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ORIGINAL ARTICLE

A Dynamic Dyadic Systems Approach to Interpersonal Communication

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This article articulates conceptual and methodological strategies for studying the dynamic structure of dyadic interaction revealed by the turn-to-turn exchange of messages between partners. Using dyadic time series data that capture partners' back-and-forth contributions to conversations, dynamic dyadic systems analysis illuminates how individuals act and react to each other as they jointly construct conversations. Five layers of inquiry are offered, each of which yields theoretically relevant information: (a) identifying the individual moves and dyadic spaces that set the stage for dyadic interaction; (b) summarizing conversational units and sequences; (c) examining between-dyad differences in overall conversational structure; (d) describing the temporal evolution of conversational units and sequences; and (e) mapping within-dyad dynamics of conversations and between-dyad differences in those dynamics. Each layer of analysis is illustrated using examples from research on supportive conversations, and the application of dynamic dyadic systems analysis to a range of interpersonal communication phenomena is discussed.

Keywords: Configural Frequency Analysis, Dyadic Interaction Analysis, Sequence Analysis, Social Support, State Space Grids

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The study of interpersonal communication is founded on the notion that people engaged in dialogue encode thoughts into symbols and draw inferences from each other's behavior. Particular research traditions emphasize message production or processing, verbal and nonverbal actions; and individual, relational, or cultural factors that affect and are affected by interpersonal communication (see Knapp & Daly, 2011). Across this array of work, conceptions of dyadic interaction are

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surprisingly coherent. Communication scholars accept as axiomatic that conversational partners participate in an interdependent system, that partners' thoughts and behaviors are mutually influential, and that the outcomes of interaction are a byproduct of the dyadic exchange. Despite widespread endorsement of these basic principles, however, research on what happens between partners during interactions to produce conversational outcomes is surprisingly scant. We hope to stimulate research on the dyadic essence of interpersonal communication by offering conceptual and methodological strategies for interrogating the dynamic structure of dyadic interaction.

Our efforts build upon pioneering work on dyadic interaction, including Cappella's (1987) exploration of mutual influence, and Burgoon, Stern, & Dillman's (1995) analysis of antecedent conditions and interaction experiences that predict patterns within conversation. These and other contributions have illuminated details about types of communication episodes, such as conflicts (e.g., Courtright, Millar, Rogers, & Bagarozzi, 1990) and "getting to know you" conversations (e.g., Kellermann & Lim, 1990). The dynamic nature of conversation is also at the heart of many diverse interpersonal communication theories (e.g., communication accommodation theory; Giles, Coupland, & Coupland, 1991; uncertainty reduction theory, Berger & Calabrese, 1975). Existing theoretical frameworks and empirical work provide important and enduring insights about interpersonal interaction.

Despite these contributions, research on interpersonal interaction, *per se*, is uncommon within the communication discipline. The reasons are not hard to discern: the study of dyadic interaction is prohibitively laborious and expensive, and the computational tools for modeling interactions are nascent. Thus, researchers have adopted modes of inquiry that make the study of dyadic interaction feasible. Some studies isolate particular utterances from the complex stream of conversation to test discrete message effects (e.g., Holmstrom & Burleson, 2011). Other research assesses features of communication that characterize conversations as a whole, rather than the specific messages delivered within those conversations (e.g., Sillars et al., 2014). Discourse analytic strategies forego larger samples and claims of generalizability to delve into the nuances of interaction (e.g., Robinson, 2003). All of these approaches have made important contributions to theory and research on interpersonal communication, but many questions about the dynamics of dyadic interaction remain unanswered.

Our goal is to advance a paradigm for studying dyadic interaction. We adopt a dynamic systems perspective (Boker & Laurenceau, 2007; Han & Lang, 2019; Thelen & Smith, 1994) wherein conversation partners are seen as entities that mutually influence each other as part of a dyadic system. Notably, we do not focus on micromomentary aspects of conversations or the overlay of behaviors that partners enact within conversation. Instead, we emphasize the interdependent, back-and-forth exchange of messages, and how operationalizations of dyadic dynamics are linked to the pragmatic outcomes of interpersonal communication. This perspective is not novel (see Coleman, Vallacher, Nowak, & Bui-Wrzosinska, 2007), but the

relative lack of research on the dynamics of dyadic interaction suggests that concrete examples of how to ask and answer these types of questions has value for the communication discipline. Thus, we offer a dynamic dyadic systems approach to encourage and enable new modes of research on interpersonal communication.

Scope conditions

To begin, we note four important scope limitations. First, our focus is on dyadic interactions that are organized around particular pragmatic functions. Although "passing the time" or "social engagement" might meet that bar, our thinking is most applicable to goal-oriented, strategic exchanges in which one or both partners intentionally seek to affect the other. Under this umbrella, we consider supportive communication, interpersonal influence, and conflict interactions as exemplars, without excluding communication that reduces uncertainty, facilitates decision making, conveys affiliation or dominance, expresses or negotiates identity, manages privacy boundaries, or addresses other activities.

Second, we examine dyadic interplay that is grounded in the interdependent turn-to-turn exchange of messages between partners. Substantial work has productively examined the synchrony and asynchrony of conversation partners' actions (e.g., Giles *et al.*, 1991), how individuals' subjective experiences change within conversations (e.g., Worley & Samp, 2018), and the expression or experience of emotion during conversation (e.g., Butler, 2011). Our perspective privileges the pragmatic force of speaking turns and turn-to-turn exchanges to reveal the dynamic dyadic qualities of conversation.

As a third scope condition, we observe that the study of dynamic dyadic patterns requires intensive repeated measurement of two partners who are interacting with one another. The quintessential dataset contains information about each partner's actions as they participate in an interaction that unfolds over time (i.e., dyadic time series data). Importantly, we do not prescribe the medium and setting in which the interaction occurs. In this article, we draw upon laboratory observation data derived from videotaped interactions between two partners engaged in a supportive conversation. Data derived from interactions that unfold through texting or other computer- or technology-mediated channels could also be used. The criterion is that the data capture the back-and-forth exchange between partners that reveals dynamic patterns of behavior.

Finally, our thinking emphasizes how partners are both autonomous and interdependent as the interplay of their messages builds a conversation in real time. As in improvizational theater, each person has the latitude to craft their contribution to the dialog, and each person's speaking turns are both responses to the partner and stimuli to which the partner responds. In other words, each turn is both contingent on what has occurred before and an innovation that shapes future turns. Together and over time, partners create an exchange that is emergent and adaptive. This view of conversation hearkens back to Goffman's (1956) view of interpersonal interaction

as a theatrical performance in which people enact identities in collaboration with each other. Building on this metaphor, our approach emphasizes how the dynamics of an interaction unfold as each person communicates in response to and in collaboration with the other.

The five layers of inquiry we outline below are intended to identify and illuminate the patterns of behavior and behavioral contingencies that give shape to dyadic interactions. Notably, our exposition here focuses on the conceptual issues and affordances associated with a dynamic dyadic systems approach. Detailed coverage of the analytic procedures used to implement the approach are elaborated elsewhere (https://lhama.la.psu.edu).

Dynamic dyadic systems analysis

Following the depiction in Figure 1, we organize dynamic dyadic systems analysis into five layers of inquiry, each of which yields theoretically relevant information. The first layer of analysis clarifies the types of conversational moves that each partner enacts (i.e., speaking turns) and where they exist in the conversational landscape. The resulting descriptions provide answers to theoretically meaningfully questions about what turn behaviors are relevant to mapping the particular type of conversation and are, thus, foundational to analysis in subsequent layers. The second layer of analysis then reveals where in the conversational terrain mapped out in Layer 1 dyads usually spend their time. Theories that address the prevalence of particular turn types (e.g., giving advice, expressing criticism, making an apology) or

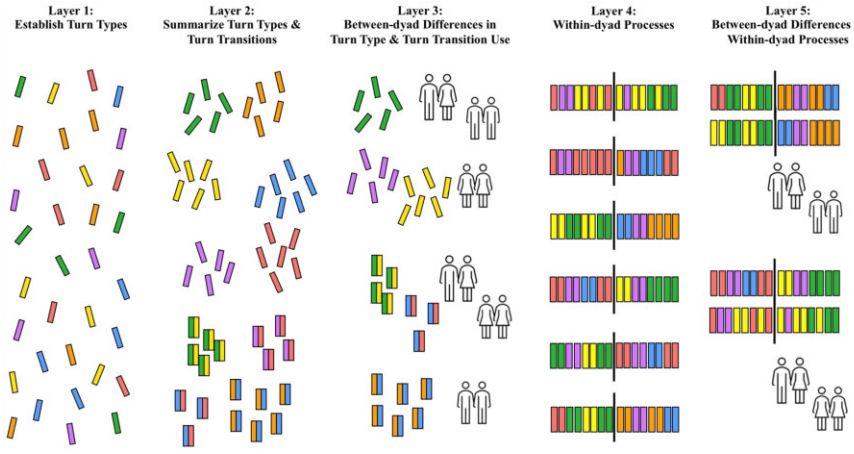

Figure 1 Summary of the layers of dynamic dyadic systems analysis. In this figure, each rectangle symbolizes a speaking turn, and different colored rectangles indicate turns with distinct content. Joining two rectangles together, as in Layer 2, symbolizes turn-pair combinations or sequences. When ordered into rows, as in Layer 4, the rectangles reflect within-dyad sequences of speaking turns, which can vary over time within conversations.

turn-sequences (e.g., demand-withdraw, dominate-submit) are tested at this layer. The third and fourth layers build on the second layer by examining differences in the prevalence of turn types and turn-to-turn sequences between-dyads and within-dyads. The third layer includes tests of theoretical predictions concerning any variety of individual or dyad differences in the antecedents or outcomes of conversational behaviors. The fourth layer provides insight into phase models of conversation that capture how particular types of interactions unfold (e.g., initial interactions, conflict negotiations, collaborative problem-solving discussions). The final layer combines insights from the previous layers to inform tests linking multi-turn conversational sequences to differences between-dyads, while appreciating that the prevalence, antecedents, and consequences of these sequences can vary within-dyad in dynamic ways.

In the sections that follow, we elaborate the purpose and possibilities afforded in each layer, and we illustrate some of those possibilities using data derived from laboratory observations of dyadic interactions in which people (i.e., Disclosers) discussed a source of stress with a partner (i.e., Listeners) for 5 minutes (see Bodie *et al.*, 2021 for details). The interactions were transcribed, vocal content was segmented into utterances, and utterances were coded for the presence/absence of verbal response modes characteristic of therapeutic interactions (per Stiles, 1992). The utterance-level codes informed a typology of six speaking turns that were used by both Disclosers and Listeners: *acknowledgement*, conveying receipt of the other's message; *advice*, making suggestions or giving directions to guide the partner; *question*, requesting information or guidance; *elaboration*, disclosing thoughts and stating objective information; *reflection*, putting the other person's experience into words and, to a lesser extent, explaining, labeling, or evaluating the other's experience; and *hedged disclosure*, qualifying elaboration statements with filled pauses and sentence fragments (e.g., "I mean," "I don't know"). (Supplemental Figure S1 offers further detail and examples.) Our example illustrations for each layer of dynamic dyadic systems analysis use the speaking turn data derived from ($N = 118$) interactions between strangers, and four exemplar dyads that represent two different relationship types (strangers and friends) and conversations that ranged in supportiveness (as indexed by pre- to post-conversation changes in the Discloser's reported emotional state). All analyses reported subsequently were conducted using R (R Core Team, 2020; see also https://lhama.la.psu.edu).

Layer 1: Identifying the moves and spaces that define the topography of dyadic interaction

The study of conversational dynamics begins to reveal the topography of interactions by identifying the behaviors appropriate for pattern analysis, operationalizing theoretically meaningful variables to index individuals' speaking turns, and specifying dyads' conversational spaces. Theoretical accounts of particular types of interpersonal communication episodes often clarify the relevant building blocks of

interaction. As noted, our study of supportive conversations (Bodie *et al.*, 2021) drew from Stiles's (1992) theorizing about therapeutic counseling interactions to code utterances for grammatical form and pragmatic intent (i.e., *verbal response mode*). Research on interpersonal influence might index turns with respect to explicitness, argument, and dominance, given the relevance of those features to the outcomes of persuasive appeals (Dillard, 1990). Studies of conflict interactions could focus on tactics evident in utterances or speaking turns or on a tendency toward constructive *versus* destructive and direct *versus* indirect messages (e.g., Canary, Cunningham, & Cody, 1988; Courtright *et al.*, 1990; Sillars, 1986).

As these examples suggest, individuals' conversational behaviors can be represented by either category codes or dimensional ratings, and the units of coding can be utterances within turns or whole speaking turns. Of course, different methods are needed when further analyzing conversational behaviors operationalized using non-continuous, categorical variables versus dimensional ratings. Our examples make use of the former, but the latter can also be used effectively and efficiently. Supplemental Table S1 provides a broad sketch of the types of analytical methods that can be employed for each layer of analysis when using categorical versus dimensional data. Ultimately, the specific operationalization employed in a given study should be driven by theory. For example, theoretical perspectives emphasizing distinctions between expressions of sarcasm versus anger during conflict interactions (Miron-Spektor, Efrat-Treister, Rafaeli, & Schwarz-Cohen, 2011) may require construction and use of categorical variables, whereas other theoretical perspectives emphasizing how communication during conflict is more or less constructive or destructive (Rusbult, Verette, Whitney, Slovik, & Lipkus, 1991) may require construction and use of continuous variables. In all cases, the objective is to operationalize each partner's contribution to an ongoing interaction as represented in conversational moves at the level of the speaking turn.

Once operationally defined, characteristics of speaking turns can be used to illuminate conversational movements. To illustrate, we focus on the data from the four example dyads previously identified, and we offer two strategies for exploring these conversational landscapes. The first strategy highlights the back-and-forth exchange of the conversation. The second strategy emphasizes the interdependence between partners as they construct their conversation over time. Both strategies shed light on the temporal structure of dyadic conversations.

In the left column in Figure 2, the two conversations between friends are depicted as sequences of Discloser and Listener turn types (see Supplemental Figure S2 for similar representations of two conversations between strangers). This visualization of the data offers several insights. For example, the interaction which left the Discloser feeling better, Friend Dyad 81 (indicated by "+"), generated fewer and longer turns during the 5-minute interaction, compared to the more rapid back-and-forth evident in Friend Dyad 48. We also see that the Listener in Friend Dyad 48 asked noticeably more questions compared to the Listener in the other friend

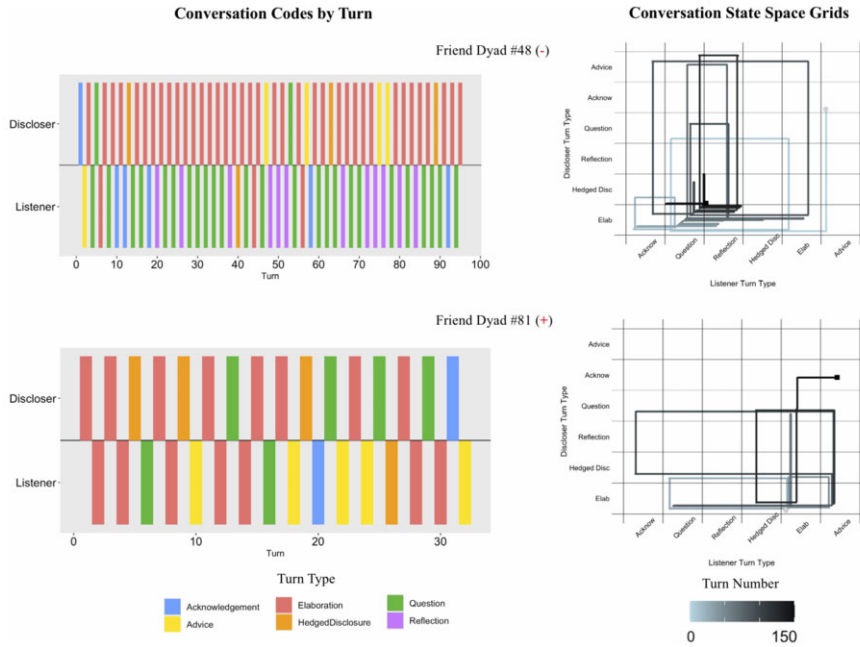

Figure 2 Dyadic time series data and state space grids for two conversations.

dyad. Gestalt-level observations, such as these, highlight some of the many ways that conversations might differ.

The interdependence between conversational partners is further revealed by examining turn-to-turn transformations dyadically using *state space grids*. Conceptually, state space grids are improvizational spaces defined by the choices available to each partner and show the dyadic states that emerge over time as a function of those individual choices (e.g., Lougheed, Brinberg, Ram, & Hollenstein, 2020). The right column of Figure 2 shows how each dyad moves through the conversational landscape over time using state space grids. To facilitate interpretation, Listener turn types are indexed along the *x*-axis, ordered from the turn type that is most aligned with the Listener's role (acknowledgement) to the type that is the least aligned (elaboration), and advice (which was very low frequency). Discloser turns are indexed on the *y*-axis, ordered with respect to alignment with the Discloser's role (elaboration to acknowledgement) and advice (low frequency). Points placed across the cell array indicate all specific two-turn sequences, Listener–Discloser and Discloser–Listener, that the dyad used in the conversation. Lines connecting those turn transitions together indicate how the dyad traveled through the conversational space. Specifically, beginning with the point representing the first turn transition in the conversation, the lines indicate the sequence of conversational moves (from the transition between turn t and turn $t+1$ to the transition between turn $t+1$ and $t+2$) made by each member of the dyad as they co-constructed the conversation.

Horizontal lines showing the Listener's moves and vertical lines showing Discloser's moves get darker over time, and they are displaced slightly to highlight repeated movement to specific types of turn pairs. Altogether, the points and lines on the grids show how dyads transitioned from one state to another as the conversations unfolded over time.

The state space grids shown in the right side of Figure 2 highlight the possibility to examine how a dyad moves through the conversational landscape, and between-dyad differences therein. In Friend Dyad 48, for example, we see that turn types at the beginning of the conversation are highly variable (the light blue lines), but most of the turn types at the end of the conversation are located in the Discloser elaboration and Listener question and reflection cells (black lines). In comparison, the conversation in Friend Dyad 81, which had fewer turns overall, spent more turns in the bottom right quadrant of the space state grid, especially toward the end of the conversation (dark blue lines); this area of the state space grid is where the dyad is engaged in mutual information sharing, and the Listener also offers advice. In these ways, state space grids reveal common states, prominent transitions between states, and overtime changes in the prominence of those qualities.

This first layer of dynamic dyadic systems analysis provides an essential foundation for subsequent analyses. Drawing upon theory, previous empirical studies, and existing coding schemes, researchers are tasked with identifying the appropriate and meaningful building blocks that partners use to enact the specific type of conversation under analysis. Whether meaningful information is embedded in utterances (within turns) or in speaking turns, this step operationalizes time series data at the unit of analysis that aligns with the back-and-forth exchange between partners. Displays of these data, using time series and state space grids, inform descriptive insights that can address substantive theoretical questions and also form the building blocks for subsequent layers in dynamic dyadic systems analysis.

Layer 2: Summarizing conversational units and sequences

Important questions about interpersonal communication can be addressed by examining the speaking turns and turn sequences that are prominent within dyadic interactions. In influence interactions, making arguments, providing evidence, and sequencing compliance-seeking requests are assumed to affect persuasion outcomes (reviewed in Dillard & Knobloch, 2011). Research on conflict interactions, using self-report data or wholistic ratings of conversational patterns, suggests that demand/withdraw tendencies are an especially consequential interaction dynamic (e.g., Sillars *et al.*, 2014). To test hypotheses such as these, a dynamic dyadic systems approach examines the distributional properties of communication phenomena indexed at the level of the speaking turn and summarizes turn sequences throughout the conversation.

To illustrate, we again focus on the two friend dyads (see Supplemental Figure S3 for the two stranger dyads), and we also analyze all of the 118 stranger dyads

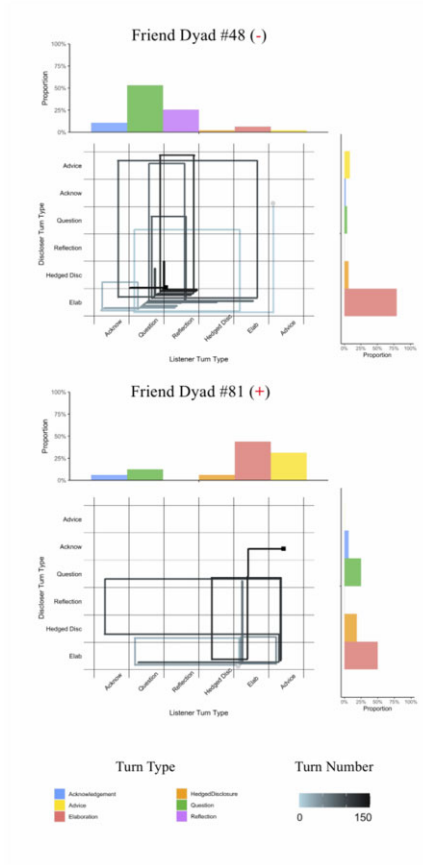

Figure 3 Summaries of the types of turns and turn transitions present in two supportive conversations.

reported in Bodie *et al.* (2021). Figure 3 shows the state space grids for the two friend dyads framed by histograms describing the proportion of each turn type enacted by each conversational partner. Differences between-dyads in the turn types used by Listeners are evident. Although the Listener in Friend Dyad 48 primarily asked questions (53%) and engaged in reflections (26%), the Listener in Friend Dyad 81 engaged primarily in elaborating (44%) or giving advice (31%). These graphics also reveal similarities and differences between-dyads in the turn types used by Disclosers. Although both Disclosers spent most of the conversation elaborating on their problem (50–82% of turns), the Discloser in the more supportive conversation (#81) engaged in question and hedged disclosure turns, as well. In these ways, the data shed light on the overall structure of dyad members' contributions to their conversation, as well as similarities and differences that may be theoretically meaningful.[1]

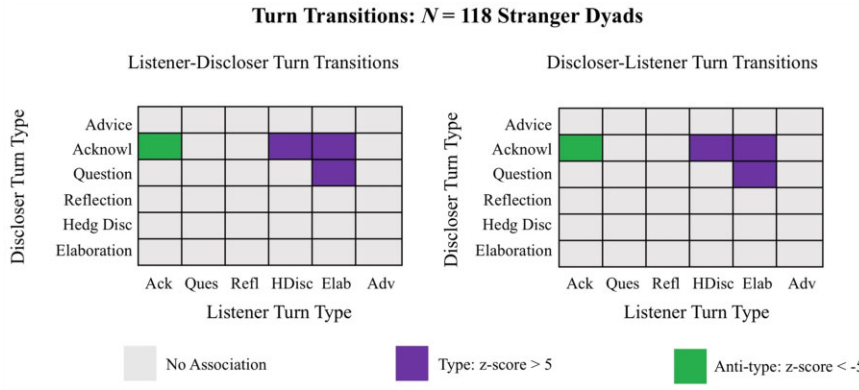

Figure 4 Configural frequency analysis results from the analysis of strangers' turn transitions.

We can also compute the prevalence of the different turn transition pairs within a set of conversations. Using the four example dyads, we examined the relative occurrence of all possible Listener-to-Discloser and Discloser-to-Listener turn transitions (see Supplemental Figure S4). The most common Listener-to-Discloser transitions were acknowledgement–elaboration turn pairs (15%), question–elaboration turn pairs (21%), and reflection–elaboration turn pairs (20%). The Discloser-to-Listener turn transitions mirrored this pattern: The Discloser elaboration turns were primarily followed by Listener acknowledgement turns (19%), Listener question turns (17%), and Listener reflection turns (20%). These turn transition pairs reflect the fact that Disclosers spent a majority of the conversation using elaboration turns.[2]

We may also wish to identify the specific turn transitions that occur more or less frequently than expected by chance. When the characteristics of turns are indexed as categorical data, this can be done using *configural frequency analysis* (see Stemmler, 2020). To illustrate, Figure 4 shows the results of configural frequency analyses of both Listener-to-Discloser sequences and Discloser-to-Listener sequences using data from the full stranger dataset (118 dyads). In these matrices, the highlighted cells indicate the particular turn-to-turn sequences defined by row-to-column transitions that occurred more (purple = *types*) or less (green = *anti-types*) frequently than would be expected by chance.[3] In the left grid in Figure 4, we can see that three Listener-to-Discloser turn transitions occurred more frequently than expected by chance: hedged disclosure–acknowledgement, elaboration–acknowledgment, and elaboration–question. In addition, one Listener-to-Discloser turn transition occurred less frequently than expected: acknowledgement–acknowledgement. The right grid in Figure 4 highlights the reciprocal Discloser-to-Listener types and anti-type, indicating the prominence of acknowledgement–hedged disclosure, acknowledgement–elaboration, and question–elaboration pairs, as well as the infrequency of Discloser-to-Listener acknowledgement–acknowledgement turn

transitions. Apparently, Disclosers were prone to respond to Listeners' hedged disclosures and elaboration with acknowledgements and questions, and Listeners were prone to respond to Discloser acknowledgements and questions by continuing to share their experiences and point of view. These patterns suggest that Listeners and Disclosers might both be drawn into emergent sequences that take the focus off of the Discloser and direct attention to the Listener.

As our examples demonstrate, the second layer of dynamic dyadic systems analysis illuminates the overall landscape of interactions through examination of the substance and sequences of speaking turns that manifested over entire conversations. Tools for this step include visualization and summarization of the aggregated turn-by-turn data (frequencies, means, variances) and summaries of the turn-to-turn transitions (frequencies, proportions). Configural frequency analysis and other counterpart methods[4] can be used to test theoretically grounded hypotheses about behavioral contingencies in dyadic interaction (e.g., demand-withdraw communication, Caughlin & Scott, 2010; communication and relational control, O'Hair, 1989). Thus, this step can contribute to testing theoretically deduced hypotheses about the content and structure of conversations as a whole.

Layer 3: Examining between-dyad differences in speaking turns and sequences

Theoretical traditions in the communication discipline often consider how contextual features (e.g., relationship type, power structure, culture) contribute to the topography of interpersonal interactions (Berger, 2014). In addition, differences between conversations are assumed to produce differences in outcomes, such as emotional improvement, conflict resolution, or attitude change (Greene & Burleson, 2003). The third layer of dynamic dyadic systems analysis is focused on evaluation of differences between dyads.

A first step is to theorize the relevant dyad-level antecedent or outcome variables and, when possible, to advance hypotheses concerning how these variables relate to conversational behavior. Research on supportive conversation, for example, is informed by Burleson and Goldsmith's (1998) theory of conversationally induced reappraisal, which draws heavily from appraisal-based theories of emotion. According to this framework, the genesis of emotional distress is not in some external event, but rather in how that event is evaluated as assisting or interfering with the accomplishment of personal goals. When an event is appraised as interfering with the accomplishment of personal goals, the individual can become distressed. Support providers thus assist with coping by helping the distressed other modify or change the appraisals that underlie emotional distress. The theory posits that coping is assisted by conversations during which Disclosers describe their experience, elaborate on their situation, and develop less distressing appraisals of their circumstances. Based on this theory, we would expect the profile of turns and turn transition pairs to differ between conversations that ultimately benefit versus fail to benefit people in a stressful situation. Specifically, we can reasonably hypothesize that

Disclosers experience more emotional improvement when they spend the conversation disclosing, elaborating, and reflecting on their situation, and when they interact with a Listener who encourages disclosure through questions, acknowledgements, and reflections.

To demonstrate how to examine differences between-dyads in turn transitions, we conducted two configural frequency analyses using the stranger dyads from Bodie *et al.* (2021) for which we had the Discloser's pre- to postconversation change in distress ($N = 117$). First, we examined the prevalence of Listener-to-Discloser turn contingencies for dyads that were identified as either "supportive" ($n = 88$; Discloser change in distress < 0) or "unsupportive" ($n = 29$; Discloser change in distress ≥ 0).[5] Then, we identified the turn transition patterns that differed significantly between the two groups using a two-sample configural frequency analysis (per Stemmler, 2020; here, the group-level aggregation provides statistical power to detect moderate effects, $d > 0.5$). Results are shown in the top and bottom parts of Figure 5, respectively.

Three Listener-to-Discloser types were unique to the supportive dyads: acknowledgement–hedged disclosure, elaboration–reflection, and hedged disclosure–acknowledgment. The first two of these contingent pairs align with the theory of conversationally induced reappraisals, which suggests that encouraging Disclosers to share and reflect on their experiences leads to emotional improvement (Burleson & Goldsmith, 1998). In addition, two Listener-to-Discloser anti-types unique to the supportive dyads revealed the low frequency of question–acknowledgement and elaboration–hedged disclosure sequences. As anticipated by the theory, these anti-types suggest that minimalist responses to questions and turn pairs where each person focused on their own experience were less common in supportive exchanges. Finally, the one Listener-to-Discloser sequence that was uniquely more pronounced in unsupportive conversations, advice–acknowledgement, coheres with claims that advice can have negative consequences in supportive conversations (MacGeorge *et al.*, 2016).

Results from a two-sample configural frequency analysis (in the bottom part of Figure 5) suggest that the supportive and unsupportive conversations differed in the use of one type of turn transition, such that supportive conversations did not use the Listener acknowledgement–Discloser elaboration transition as much as the unsupportive conversations. This finding runs counter to theory by suggesting that Listener turns that encourage Discloser elaboration lead to less supportive outcomes and, thus, invites formulation of more specific questions about how particular conversational moves affect emotional improvement. More generally, our illustrative examinations of the prevalence of turn transitions across groups of dyads demonstrate how this third layer of dynamic dyadic systems analysis interrogates similarities and differences between theoretically meaningful groups. Using these techniques, researchers could examine differences in turns and turn sequences associated with any variety of antecedent or outcome variables.

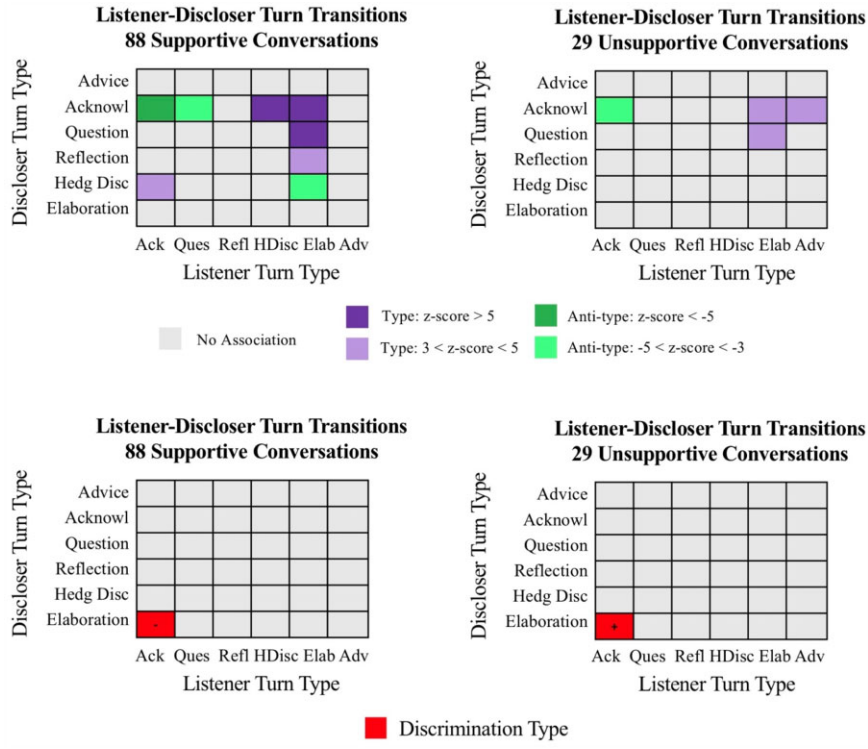

Figure 5 Descriptions of supportive and unsupportive dyads using configural frequency analysis. Because statistical power of the one-sample analyses was greater for the larger sample of supportive conversations, we used two thresholds to identify nonrandom turn pairs; contingencies exceeding $|z| = 5$ are in a darker shade of purple or green, and those meeting a lower threshold ($|z| > 3$) are signified by a lighter shade of those colors.

Layer 4: Describing the temporal evolution of conversational units and sequences

Aggregated descriptions of the prevalence of turn types and turn pairs at the conversation-level obscure whether specific conversational moves occur more or less often at different points in an interaction. Formally, the summarizing calculations assume stationarity in transitional properties across the conversation (see Boker & Martin, 2018). The communication discipline offers numerous examples of how conversations evolve (i.e., are nonstationary), such as when partners progress through an initial interaction (Kellermann & Lim, 1990), group members make a decision (Seibold & Meyers, 2007), or patients consult with a doctor (Robinson, 2003). Thus, the fourth layer of dynamic dyadic systems analysis considers the temporal distribution of conversational units and sequences.

Jefferson (2015) offered a theoretical account of the functional sequences that give form to supportive conversations that she called "troubles talk." The conversations reported in Bodie *et al.* (2021) likely manifest the three middle phases of

Jefferson's six-stage model: delivery, work-up, and close implicature. *Delivery* is the phase when partners collaborate to elucidate the problem through Listener questions, Discloser descriptions of the situation, and Listener acknowledgements. During the *work-up*, partners probe the issue for a deeper understanding by considering causes, consequences, options, and related experiences. Speaking turns prominent in the work-up phase should include further Discloser descriptions and Listener questions and acknowledgments, whereas Discloser elaboration and reflection turns should also make an appearance during this phase of the interaction. Jefferson proposed that the work-up is followed by *close implicature*, during which partners make projections about the future, integrate the problem into everyday events, and lighten the mood to signal the end of the focus on the problem. *Close implicature* should involve a decrease in Listener questions and Discloser elaborations and disclosures, whereas Listeners share their experiences and offer reflections, acknowledgement, and perhaps advice.

To evaluate how the conversations of our four example dyads align with Jefferson's prototypical sequence of troubles talk, we compared the frequency of the six turn types in the first, middle, and final third of the conversations. Parsing the conversations into thirds is an admittedly crude way to capture the three phases of troubles talk that our data likely represent (see also, Rains *et al.*, 2021). Indeed, this approach ignores variation in turn duration, the total number of turns, and progression through the theorized phases. In practice, we suggest that researchers segment conversations in ways that more cogently align with theoretically meaningful developmental phases; for example, coders could identify the specific points at which each conversation actually transitions between the phases specified by Jefferson (2015). Regardless of how conversational phases are identified, this layer of analysis examines how conversational turn types and sequences vary across those phases.

The descriptives (shown in Figure S5) indicate that Disclosers' speaking turns were mostly characterized by elaboration in all three segments of the conversation. In contrast, the Listeners' speaking turns shifted over the course of the conversations; most notably, reflection turns increased over the course of the conversations, questions were less prominent in the final third of the conversations; and elaboration turns were most frequent in the middle third of the conversations. As anticipated by Jefferson's (2015) model, Listener question turns were prominent during the first and middle parts of the conversations (i.e., delivery and work-up), Listener elaboration turns were prominent in the middle of the conversations (i.e., work-up), and Listener reflection turns were more prominent later in the conversations (i.e., close implicature).

Questions about the temporal structure of conversations can also be answered using growth models assessing the prevalence of specific turn types over the course of conversations. To illustrate, we fit categorical outcome growth models (implemented as dyadic parallel process logistic multilevel models for acknowledgement turn and elaboration turns separately) to the 118 stranger dyads data to describe how Listeners' and Disclosers' use of acknowledgement and elaboration turns

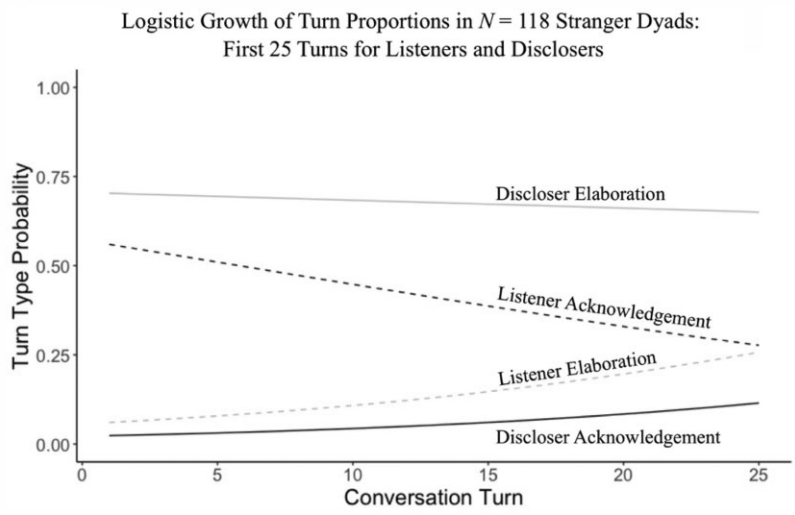

Figure 6 The temporal distribution of turns in supportive conversations. We fit dyadic/bivariate logistic multilevel models to acknowledgement and elaboration turns separately, but have plotted the results in the same figure for parsimony. Each line represents the prototypical change in turn use across the first 50 turns (25 turns for each dyad member) of the conversation.

changed across the first 25 pairs of speaking turns of those conversations.[6] As seen in Figure 6 and Supplemental Table S3, Listeners' use of acknowledgement turns decreased as conversations progressed (dashed black line); their use of elaboration turns increased across their first 25 turns (dashed gray line). For Disclosers, the use of acknowledgement turns increased as conversation progressed (black line); there were no significant changes in elaboration turn use (gray line) during the conversations. Consistent with Jefferson (2015), these analyses show that Disclosers generally share their stories, which Listeners initially acknowledge; as the exchange continues, Listeners increasingly share their own experiences.

Third, we can examine how the turn-to-turn interplay between interlocutors' changes as conversations unfold. For example, complementing the analysis where we summarized the prevalence of turn-pairs at the conversation level for the four example dyads (described previously and summarized in Supplemental Figure S4), is analysis of how the turn transitions are allocated across the first, middle, and final thirds of conversations (delivery, work-up, and close implicature). The proportional frequency of three types of Listener-to-Discloser turn-pairs changed across the three phases of conversation (see Supplemental Figure S7 for the full matrix). In particular, Listener question–Discloser elaboration turn transitions that accounted for 36% of the turn pairs in the first third of the conversations only accounted for 28 and 25% of the turn pairs in the middle and final phases, respectively. Similarly, Listener acknowledgement–Discloser hedged disclosure turn transitions declined from 11%

to 8% and 5% of the turn transitions across the first, middle, and final thirds of the conversations. Conversely, Listener elaboration–Discloser elaboration turn transitions increased from 7% of the turn transitions in the first third of conversations to 13% and 17% in the middle and final thirds of the conversations. Once again, these findings resonate with the over-time phasic shifts in supportive conversations outlined by Jefferson (2015).

Although the examples offered here are simplistic in how they parse temporal segments of interaction, the analyses are easily extended to more meaningful operationalizations of temporal phases. Guided by theory or inductive analyses, researchers can parse conversations into the specific segments that are relevant for the phenomenon being studied. As noted previously, researchers could segment supportive interactions into the specific phases articulated by Jefferson (2015), based on the dialog prominent within parts of the conversation. In analogous fashion, meaningful movements in, for example, decision-making discussions, influence interactions, or conflict negotiations could be identified and then assessed using the methods we have illustrated here. In sum, Layer 4 opens possibility to study how features of dynamic dyadic systems change over time as conversations unfold.

Layer 5: Mapping the dynamics of conversations within- and between-dyads

Understanding of dyadic interaction is elusive because conversations can unfold in so many different ways—with interlocutors seemingly able to enact many different conversational moves at almost any time. Consider again the example of improvizational theater, and imagine that one of our actors is hoping to bring some happy news into the dialog. If the partner opens the exchange with a sad disclosure, sharing happy news on the next turn would fall flat. Instead, our actor might need to first focus on the partner's sad narrative before concluding that phase of the conversation or nudging the conversation toward sunnier topics. Whether our actor gets to share the happy news, as well as how that news is received, depends on whether the dyad can make its way to a location in the conversational terrain where the happy news is fitting. This improvisation-based view of interaction highlights how each moment in an interaction presents a participant with a variety of choices, and those choices will shape the conversation that the partners co-create in real time. Discerning theoretically meaningful and pragmatically consequential splices of interaction, as well as understanding how their frequency and location are related to between-dyad differences in antecedent conditions and postconversation outcomes, is the ultimate aim of dynamic dyadic systems analysis.

A number of theoretical frameworks offer guidance on particular conversational sequences that are consequential in dyadic interactions. For example, Feng's (2014) integrated model of advice-giving proposes that receptiveness to advice improves when advice messages follow emotional support and problem inquiry and analysis. In interpersonal conflicts, Rusbult *et al.* (1991) theorized that accommodation,

defined as the willingness to respond constructively to a partner's destructive conduct, represents a critical departure from somewhat reflexive reactions within conflict interactions. In other research, scholars have discerned consequential sequences in scripts for communication within particular types of episodes, such as between married men and women proposing sexual intercourse (Coffelt & Hess, 2015). These examples illustrate how interpersonal interactions present numerous opportunities to inflect the course of a conversation through dyadic performance of specific and identifiable sequences.

Analysis at this layer may start by identifying the underlying architecture of conversations—the recurrent and distinctive sequences of conversational turns that interaction partners use to build their conversations. By analogy, each human's DNA is composed of a unique sequence of nucleotides (A, C, T, G). Similar to how the polynucleotide chain can be split into a collection of shorter sequences (single nucleotide polymorphisms or "snips"), conversations can also be split into a collection of potentially meaningful multiturn sequences—what we call *conversational motifs*. To illustrate, we sought to identify all the ways that Discloser–Listener–Discloser–Listener–Discloser turn sequences manifested in strangers' supportive conversations data obtained by Bodie *et al.* (2021; 3,284 sequences extracted with a five-turn moving window passed through the data with three turn overlap[7]). Using sequence analysis[8] (MacIndoe & Abbott, 2004) we identified three supportive conversational motifs that characterized the interplay between Disclosers and Listeners.[9] As shown in the top of Figure 7, the most frequent motif (46% of five-turn windows) is a pattern of Discloser elaboration and Listener acknowledgement or reflection that would be expected given the conversational task. We labeled this conversational motif *Discloser problem description*. This motif can be contrasted with the moments in the conversation where Disclosers instead tended to engage in hedged disclosure. Hedged disclosure speaking turns include utterances that involve disclosure and edification along with filled pauses (see Supplemental Figure S1 and Bodie *et al.*, 2021), and Bodie *et al.* (2021) suggested that the filled pauses may reflect cognitive processes as people think about and make sense of information. Accordingly, we labeled this motif *Discloser problem processing* (25% of five-turn windows). The third motif (29% of five-turn windows) was characterized by *Listener-focused dialog*, with Listeners engaging in elaboration turns and Disclosers enacting acknowledgements and questions. Notably, the three supportive conversational motifs extracted from these data distinguish Discloser narratives that assert information from those that are more tentative, as well as sequences that focus on the Discloser versus the Listener. Thus, these three motifs illustrate how sequence analysis can be used to illuminate theoretically meaningful patterns in the ways interlocutors interact during supportive conversations.

Once the supportive conversational motifs are identified and described, we can examine how differences in the prevalence and location of particular motifs are related to post-conversation outcomes. Theoretically, we were guided by Jefferson's (2015) functional sequence model of supportive conversation, as previously noted,

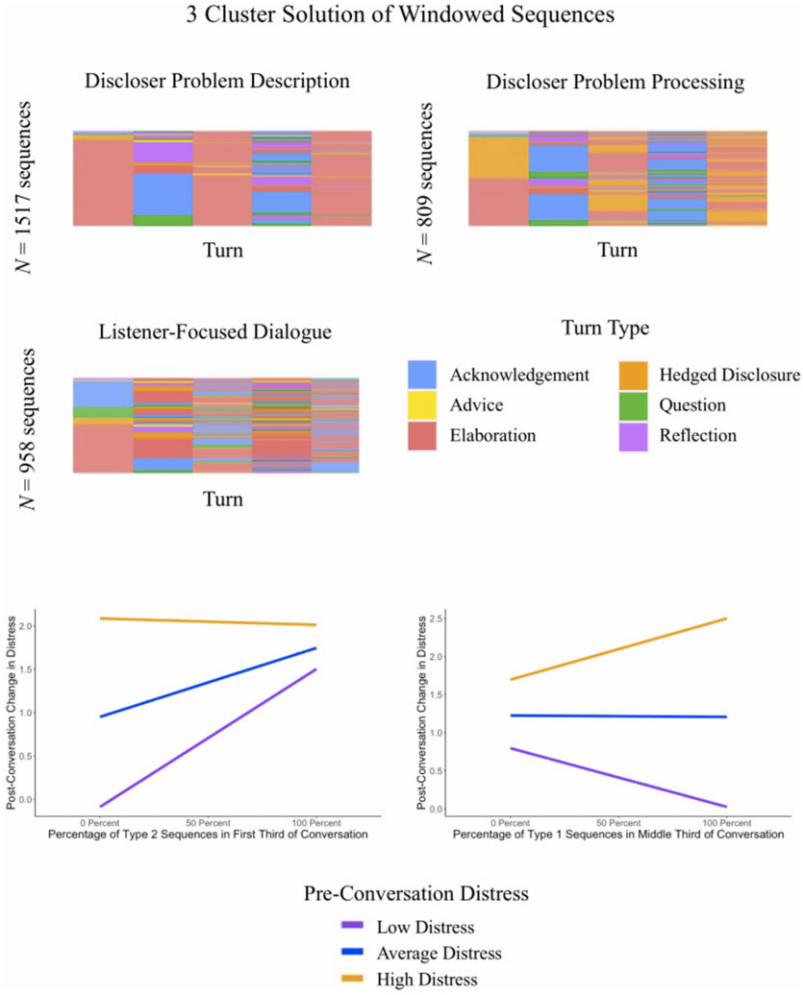

Figure 7 Supportive conversational motifs: types and frequencies over time.

as well as the dual-process framework applied to supportive communication (Bodie & Burleson, 2008). A contribution of the dual-process perspective is to outline contextual parameters that shape the outcomes of supportive conversations. One important moderator of the impact of messages on outcomes is problem severity (i.e., the degree of emotional upset triggered by an event). Research shows that emotional upset serves a dual function, motivating increased processing of support at moderate levels of upset (compared to mild upset) and diminishing processing ability at high levels of upset (Bodie *et al.*, 2011). Accordingly, we used multiple linear regression to examine how preconversation distress and the prevalence of each conversational motif in the first, middle, and final third of the conversation was related to differences in Disclosers' self-reported change in distress (see Supplemental Table S2 for the full regression results).

Results suggested the possibility that greater listener-focused dialog in the first third of the conversations was associated with change-in-distress scores indicative of emotional improvement, B = −0.86, $t(109) = -1.82$, $p = .07$, 95% CI [−1.80, 0.07]. Consistent with Jefferson's (2015) theorizing, this pattern would be consistent with the negative effects of discussing the Listener's experiences in the opening phase of troubles talk. The regression models also suggested that preconversation distress might moderate the association between change in distress and (a) the prevalence of Discloser problem processing in the first third of the conversation, $B = -0.74$, $t(107) = -1.86$, $p = .07$, 95% CI [−1.53, 0.05] and (b) the prevalence of Discloser problem description in the second third of the conversation, $B = 0.70$, $t(107) = 1.87$, $p = .06$, 95% CI [−0.04, 1.45].[10]

The interaction plot in the bottom left of Figure 7 shows limited benefits associated with increases in Discloser problem processing in the first third of the conversations when initial distress was high; people who were initially the most distressed saw the most improvement in their emotional state after the interaction. When initial distress was low, however, the proportional frequency of Discloser problem processing in the first phase of the interaction showed signs of a positive association with improvements in distress pre- to post-conversation. The second interaction, shown in the bottom right of Figure 7, suggested that a greater proportion of Discloser problem description sequences in the middle phase of the conversation may correspond with better outcomes (i.e., a greater decrease in distress) when initial distress levels were high. Conversely, proportional increases in Discloser problem description during the middle third of interactions may correspond with less emotional improvement when initial distress is low.

These very initial results suggest that conversations that begin with a more tentative description of the Discloser's problem may be especially supportive, provided that Disclosers are not highly distressed before the conversation. In addition, keeping a Discloser's focus on problem description into the middle phase of an interaction seems to exacerbate distress when initial distress is low, but may help people who are already highly distressed about their situation. These findings align with a dual-process approach to supportive communication by showing that highly distressed people might benefit more from less analytical discussions of their problems, whereas ruminating without gaining insight magnifies minor issues (e.g., Cloven & Roloff, 1991). More generally, these analyses show how differences between-dyads (e.g., pre-conversation distress and pre- to post-conversation changes in distress) can be linked to within-dyad conversational sequences and their timing.

In summary, this fifth layer of analysis elucidates the sequences within interactions that make up the texture of conversations and connects the prevalence and timing of those conversational motifs to situational antecedents and emotional outcomes. Because conversational motifs are discerned using sequence analysis, an inductive tool, researchers must draw upon theory and their research aims to identify meaningful clusters of speaking turn sequences. Likewise, theoretical considerations should drive the parsing of phases of interaction and the identification of conditions

that may affect the timing of conversational motifs or moderate their impact on substantive between-dyad conversational outcomes. Although our specific findings are closely tied to the supportive conversations we used to illustrate these conceptual and analytical tools, the analyses we have detailed should be replicable within other types of interactions.

Directions for future research

The dynamic dyadic systems approach we have outlined allows researchers to transform discrete units of communication within conversations into the patterns and interdependencies that comprise conversation. As our examples have illustrated, dynamic dyadic systems analysis offers ways of characterizing the content of supportive conversations (Layer 1), identifies prominent turns and sequences that organize those conversations (Layer 2), clarifies patterns that distinguish supportive and unsupportive conversations (Layer 3), reveals how the prevalence of turn types and sequences change as conversations unfold (Layer 4), and shows how the prevalence and timing of particular motifs are linked to antecedents and outcomes (Layer 5). We see the potential for useful insights about conversation that build and test theory to emerge from any and all five layers of analysis. Moreover, a dynamic dyadic systems approach has heuristic value for research on initial interaction, conflict discussions, interpersonal influence efforts, and many other pragmatically oriented interpersonal episodes.

An important affordance of a dynamic dyadic systems analysis is the ability to link characterizations of conversations to individual, relational, and situational phenomena that shape conversations and index their outcomes. Indeed, a dynamic dyadic systems analysis invites questions about factors that influence base rate means, standard deviations, contingent associations, state space grid configurations, and conversational movements. For example, Bodie *et al.* (2021) examined how the structure and dynamics of conversation differed across types of relationships (i.e., strangers, friends, romantic partners). The communication discipline is also rich with theoretically grounded questions about how interpersonal communication experiences produce substantive outcomes, such as conflict escalation or resolution, attitude change or reactance, and relational repair or dissolution.

A theory proposed by Levine (2020) provides a fitting example of how the methods we outline in this manuscript can be applied more broadly. According to Truth-Default Theory (TDT), our interactions with others are marked by a truth bias. We tend to believe people, and this truth-default makes communication efficient and cooperative. Before TDT, the leading framework for understanding how humans detect deception was cue theory, which assumed liars give themselves away through micromomentary displays of nonverbal leakage. Training people to be human lie detectors, therefore, entailed a heavy dose of training in looking for changes in facial expressions, body movement, and other behaviors that revealed the truth. In contrast, TDT claims that people detect lies over time, perhaps through multiple

conversations, or at the very least by asking the right questions in the right order and listening closely for diagnostically useful information, often comparing what is said to what is known or revealed in the course of conversation. Several experiments outlined in Levine (2020) have shown deception detection rates of approximately 90% can be achieved by asking a series of strategic questions. The ideal sequence is derived from theory, and the dynamic dyadic systems analysis outlined in this manuscript could be used to test many theory-based predictions.

Ultimately, we seek to conceptualize conversations as terrains through which partners travel together, with the aim of identifying parts of the landscape toward which conversational partners gravitate, areas where they might linger or get stuck, and pathways that encourage particular destinations. Viewed this way, members of the dyad are somewhat autonomous in their performance of a particular behavior or in their proclivity to aim for a particular place in the conversational landscape. In the vernacular of the supportive conversations upon which we focused, a Listener has the latitude to follow a Discloser's revelation with a question, acknowledgment, or a disclosure of their own. However, where the dyad moves is the product of both partners' actions. When a Discloser's repeated requests for assistance are met by a Listener's persistent questions, neither the Discloser nor the Listener gains insights that would be helpful or resolve questions. The dyad, in a sense, gets stuck in a part of the landscape that impedes the pragmatic aims of supportive conversation. We believe the conceptual and analytical tools outlined in this essay offer a path toward identifying propitious moments that emerge in dyadic interaction, and also the cul de sacs in which partners sometimes find themselves.

Throughout this endeavor, we have developed terminology that we also hope can inform future research on interpersonal communication, in general, and dyadic interaction, in particular. Our metaphorical representation of conversation as improvizational theater was intended to highlight how the autonomous and innovative actions of individuals combine in nonrandom, interdependent ways that can be revealed through a dynamic dyadic systems approach. We also conceptualized conversations as terrains with knowable landscape features, and we offered strategies for mapping partners' movements through these spaces. One final direction for future research, then, is further advances in the *topology of conversations* or the study of how the constituent parts of conversations are arranged and interrelated in meaningful and consequential ways.

Conclusion

Our aim in this article is to offer conceptual tools and methodological strategies for interrogating the dynamic structure of dyadic interaction. In many ways, the questions we raise about the nature of conversation are not new; balance and animation are both present in dynamic systems, and we are not the first to try to operationalize and reconcile them. We also draw upon a variety of existing tools, such as behavioral coding, cluster analysis, state space grids, contingency analysis, and sequence

analysis, that have been around for a long time and fruitfully employed by others. By bringing these conceptions of interpersonal interaction and various methodological tools together and organizing them as layers of analysis that build knowledge of a dynamic dyadic system, we hope to invigorate a research paradigm that both carves interaction at its joints and probes the dynamics and dependencies that hold it together. In doing so, we are continuing a long tradition of research seeking to illuminate the antecedents, intricacies, and outcomes of interpersonal communication.

Supporting information

Additional supporting information may be found in the online version of this article.

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Notes

1. State space grids also can be summarized by metrics indexing, for example, time spent in particular cells, variability (e.g., entropy, dispersion), and the location and strength of attractors (see Hollenstein, 2013).
2. The analysis of turn transitions can easily be expanded to summarize three-turn sequences. Across our four example dyads, the four most prominent three-turn sequences included (a) Listener acknowledgement–Discloser elaboration–Listener acknowledgement (7.3%), (b) Listener question–Discloser elaboration–Listener question (6.1%), (c) Listener question–Discloser elaboration–Listener reflection (5.5%), and (d) Listener reflection–Discloser elaboration–Listener question (5.5%). The most frequent Discloser–Listener–Discloser three-turn sequences are all bookended by Discloser elaboration with either Listener reflection (16.5%), Listener question (14.1%), Listener acknowledgment (12.9%), or Listener elaboration (7.4%) in the middle. This strategy for summarizing frequent sequences in conversations straightforwardly extends beyond the three-turn segment.
3. The configural frequency analysis is specifically constructed to examine how the type of turn at turn t is related to the type of turn at turn $t + 1$ and can be considered a representation of the autoregressive features of the dyad-level categorical data.
4. Supplemental Table S1 identifies other analyses that can assess turn sequences when turns are represented by categorical codes (e.g., sequential analysis, hidden Markov models) or dimensional ratings (e.g., vector autoregressive models).
5. We discretized this measure for the sake of demonstrating two-sample configural frequency analysis, which is a relatively straightforward way of making any between-groups comparison of turn transition frequencies. If the outcome variable is maintained as continuous, one can fit a linear regression model in which the frequency or proportion of each turn transition predicts the Discloser's change in distress.

6. See https://lhama.la.psu.edu for details on categorical growth modeling. Aggregate frequencies across turns are plotted in Supplemental Figure S6.
7. This window size was selected based on an inductive examination, alongside 7-, 10-, and 20-turn moving windows. The five-turn moving window best identified distinctive and theoretically relevant segments. To assist interpretation, the three-turn overlap was selected so that the Discloser turn was consistently the first turn of every sequence.
8. Sequence analysis proceeds by computing the number of insertions, deletions, or substitutions needed to make one sequence identical to a comparison sequence, thereby, quantifying the distance between all pairs of sequences. The resulting distance matrix is subjected to cluster analysis, which allows the identification of groups of sequences that are least dissimilar from each other. This analysis can use the full sequence of conversational turns within each interaction, or it can use segments of interaction defined by any number of turns (e.g., 10-turn windows) with the degree of overlap among sequences defined by the researcher.
9. A dendrogram of the cluster analysis and an alternative 6-cluster solution are provided in Supplemental Figures S8 and S9.
10. These findings do not meet traditional, $p < .05$, standards for significant effects, and we do not mean to suggest that dynamic dyadic systems analyses should engage different standards. Because our intention is to illustrate how researchers can unpack significant effects that emerge from these analyses, we identified associations that came closest to that standard and proceeded accordingly.

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