negative emotions seem to cross-over and the cross-over increases when the family is under chronic stress (Larson & Almeida, 1999). Relatedly, susceptibility of children to others' distress and parents' negative emotions has been related to poorer affect regulation abilities and social development (Eisenberg & Fabes, 1995; Kim, Conger, Lorenz, & Elder Jr., 2001). Also, negative affect reciprocity (negative emotions augmenting negative emotions) during conflict discussions mainly characterizes distressed romantic relationships (Gottman, 1998; Levenson & Gottman, 1983). However, focusing on overall affect, being influenced more by a romantic partner's emotions goes together with more cooperation (Randall et al.,

2013) and perspective taking (Schoebi, 2008). In parent-child dyads, affective coordination is crucial for child development as it positively predicts for instance the child's use of symbolic play and self-control later on (Feldman & Greenbaum, 1997; Feldman, Greenbaum, & Yirmiya, 1999). To our knowledge, only a few studies investigated cross-lags between opposite-valence emotions (Randall & Schoebi, 2015; Sels, Ceulemans, Bulteel, & Kuppens, 2016), showing that individuals whose negative emotions were predicted more by their romantic partner's previous positive emotions, showed less distress over a year (Randall & Schoebi, 2015), and that overall emotional influence in couples (including both cross-lags between similar and opposite-valence emotions) was positively related to higher individual adjustment in terms of life satisfaction but not depression (Sels et al., 2016). However, this association with life satisfaction was mainly driven by the extent to which people influenced their romantic partner's positive emotions, indicating that the valence of the emotions and being able to change or drive a partner's emotions versus being susceptible for a partner's emotions matters for associations with well-being.

## Emotional Variability

With interpersonal emotional variability, we move our focus to the interpersonal system level, which incorporates both individual and interpersonal emotional dynamics as well as their interactions. As in daily life, all these dynamics are likely to simultaneously exert their influence, studying the interpersonal system as a whole aligns more with reality, and is an important avenue for future research. Interpersonal emotional variability specifically is defined as the range and extremity of the interpersonal system's emotional states[4]. To our

[4] It does not include temporal dependency and moment-to-moment changes are thus not accounted for (e.g., Ebner-Priemer et al., 2009). Therefore, emotional variability differs from other constructs that were previously referred to as such, but that actually also include moment-to-moment fluctuations and thus more closely represent emotional instability or inertia (Ferrer, Steele, & Shieh, 2012; Hollenstein, 2015; Van der Giessen, Branje, Frijns, & Meeus, 2013; Van der Giessen et al., 2014).

knowledge, interpersonal variability as defined here has not been investigated before, but could be construed in different ways.

First, interpersonal emotional variability can be construed unidimensionally by computing the variance of the portion of emotional experience that is shared among different individuals. To this end one factor or principal component is extracted per dyad, which captures the shared emotional state of the interpersonal system (just as extracting one factor from different items that represent a scale reflects the shared variance of the scale items). To also take possible time dependencies into account, dynamic factor analysis (e.g., Ferrer & Nesselroade, 2003) or a time series version of the common fate model (Ledermann & Kenny, 2012; Ledermann & Macho, 2014) can be applied, after which the variance or standard deviation of the scores across time on the extracted latent variable can be calculated. Given its factor-analytic basis, a necessary condition for this unidimensional approach to work adequately is that the emotions of the partners involved covary to some extent.

Second, multidimensional measures can be used, based on research on socio-emotional development, where the set of emotional states an interpersonal system such as a parent-child dyad can be in, is called the emotional *state space* of the system (Granic & Lamey, 2002; Lewis et al., 1999). Concretely, for dyads, a two-dimensional state space grid is composed of two categorical variables that represent the different possible emotional states for each individual. Given this state space, the variability of the system is quantified by looking at the number of different states the system is in across time. Adopting this approach, it is not necessary that the emotions of the partners involved covary, but the amount of covariation does impact the variability score obtained. In case the emotional variables are continuous rather than categorical, we suggest to use other variability indicators, such as the generalized variance of the two individuals' experienced emotional experiences, which is a multivariate measure of variability (Wilks, 1932). Using this generalized variance,

interpersonal emotional variability is explicitly defined as a combination of both partners' individual variability, taking out the amount of overlap they show in emotional states (emotional covariation). Here, emotional variability becomes smaller when there is more concurrent covariation in partners' emotions. One other possible measure to assess interpersonal variability is *spin*, which is a measure originally developed to quantify how much fluctuation people show in the interpersonal circumplex (Moskowitz & Zuroff, 2004).

In both the unidimensional and multidimensional approach, interpersonal variability will be related to individual variability as well as interpersonal covariation. Specifically, in both cases the individual variabilities are positively related to interpersonal variability. However, conditional on these individual variabilities, the size of the interpersonal variability will decrease with lower interpersonal covariation in the unidimensional approach, whereas the multidimensional measures will increase.

Interpersonal emotional variability can be interpreted as a measure of the sensitivity of the system towards contextual changes. Low variability may reflect unresponsiveness towards environmental demands, as the system remains in one or a few specific emotional states[5] across time (Hollenstein, 2013). Therefore, we hypothesize that low variability relates negatively to well-being. On the other hand, high variability may reflect hypersensitivity to the context and failure to keep one's own and the other's emotions in check, indicating impaired (interpersonal) emotion regulation, which might also be considered maladaptive.

To our knowledge, interpersonal emotional variability and its association with well-being has not been studied yet, which reveals an important potential direction for future research. In research on dyadic flexibility (referring to transitions in and out of emotional states over time) in parent-child interactions and its associations with socio-emotional

[5] Under the prerequisite that people experience a similar amount of emotional stimulation (e.g. in experiments). Without keeping the external environment constant, low variability could also reflect that individuals do not encounter many emotion eliciting events.

development, a composite flexibility measure is mostly calculated (e.g., Hollenstein, 2015). These measures encompass variability and time-dependency of the system's states, and thus capture both emotional variability and inertia. As flexibility is defined as the opposite of dyadic rigidity, the findings of this line of research will be discussed in the next section.

## Emotional Inertia

Emotional inertia refers to emotional experiences carrying over from one moment to the next, indicating an interpersonal system's self-predictivity and resistance to change. Again, interpersonal emotional inertia can be investigated in a uni- or multidimensional way, and consists of both intrapersonal and interpersonal dynamical aspects.

The unidimensional approach operationalizes interpersonal emotional inertia as the autocorrelation of the interpersonal system's scores on the extracted shared emotions factor. This measure is affected by how much the individuals' emotions persist over time and their covariance. The autocorrelation captures the degree to which the current level of shared emotions can be predicted by its level at the previous time point, with a higher autocorrelation reflecting a more self-predictive emotional system. As was the case for emotional variability, this unidimensional approach is only meaningful if individuals' emotions covary at least to some extent.

A multidimensional version of emotional inertia involves the tendency to linger in a specific emotional state. In case of continuous data, interpersonal inertia could be captured by a measure that combines the individuals' autocorrelations and how much their emotions are predicted by the other people's previous emotions (cross-correlations). Interpersonal emotional inertia will thus be highest for interpersonal systems whose members show high individual inertia and high emotional influencing. For categorical data, state space grid

measures can be used, such as the duration that a dyad remains in a certain emotional state or cell, or the distance between consecutive emotional states (Hollenstein, 2013).

Theoretically, we expect emotional inertia to reflect a reduced ability to regulate both one's own and each other's emotions back to baseline levels, and decreased emotional recovery. The system gets "stuck" in a certain state, becomes more self-predictive, and therefore less responsive to external and internal demands and regulation efforts. Consequently, it indicates rigidity instead of resilience, which is often viewed as a hallmark of dysfunctional systems. For instance, in family system theories, a functional family system is conceived as a system that is able to appropriately adapt to both external and internal demands. Closed, rigid systems (as seen in dysfunctional families) have impermeable boundaries, and thus fail to interact with the outside environment, becoming resistant to change (e.g., Goldenberg & Goldenberg, 2012; Minuchin, 1974, 1985). Therefore, we hypothesize high interpersonal emotional inertia to relate to maladjustment.

As mentioned above, interpersonal flexibility is considered to be the opposite of interpersonal rigidity, and has been extensively studied (for an overview, see Hollenstein, 2015). More concretely, flexibility in dyads is defined as a combination of the amount of states a dyad switches between and the ability to move quickly between different emotional states (e.g., Hollenstein & Lewis, 2006). Recently, it has been advocated that dyadic emotional flexibility and individual emotional inertia are reciprocally related to each other: a change in an individual's emotional flexibility generates a change in the dyad's flexibility and vice versa (Mancini & Luebbe, 2016). More flexibility in parent-child dyads has been found to go together with, and to predict more adaptive functioning in children and adolescents, as evident by less externalizing and internalizing problems (Hollenstein, Granic, Stoolmiller, & Snyder, 2004; Van der Giessen, Hollenstein, Hale III, & Branje, 2014). Because interpersonal

inertia is partly determined by each person's individual inertia, the findings on interpersonal flexibility support our hypothesis on the maladaptivity of interpersonal inertia.

Additionally, Gottman et al. have shown by the use of advanced mathematical methods that intrapersonal emotional inertia in combination with certain patterns of emotional influencing seem characteristic for distressed marriages (Gottman, Swanson, & Murray, 1999). They invited married couples in their lab to discuss a problem that was a source of continued disagreement, coded the emotions that these couples expressed during the conversations, and did a follow-up on the couples' marital status. It turned out that couples that were high in individual inertia and that showed mismatches in the emotional influence patterns they exhibited on each other, were particularly prone for divorce.

## Discussion and Future Directions

The purpose of this chapter was to propose a systematic taxonomy that captures key characteristics of interpersonal emotional dynamics, each providing unique information about the dynamical unfolding of emotions between different people across time. These characteristics reflect ways in which people experience, influence, and regulate their own and others' emotions, which may shed light on psychological and relational functioning.

Separately discussing each dynamic characteristic and associations found with (mal)adjustment revealed important gaps in existing research. First, much remains unknown about the precise contexts that result in positive versus negative associations between interpersonal interwovenness and adjustment. For instance, interpersonal emotional covariation and influencing may only indicate coordination or coregulation if people's emotions are also oscillating in a coordinated stable pattern (Butler & Randall, 2013; Vallacher et al., 2005). Also, it is important to know if the direction of interpersonal covariation is positive or negative, if emotional influencing is unidirectional or bidirectional, if there is high interpersonal emotional variability because of low emotional covariation or

not, et cetera. In addition, while emotional variability and emotional inertia have been studied extensively in the context of intrapersonal emotion dynamics, they remain to be explored as dynamic characteristics of interpersonal systems. We hope that we have given some starting points for how these dynamical characteristics can be understood and investigated. More generally, there is a need for integration between intrapersonal and interpersonal emotion dynamic disciplines, because these dynamics do not operate fully independently from each other; which also became evident in the multidimensional operationalization of emotional variability and inertia (see also Chapter 10).

Finally, it needs to be underscored that the timescale on which emotions are assessed plays a critical role in interpersonal emotion dynamics, and how data can be interpreted (see also Hollenstein et al., 2013). First, it is well known that emotion dynamic characteristics observed on short time scales such as second by second (e.g., unfolding of initial response) can be driven by sometimes similar, but often also very different processes than characteristics observed on longer time scales (e.g., moods; Koval et al., 2013). Second, the timescale on which emotions are observed may sometimes obscure the processes really taking place. As mentioned above, people's emotions can seem to covary on time scales such as daily or hourly assessments, due to people's emotions influencing each other on shorter timescales. Caution is therefore needed in interpreting such results.

Interpersonal emotion dynamics are inherently complex, and we zoomed in on four basic dynamic characteristics, to be able to define logical relations and hypotheses in a manageable way without requiring very advanced mathematical skills. Still, one of the key characteristics of dynamic systems is nonlinearity (Lewis, 2000), and for future research it is important to incorporate non-linear extensions and patterns to provide a complete and nuanced picture of interpersonal emotion dynamics. For instance, one could focus on interpersonal linkages in cyclical changes unfolding across a longer time span (Butner et al.,

2007). To investigate such cyclical patterns, we refer the interested reader to coupled oscillator models as described in chapter 3 (Butner et al., 2005) and coupled nonlinear difference equations (Cook et al., 1995; Gottman et al., 2002). Other possibilities to investigate more complex nonlinear processes, are the use of exploratory techniques (Ferrer, 2016), threshold autoregressive (TAR) models (Hamaker, Zhang, & Van der Maas, 2009), or models that allow for time-varying changes in interpersonal associations (Chow, Haltigan, & Messinger, 2010).

In conclusion, the characteristics of interpersonal emotion dynamics are important indicators of psychological and relational functioning. However, future research is needed to test more nuanced hypotheses about which combinations of dynamical characteristics precisely reflect adaptive or maladaptive functioning. It has recently been advocated that interpersonal emotion dynamics not only flag important relationship processes (Schoebi & Randall, 2015), but also contribute to partners' health and adjustment (Butler & Randall, 2013), providing important insights in couple functioning. This will bring us closer to a true understanding of the far reaching social dimension of emotions, and to developing successful clinical interventions for improving human relationships.

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