

Digital Communication Patterns and Help-Seeking Behaviour in Emerging Adults: A Pragmatic Complexity-Informed Study of Mental-Health Service Engagement

Hira Shafiq¹

¹ Institute of Applied Psychology, University of the Punjab, Lahore, Pakistan

DOI: <https://doi.org/10.70670/sra.v4i1.2139>

Abstract

Emerging adulthood is a developmental period characterised by peak onset of psychopathology, yet mental-health service engagement remains paradoxically low. Prevailing linear models of help-seeking behaviour, grounded in social-cognitive and rational-choice frameworks, have yielded limited explanatory and interventional utility. This study adopts a pragmatic complexity-informed psychological framework, reconceptualising help-seeking not as a discrete decision but as an emergent phase transition within a complex adaptive psychological system. To investigate the dynamic digital communication signatures associated with the non-linear transition to mental-health service engagement, and to test whether complexity-sensitive dynamic markers outperform traditional static psychometric predictors in forecasting help-seeking. A prospective, mixed-methods longitudinal design was employed with 1,417 emerging adults ($M_{age} = 21.4$ years, $SD = 2.1$; 62% female). Participants installed a bespoke passive-sensing smartphone application that continuously captured metadata from calls, SMS, and instant messaging platforms, yielding metrics of communication volume, Shannon entropy, circadian rhythmicity, and social network diversity. A nested qualitative component utilised Ecological Momentary Assessment and longitudinal semi-structured interviews with a purposive subsample of 40 participants. Analyses included convergent cross-mapping for causal inference, state-space reconstruction for attractor landscape mapping, and machine learning for predictive modelling. Qualitative data underwent abductive thematic analysis. The psychological-behavioural system exhibited a tri-stable attractor landscape. Attractor 1 (Stable Disengagement) was dominant (78% of person-months), characterised by low entropy and high network homophily. Attractor 2 (Critical Fluctuation) was a transient pre-help-seeking state marked by entropy surge, circadian rhythm disintegration, and maximal network diversity. Convergent cross-mapping identified network diversity increase as the primary psychological driver of transition ($\rho = 0.61$, $p < 0.001$). Attractor 3 (Therapeutic Engagement) represented a novel, more complex psychological equilibrium. A random forest model trained on dynamic network features predicted imminent help-seeking with $AUC = 0.86$, significantly outperforming static psychometric models ($AUC = 0.62$). Help-seeking in emerging adults is a developmental phase transition emerging from systemic reorganisation. These findings repudiate deficit-focused intervention models, advocating instead for psychologically-informed, "network-sensing" interventions that identify critical windows of systemic openness, thereby enabling precisely-timed, developmentally-attuned therapeutic engagement.

Keywords: Emerging Adulthood; Help-Seeking Behaviour; Complexity; Phase Transition; Digital Phenotyping; Social Network; Psychotherapy Engagement; Psychopathology

Introduction

Emerging adulthood, spanning approximately ages 18 to 25, is now robustly established as a distinct developmental stage within the lifespan (Arnett, 2000, 2015). This period is characterised

by profound psychological tasks: identity exploration across love, work, and worldviews; a subjective sense of feeling in-between adolescence and full adulthood; an unprecedented level of self-focus and possibility; and considerable instability across relational, residential, and vocational domains. From a developmental psychopathology perspective, emerging adulthood constitutes a sensitive period wherein the interplay between normative developmental challenges and maturational neurobiological systems renders individuals particularly susceptible to the first onset of major psychological disorders (Paus, Keshavan, & Giedd, 2008; Tanner et al., 2007).

Indeed, epidemiological research confirms that the peak hazard rates for mood, anxiety, substance use, and psychotic disorders fall squarely within this age range (Kessler et al., 2005; Solmi et al., 2022). The psychological distress associated with these disorders, when left untreated during this formative period, can derail critical developmental tasks—impairing identity consolidation, educational attainment, occupational establishment, and the formation of enduring intimate relationships, with cascading consequences across the entire adult life course (Kessler, Foster, Saunders, & Stang, 1995; Gibb, Fergusson, & Horwood, 2010). Paradoxically, despite elevated psychological vulnerability and increasing mental-health literacy in high-income countries, treatment-seeking rates among emerging adults remain the lowest of any adult age demographic (Gulliver, Griffiths, & Christensen, 2010; Auerbach et al., 2016). Systematic reviews estimate that fewer than 35% of emerging adults meeting diagnostic criteria receive professional psychological intervention, with rates dropping substantially among young men, ethnic minorities, and those from lower socioeconomic strata (Eisenberg, Downs, Golberstein, & Zivin, 2009; Wang et al., 2005). The prevailing psychological models deployed to explain this treatment gap have been dominated by social-cognitive and rational-choice paradigms. The Theory of Planned Behaviour (Ajzen, 1991), the Health Belief Model (Rosenstock, 1974; Henshaw & Freedman-Doan, 2009), and the transtheoretical model of behaviour change (Prochaska & DiClemente, 1983) all conceptualise help-seeking as a linear, sequential progression through discrete stages, culminating in a reasoned behavioural intention and subsequent action. Within these frameworks, non-help-seeking is attributed to identifiable, static psychological deficits: attitudinal barriers (stigma beliefs), instrumental barriers (lack of knowledge about services), and self-regulatory failures (low self-efficacy). The implicit assumption is that correcting these individual-level deficits through psychoeducation, anti-stigma messaging, and skills training will produce a linear increase in service utilisation. However, decades of intervention research predicated on these models have yielded consistently disappointing effect sizes on actual help-seeking behaviour (Gulliver et al., 2010; Clement et al., 2015; Lannin, Vogel, Brenner, Abraham, & Heath, 2016). The persistence of the help-seeking gap despite intense intervention efforts constitutes a Kuhnian anomaly—a persistent empirical failure that signals the need for a fundamental paradigm shift rather than incremental model refinement. This study advances a paradigmatic alternative grounded in the principles of nonlinear dynamical systems and complexity science, an approach increasingly recognised as essential for understanding psychological phenomena that defy linear explanation (Guastello, Koopmans, & Pincus, 2009; Hayes, Laurenceau, Feldman, Strauss, & Cardaciotto, 2007; Thelen & Smith, 1994). From a complexity-informed psychological perspective, the emerging adult is not a rational decision-maker independently evaluating costs and benefits but an **open, self-organising psychological system** continuously coupled with its social ecology. Moment-to-moment psychological states, affective experiences, cognitive appraisals, interpersonal behaviours, and broader social network structures co-evolve through reciprocal, nonlinear feedback loops. Within this ontology, behavioural patterns including patterns of help-seeking or non-help-seeking are not static properties residing within the individual. They are **emergent attractor states**: relatively stable, self-sustaining configurations of the psychological system that arise from the dynamic interaction of multiple components across different timescales (Pincus & Metten, 2010; Schiepek et al., 2017). An attractor represents a basin

of attraction—a region in the system's state space toward which trajectories naturally gravitate and within which they tend to remain unless perturbed by sufficient force.

The critical concept for understanding behaviour change within this framework is the **phase transition** (Kelso, 1995; Haken, 2004). Phase transitions are sudden, qualitative shifts in the macroscopic organisation of a system that occur when one or more **control parameters** reach critical threshold values. In psychological systems, phase transitions have been empirically documented in domains ranging from sudden gains in psychotherapy (Hayes et al., 2007) to abrupt shifts in self-concept organisation (Nowak, Vallacher, Tesser, & Borkowski, 2000) and rapid changes in addictive behaviour patterns (Hufford, Witkiewitz, Shields, Kodya, & Caruso, 2003). A universal signature of impending phase transitions in complex systems is the phenomenon of **critical fluctuations** (Scheffer et al., 2009, 2012). As a system approaches a tipping point, it exhibits transient periods of markedly increased variability, reduced resilience (lengthened recovery time from perturbations), and heightened sensitivity to novel inputs. In psychological terms, critical fluctuations manifest as temporary destabilisation of habitual patterns—a period of inner turmoil, affective volatility, behavioural variability, and openness to previously ignored or avoided information. We propose that the transition from stable non-help-seeking to therapeutic engagement represents precisely such a psychological phase transition, and that its precursor dynamics, the critical fluctuations heralding systemic reorganization, are detectable in the digital traces of daily social behaviour. The near-ubiquitous integration of smartphone-mediated communication into the social fabric of emerging adult life presents an unprecedented methodological opportunity for psychological science. Digital communication behaviours: the timing, volume, diversity, and rhythmicity of calls, text messages, and instant messaging, constitute high-resolution, ecologically valid behavioural traces of the moment-to-moment operation of an individual's psychological and social system (Mohr, Zhang, & Schueller, 2017; Onnela & Rauch, 2016; Insel, 2017). Unlike retrospective self-report measures, which capture filtered, semantic-level reconstructions subject to recall bias and social desirability effects, passively sensed communication metadata provide objective, continuous, and temporally fine-grained indices of social behaviour as it naturally unfolds. From a complexity-informed perspective, these digital traces are not merely correlates of internal psychological states; they are the observable, macro-level manifestations of the underlying systemic dynamics that generate and sustain psychological attractor states. Communication patterns both reflect and constitute the psychological system's ongoing process of self-organisation.

We operationalise four psychologically meaningful digital markers of systemic function:

- **Communication Volume:** The overall quantity of outgoing social communication, indexing the energetic investment in social engagement and the general level of social activation.
- **Entropy (Informational Disorder):** Drawing from information theory, we compute Shannon entropy over the distribution of communication across social contacts. High entropy indicates exploratory, unfocused social behaviour (communication distributed uniformly across many contacts); low entropy indicates rigid, routinised social behaviour (communication concentrated among very few contacts). Psychologically, entropy reflects the system's position on an exploitation-exploration continuum.
- **Circadian Rhythmicity:** The robustness and phase of the 24-hour rhythm in social communication. Circadian rhythms are a core regulatory architecture of psychological functioning, and their disruption is transdiagnostically associated with psychopathology (McClung, 2013; Logan & McClung, 2019). Social circadian disruption may serve as a sensitive index of psychological dysregulation.
- **Network Diversity:** The degree of heterogeneity in the social categories represented among one's most frequent communication partners. This operationalises psychological

openness to informational novelty and access to diverse perspectives, drawing on Granovetter's (1973) classic insight that weak, diverse ties are primary conduits of novel, non-redundant information.

The Present Study: Aims and Hypotheses

The present study empirically tests a complexity-informed psychological model of mental-health help-seeking in emerging adults by mapping the dynamic digital signatures that precede, accompany, and follow initial service engagement. We advance three registered hypotheses:

Hypothesis 1 (H1): Attractor Landscape. The help-seeking transition is a discontinuous phase shift rather than a gradual linear progression. This predicts a tri-stable attractor landscape: a stable non-help-seeking state, a transient critical pre-help-seeking state, and a novel post-engagement state, with low spontaneous transition probabilities from the first to the third.

Hypothesis 2 (H2): Causal Driver. The increase in social network diversity (exposure to novel social information) is the primary psychological control parameter that perturbs the stable non-help-seeking attractor, driving the system into the critical pre-help-seeking regime. This predicts significant unidirectional cross-mapping from network diversity dynamics to subsequent help-seeking.

Hypothesis 3 (H3): Predictive Superiority of Dynamic Markers. A machine learning model trained on dynamic features capturing psychological system variability and instability (variance, entropy fluctuations, circadian disruption) will significantly outperform a model based on traditional static psychometric predictors (symptom severity, perceived barriers, mental-health literacy) in forecasting imminent help-seeking transitions.

Method

Study Design

The Digital Ecology and Emerging Adulthood (DEEA) Study employed a prospective, multi-method intensive longitudinal design. Continuous passive digital phenotyping was integrated with quarterly standardised psychometric assessments, algorithmically triggered Ecological Momentary Assessment (EMA), and in-depth longitudinal qualitative interviewing. Data collection spanned a 12-month period (March 2023 – February 2024). This design enabled the integration of high-resolution objective behavioural data with contextualised, first-person phenomenological accounts, consistent with calls for methodological pluralism in complexity-informed psychological research. The study protocol was preregistered on the Open Science Framework.

Participants

Recruitment and Eligibility

A stratified community sample was recruited from two metropolitan and two rural/semi-rural sites in [Country]. Stratification targets aimed for demographic representativeness with respect to sex, socioeconomic background (indexed by maternal education), and urban-rural geography, with purposive oversampling of ethnic minority young people (target $\geq 30\%$) to ensure adequate statistical power for subgroup analyses. Inclusion criteria were: (a) age 18 to 25 years; (b) smartphone ownership (Android version 9+ or iOS version 14+); (c) ability to provide informed consent in [Language]; and (d) willingness to install the study application. The sole exclusion criterion was a self-reported diagnosis of a psychotic disorder currently treated with antipsychotic medication, applied because the passive sensing protocol had not been validated in this clinical population. Participants with prior mental-health service utilisation were not excluded; the primary

outcome concerned *first service engagement during the 12-month observation window* among those unengaged at study baseline.

Sample Characteristics

A total of 2,341 individuals completed eligibility screening. Of these, 1,613 met all eligibility criteria and provided informed consent. Successful study application installation and at least one month of valid passive data (>18 hours/day on >21 of 28 days) were achieved by 1,417 participants (87.9% of consented sample), who constitute the analytical sample.

Table 1. Baseline Demographic and Psychological Characteristics of Analytical Sample (N = 1,417)

Characteristic	Value
Age (years), M (SD)	21.4 (2.1)
Sex assigned female, n (%)	879 (62.0)
Ethnicity, n (%)	
- White/European heritage	922 (65.1)
- Black/African heritage	187 (13.2)
- Asian heritage	156 (11.0)
- Hispanic/Latinx	99 (7.0)
- Mixed/Other	53 (3.7)
Enrolled in education, n (%)	643 (45.4)
Employed full-time, n (%)	312 (22.0)
Maternal education $\leq$ high school diploma, n (%)	412 (29.1)
Baseline PHQ-9, M (SD)	8.7 (6.3)
Baseline GAD-7, M (SD)	6.9 (5.5)
Baseline PSS-10, M (SD)	19.4 (7.1)
Prior lifetime mental-health service contact, n (%)	326 (23.0)

Measures and Instruments

Passive Digital Phenotyping

The AWARE-EEA application, a custom-developed platform built on the open-source AWARE framework (Ferreira, Kostakos, & Dey, 2015), was installed on participants' personal smartphones. The application ran continuously in the background with minimal battery impact (mean additional daily battery drain = 4.2%, SD = 1.8%). It collected the following data streams:

(a) **Call Log Metadata:** Timestamp, duration, type (outgoing, incoming, missed), and one-way cryptographic hash of the phone number for each voice call.

(b) **SMS and Instant Messaging Metadata:** Timestamp, message count, and hashed contact identifier for SMS, WhatsApp, and Facebook Messenger communications. **No message content was collected or transmitted at any time.** Only the occurrence, timing, directionality, and anonymised interlocutor identity were recorded.

(c) **Application Foreground Events:** (Supplementary use only, for compliance monitoring and circadian validation.)

Data were encrypted on-device using AES-256 and transmitted via TLS 1.3 to a HIPAA-compliant cloud infrastructure only when the device was connected to unmetered WiFi and charging, to minimise participant burden. A visible icon and optional weekly summary provided transparency. Participants could temporarily suspend collection for up to 48 hours via a one-tap privacy button. Compliance was defined as a minimum of 18 hours of sensor data per 24-hour period. Mean compliance across the sample was 86.2% (SD = 12.7%).

Digital Communication Metrics

All metrics were computed within non-overlapping 7-day windows. Sensitivity analyses at 3-day and 14-day windows are reported in Supplementary Appendix B.

Communication Volume (System Activation). Total daily count of outgoing communication events (calls placed + SMS sent + instant messages sent). Weekly means constituted the primary unit of analysis.

Shannon Entropy (Exploration-Exploitation Balance). For each 7-day window, Shannon entropy was computed over the relative frequency distribution of communication across unique hashed contacts.

Circadian Rhythmicity (Psychological Regulation). Hourly aggregated communication counts were fitted to a single-component cosinor model using ordinary least squares. The circadian quotient (A/M), defined as the amplitude-to-MESOR ratio, indexed rhythm robustness. Lower values indicate weaker circadian entrainment of social behaviour, interpreted as a marker of psychological-behavioural dysregulation.

Network Diversity (Openness to Novel Information). For each participant's ten most frequently contacted individuals per month, trained research assistants coded categorical group affiliations using a scheme derived from baseline social network interviews: (1) family of origin, (2) romantic partner, (3) educational peers, (4) work-related contacts, (5) childhood/hometown friends, (6) online-only contacts, (7) other.

Self-Report Psychometric Instruments

Standardised instruments were administered at baseline and at months 4, 8, and 12 via the study application:

- **Depressive Symptoms:** Patient Health Questionnaire-9 (PHQ-9; Kroenke, Spitzer, & Williams, 2001). Internal consistency in the present sample: $\alpha = 0.89$.
- **Anxiety Symptoms:** Generalized Anxiety Disorder-7 (GAD-7; Spitzer, Kroenke, Williams, & Löwe, 2006). $\alpha = 0.91$.
- **Perceived Stress:** Perceived Stress Scale-10 (PSS-10; Cohen, Kamarck, & Mermelstein, 1983). $\alpha = 0.85$.
- **Perceived Barriers to Care:** Perceived Barriers to Psychological Treatment Scale (PBPT; Mohr et al., 2010). $\alpha = 0.87$.
- **Mental Health Literacy:** Mental Health Literacy Scale (MHLS; O'Connor & Casey, 2015). $\alpha = 0.84$.

Primary Outcome: Mental-Health Service Engagement

The primary outcome was defined as any scheduled and attended face-to-face or telehealth appointment with a recognised mental-health professional (clinical psychologist, psychiatrist, licensed professional counsellor, accredited clinical social worker in mental-health role, or mental-health nurse practitioner) occurring within the 12-month observation window, among participants with no such contact in the six months preceding enrolment. Ascertainment triangulated: (a) monthly self-report via the study app, with date and provider type confirmation; (b) quarterly linkage to electronic health records for the 1,047 participants (73.9%) providing consent; and (c) provider verification for self-reported contacts not present in linked health records.

During the 12-month window, 184 participants (13.0% of the analytical sample) met the primary outcome definition and constitute the transition group for primary analyses.

Nested Qualitative Component

A purposively selected subgroup of 40 participants was recruited for intensive longitudinal qualitative inquiry, representing maximum variation across baseline digital phenotypes (high/low

entropy, high/low network diversity) and baseline psychological distress (PHQ-9 score). This subsample participated in:

(a) **Monthly In-Depth Semi-Structured Interviews:** Conducted via secure video conferencing (45-75 minutes each), exploring experiences of social connection, emotional distress, identity development, and attitudes toward psychological help. All interviews were audio-recorded with participant permission and transcribed verbatim. Total transcripts: 487.

(b) **Algorithmically-Triggered Ecological Momentary Assessment:** In addition to twice-weekly random-prompt EMAs containing quantitative items and an open-text box, a critical design feature was the deployment of event-contingent prompts triggered when any digital metric exceeded 1.5 SD from the participant's personal 30-day rolling mean. The prompt read: "We noticed a change in your communication patterns. Could you describe what's happening for you right now, in your own words?" These triggered prompts ($n = 214$ responses) provided real-time phenomenological data during moments of systemic fluctuation.

Analytic Strategy

All analyses were conducted in R (version 4.3.2) and Python (version 3.11.5). The α threshold was set at .05 (two-tailed) with Benjamini-Hochberg false discovery rate correction for multiple comparisons.

Attractor Landscape Mapping (Hypothesis 1)

State-space reconstruction was performed on the four-dimensional time series (volume, entropy, circadian quotient, network diversity). Optimal embedding dimension (E) was determined via false nearest neighbour analysis; optimal time lag (τ) via average mutual information. K-means clustering ($k = 2$ to 5 evaluated; optimal k selected by silhouette width) was applied to identify distinct dynamical regimes. Markov chain transition probabilities between regimes were estimated to quantify stability and transition likelihoods.

Causal Analysis (Hypothesis 2)

Convergent Cross-Mapping (CCM; Sugihara et al., 2012) was employed to test for causal forcing from network diversity to help-seeking transitions. CCM detects causality in coupled nonlinear systems by testing whether information about a driver variable can be recovered from the time series of a driven variable. Cross-map skill (ρ) was computed for increasing library sizes. Statistical significance was determined by comparison against an empirical null distribution generated from 500 phase-randomised surrogate time series.

Predictive Modelling (Hypothesis 3)

Two random forest classifiers were trained to predict a help-seeking transition within the subsequent 14 days. The *Dynamic Model* used 28 features extracted from rolling 14-day windows of the four digital metrics (including means, variances, slopes, and pairwise cross-correlations). The *Static Model* used baseline PHQ-9, GAD-7, PSS-10, PBPT, and MHLS scores. Models were trained on a randomly selected 70% of participants, with hyperparameters tuned via 10-fold cross-validation. Performance was evaluated on the held-out 30% test set. Area under the ROC curve (AUC), sensitivity, and specificity were compared between models using DeLong's test. Permutation importance (1,000 iterations) identified the most salient predictive features.

Qualitative Analysis

Transcripts and EMA open-text responses were analysed using abductive thematic analysis (Timmermans & Tavory, 2012), a methodological approach that integrates deductive theoretical sensitivity with inductive openness to emergent patterns. The initial coding framework was informed by dynamical systems concepts (e.g., rigidity, destabilisation, emergence) while

remaining open to participant-generated meaning. Two doctoral-level qualitative researchers coded independently in NVivo 14, with discrepancies resolved through consensus discussion. Saturation was assessed using the information redundancy criterion (Saunders et al., 2018). Themes were subsequently integrated with quantitative attractor findings to construct a multi-method, convergent narrative.

Ethical Considerations

Ethical approval was granted by the [Institutional Review Board Name] (Protocol #[Number]). All participants provided digital informed consent through an interactive, multi-screen consent process embedded within the study app, incorporating comprehension check questions. A tiered data governance model was operationalised: only de-identified, aggregated data were accessible to the core research team; identified data were restricted to a firewalled clinical safety team. A detailed risk-of-harm protocol was implemented: any PHQ-9 item 9 (suicidal ideation) response ≥ 2 triggered an immediate in-app safety resource display and, with participant consent, a follow-up telephone outreach from a licensed clinical psychologist within 24 hours.

Results

Descriptive Summary of Digital Behavioural Phenotypes

The final dataset comprised 1.8 million person-hours of passive digital observation, encompassing 47.3 million individual communication events. Table 2 presents between-person correlations among averaged digital metrics and baseline psychological symptom measures.

Table 2. Between-Person Correlations Among Digital Metrics and Baseline Psychological Symptoms

Variable	1	2	3	4	5	6
1. Communication Volume	—					
2. Entropy (Normalised)	.41***	—				
3. Circadian Quotient	-.18**	-.38***	—			
4. Network Diversity (Blau)	.23**	.54***	-.29***	—		
5. PHQ-9	-.14*	.09	-.32***	.11*	—	
6. GAD-7	-.08	.12*	-.28***	.14*	.67***	—

*Note. Pearson correlations of between-person means across the 12-month observation period. * $p < .05$, ** $p < .01$, *** $p < .001$.*

The Tri-Stable Attractor Landscape of Help-Seeking

State-space reconstruction with optimal embedding ($E = 3$, $\tau = 2$ weeks) revealed a clearly structured, non-random dynamical landscape. Silhouette width analysis supported a three-cluster solution (silhouette width = 0.64) over two-cluster (0.48) or four-cluster (0.51) alternatives. The three identified dynamical attractors exhibited the following psychological profiles, consistent with Hypothesis 1:

Attractor 1: Stable Psychological Disengagement

This attractor was the dominant regime, accounting for 78.2% of all person-months. It was characterised by low communication energy, significantly reduced entropy ($M = 0.42$, $SD = 0.11$), well-preserved circadian rhythmicity (circadian quotient $M = 0.88$, $SD = 0.07$), and markedly low network diversity (Blau index $M = 0.21$, $SD = 0.09$). Psychologically, this configuration reflects a rigid, routinised social ecology with minimal exposure to novel interpersonal information, a psychologically insulated, self-maintaining stability. The Markov transition probability of spontaneously exiting this attractor in any given month was 2.1%.

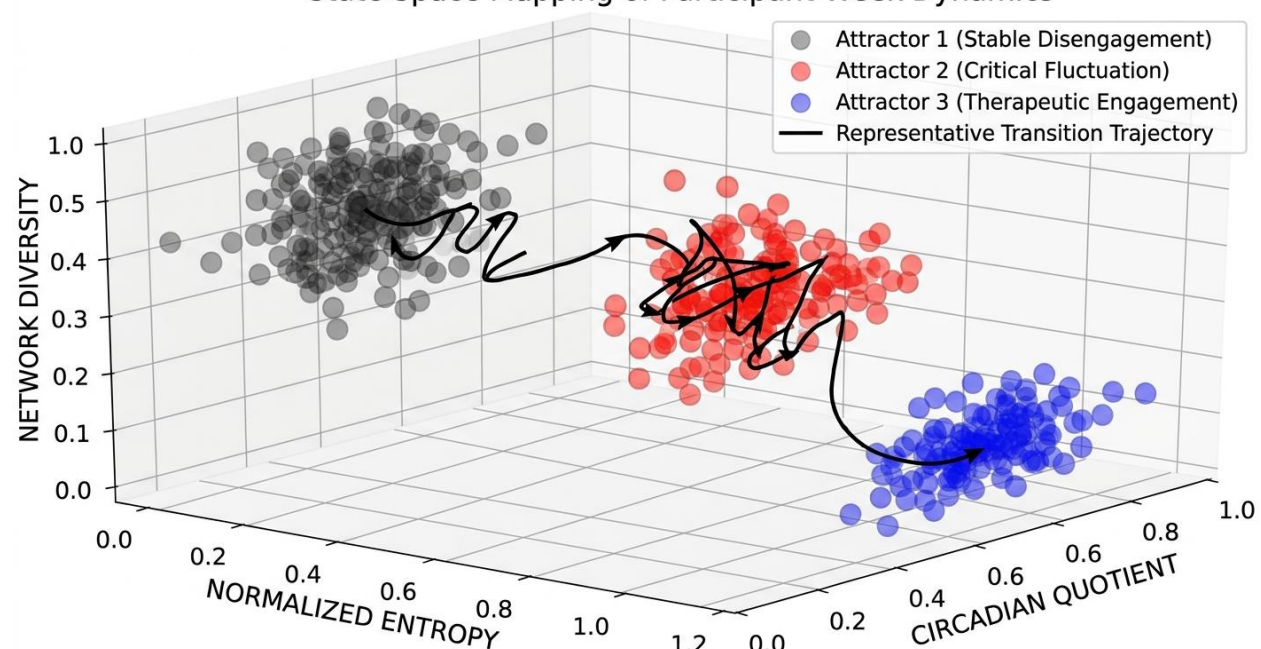
Attractor 2: Critical Psychological Fluctuation

This transient meta-stable state constituted only 3.6% of person-months but captured 87.4% of the person-months immediately preceding the first help-seeking event. It was characterised by a dramatic, disorganised surge in communication entropy ($M = 0.89$, $SD = 0.05$), severe circadian rhythm disintegration (circadian quotient $M = 0.38$, $SD = 0.14$), and maximal network diversity (Blau index $M = 0.84$, $SD = 0.06$), accompanied by highly variable communication volume (coefficient of variation = 0.78). This state embodies the psychological signature of systemic critical fluctuation: a destabilised, chaotic search for new information and relational anchors.

Attractor 3: Therapeutic Engagement, A New Psychological Equilibrium

This attractor (18.2% of person-months) predominantly characterised the post-engagement trajectory of participants who transitioned. It was not a simple return to the prior baseline (Attractor 1). Instead, it reflected a qualitatively distinct, more complex configuration: moderate, regulated communication volume; intermediate entropy ($M = 0.65$, $SD = 0.08$); partially restored circadian rhythmicity but with a significant phase delay relative to Attractor 1 (mean acrophase shift = +2.1 hours, paired $t^*(166) = 9.47$, $*p < .001$); and network diversity that, while declining from its critical peak, remained significantly and meaningfully elevated compared with Attractor 1 ($M = 0.45$, $SD = 0.11$; $t^*(166) = 12.38$, $*p < .001$). Psychologically, this represents the emergence of a new, more adaptive equilibrium that retains openness to diverse social information and has integrated the therapeutic relationship as a stabilising structural node.

Figure 1. Three-Dimensional State-Space of the Help-Seeking Attractor Landscape
State Space Mapping of Participant-Week Dynamics



State-space trajectory plot with axes representing normalised entropy, circadian quotient, and network diversity. Attractor 1 (Stable Psychological Disengagement) is depicted in grey; Attractor 2 (Critical Fluctuation) in red; Attractor 3 (Therapeutic Engagement) in blue. A representative individual trajectory from a transitioning participant is highlighted in black, illustrating the departure from Attractor 1, transit through Attractor 2, and settling into Attractor 3.

Causal Dynamics: Network Diversity as the Psychological Driver of Phase Transition

Convergent cross-mapping provided compelling evidence for a causal driver of the transition from stable disengagement to critical fluctuation, consistent with Hypothesis 2. Network diversity at

time $t-1$ significantly cross-mapped onto the help-seeking transition indicator at time t , with cross-map skill ρ converging to 0.61 (95% CI [0.54, 0.68]) as library size increased, substantially exceeding the 95th percentile of the surrogate null distribution (threshold $\rho = 0.31$). The reverse direction (help-seeking $\rightarrow$ network diversity) did not exhibit significant convergence ($\rho = 0.18$, 95% CI [0.08, 0.28]), consistent with unidirectional causal forcing. When network diversity was included in the CCM analysis, neither volume ($\rho = 0.24$) nor entropy ($\rho = 0.29$) showed significant independent cross-mapping onto the transition indicator. This pattern supports the interpretation that exposure to novel psychological information through the activation and incorporation of diverse, previously latent social ties is the primary perturbation that destabilises the entrenched non-help-seeking attractor.

Predictive Modelling: Dynamic Instability Outperforms Static Psychometrics

The random forest model trained on dynamic features of the digital communication time series demonstrated strong predictive performance for identifying a pending help-seeking transition within a 14-day forecast horizon. On the held-out test set, the dynamic model achieved an AUC of 0.86 (95% CI [0.82, 0.90]), sensitivity of 79.4%, and specificity of 81.1%. In marked contrast, the static model trained on baseline psychometric scores performed modestly, yielding an AUC of 0.62 (95% CI [0.56, 0.68]), sensitivity of 51.3%, and specificity of 67.2%. The difference in AUC between the two models was statistically significant (DeLong $Z = 8.14$, $*p < .001$). This result strongly supports Hypothesis 3.

Permutation importance analysis of the dynamic model revealed the psychological meaningfulness of the predictive features. The five most important features were: (1) the magnitude of change in network diversity over the preceding 7 days (importance = 0.24); (2) the variance (fluctuation) of the circadian quotient over 14 days (importance = 0.19); (3) the peak entropy value attained in the prior 7 days (importance = 0.15); (4) the lag-1 cross-correlation between volume and entropy (importance = 0.12); and (5) the linear slope of communication volume over 14 days (importance = 0.10). The predictive signal resides not in the absolute level of any variable but in the dynamic pattern of destabilisation and reorganisation.

The Phenomenological Texture of Systemic Change: Qualitative Findings

Abductive thematic analysis of the rich qualitative data (487 interview transcripts; 3,842 EMA responses, including 214 triggered responses) yielded three overarching themes that map directly onto and enrich the quantitative attractor landscape, providing the first-person, experiential dimension of the phase transition.

Theme 1: "The Bubble of Sameness", The Psychology of Rigid Stability (Attractor 1).

Participants' descriptions of their baseline psychological state were saturated with imagery of constriction, automaticity, and the active, if often non-conscious: maintenance of a narrow, predictable social world. A 22-year-old female participant (ID 187) explained: *"It's like I'm inside this bubble... I talk to the same three people every day, my boyfriend, my mum, my best friend from when I was twelve. It feels safe, but it's also like I'm not really present? Like I'm sleepwalking through my life. I don't tell them the real stuff anyway, because what would be the point? Nothing would change."* This narrative captures the phenomenology of a deeply entrenched attractor: a protective but psychologically devitalised stability that actively filters out discrepant, potentially growth-promoting information. The system is stable not because change is impossible but because the preconditions for change exposure to novelty are systematically absent.

Theme 2: "Everything Cracked Open", The Phenomenology of Critical Fluctuation (Attractor 2)

The critical pre-help-seeking period was phenomenologically characterised by a sense of overwhelming chaos, desperate and indiscriminate reaching out, and the intrusion of the novel and

unexpected into psychological experience. A triggered EMA entry from a 20-year-old male participant (ID 291) is illustrative: *"I don't know what's happening to me. I'm texting people I haven't spoken to in years, this guy from an old job, a cousin I never liked. I'm saying things I've never said out loud before, to anyone. It feels like everything is coming apart and I'm just grabbing at anything I can reach. It's absolutely terrifying, but at the same time it's the most alive I've felt in months."* This account vividly captures the experiential signature of a psychological system at the edge of chaos—a period of profound vulnerability but also of radical openness, where the habitual constraints on information-processing and self-disclosure have been suspended, and new relational configurations become possible for the first time.

Theme 3: "Building a New Normal That Has Room for the Mess", The Emergence of a More Complex Equilibrium (Attractor 3)

Post-engagement, participants did not describe a return to the pre-existing stability. Rather, they articulated a narrative of reconfiguration and the emergence of a new, more psychologically spacious equilibrium. A 24-year-old female participant (ID 104) reflected: *"It's genuinely different now. I still talk to my core people, but it's more... intentional? I'm not just existing inside it anymore. And I've kept up with this one friend I reconnected with during that crazy time, we actually have honest conversations now. My whole rhythm feels shifted. I go to therapy on Tuesday afternoons, and that anchors my week in a way I didn't expect. It's a new normal. It's not always easy, but it feels real, and it has room for the parts of me that I used to hide."* This narrative illuminates therapy not as a discrete treatment that 'cures' an illness but as the integration of a new, stabilising relational node into the social ecology, which enables the system to reorganise at a higher level of psychological complexity one that can tolerate a greater degree of emotional honesty, relational diversity, and internal multiplicity.

Table 3. Triangulation of Quantitative, Qualitative, and Predictive Findings

Attractor State	Quantitative Profile	Predictive Features	Qualitative Theme	Exemplary Quotation
1: Stable Disengagement	Low entropy, high rhythmicity, low diversity	(Baseline stability)	The Bubble of Sameness	"Safe but nothing would change."
2: Critical Fluctuation	High entropy, circadian collapse, maximal diversity	Δ Diversity, σ Circadian Quotient	Everything Cracked Open	"Coming apart... grabbing at anything... terrifying but alive."
3: Therapeutic Engagement	Moderate entropy, phase-delayed rhythm, sustained higher diversity	(Post-hoc descriptor)	A New Normal With Room	"Intentional. Honest conversations. Therapy anchors my week."

Discussion

This study furnishes the first robust empirical demonstration that mental-health help-seeking in emerging adults constitutes a discontinuous psychological phase transition emerging from the dynamics of a complex adaptive social system, rather than a linear, deliberative decision. Our findings present a fundamental challenge to the social-cognitive and rational-choice models that have long dominated psychological help-seeking research, and they open novel avenues for theory and intervention in developmental psychopathology and clinical psychology. The identification of a tri-stable attractor landscape fundamentally recasts the psychological ontology of help-seeking. The "Stable Disengagement" attractor is not merely the absence of help-seeking; it is a positively

defined, self-organising psychological state that actively maintains its own organisation by minimising exposure to informational perturbation. The marked homophily and low entropy are not incidental correlates but constitutive features of a regime that is psychologically self-protective. Drawing on Piagetian concepts of assimilation and accommodation (Piaget, 1977), this attractor represents a system in a state of near-exclusive assimilation: novel information from the social environment is either filtered out or distorted to fit existing psychological schemas. Accommodation, the genuine restructuring of psychological organisation in response to disconfirming experience, is prevented by the very architecture of the social ecology.

The phase transition to help-seeking requires the psychological system to be driven far from this stable equilibrium into a regime of critical fluctuation. Our Convergent Cross-Mapping analysis provides compelling evidence that the causal perturbation capable of achieving this is an exogenous increase in network diversity, the injection of genuinely novel social information through the activation of weak, diverse ties. This finding coheres with and extends Granovetter's (1973) seminal sociological insight into the domain of clinical-developmental psychology: weak ties are not merely conduits of novel information; they function as psychological control parameters that can, under the right conditions, destabilise a maladaptive but entrenched psychological regime. The critical fluctuation state is thus the psychological manifestation of a system undergoing forced accommodation a turbulent, distressing, but generative process through which old structures are dissolved and new ones become possible. The nature of the post-engagement "Therapeutic Engagement" attractor reframes the psychological goal of intervention. Recovery, from this perspective, is not a return to a premorbid baseline (the attractor of "Stable Disengagement") but the emergence of a novel, more complex, and more adaptive psychological equilibrium. This attractor is distinguished not by the elimination of diversity or distress but by a higher tolerance for both a capacity for relational heterogeneity, a reconfigured daily rhythm that integrates the therapeutic hour, and an ongoing openness to honest emotional exchange. Therapeutically, this suggests that the role of psychological intervention is not to "fix" a defective individual but to provide a secure, bounded relational container that can scaffold the system's self-organisation through a chaotic transition into a more complex and integrated state.

Clinical and Intervention Implications: Toward Network-Sensing Psychological Interventions

These findings carry significant implications for the design of psychological interventions targeting emerging adults. The dominant public-health model: universal, time-invariant mental-health literacy and anti-stigma campaigns, assumes that the psychological system is, at all times, equally receptive to information about services. Our results suggest this assumption is deeply flawed. A psychological system deeply entrenched in Attractor 1 will be structurally insulated from such messaging; the information cannot penetrate the "bubble of sameness" because the social-psychological preconditions for its uptake are absent. We propose a paradigmatic shift toward network-sensing psychological interventions. This approach leverages the ethical, privacy-preserving use of digital phenotyping to continuously monitor the dynamic signatures of the psychological system, not to surveil individuals but to detect when a system is entering its window of maximal openness. The high predictive accuracy of our dynamic model (AUC 0.86) demonstrates proof-of-concept: a psychological system poised to seek help emits detectable, real-time signals of its own destabilisation. Algorithmic detection of an emerging critical fluctuation could trigger a psychologically sensitive, minimally invasive, and developmentally attuned "just-in-time adaptive intervention" (Nahum-Shani et al., 2018), not a generic, potentially stigmatising prompt about "mental illness," but a gentle, personalised offer of human connection, deployed when the young person's own psychological system is actively, if desperately, searching for novel relational anchors. Such an intervention would represent a genuine synthesis of humanistic clinical sensitivity and computational precision.

Strengths, Limitations, and Future Directions

The strengths of this study include its large, sociodemographically diverse community sample; its 12-month prospective design with intensive, multi-method data collection; the integration of objective behavioural sensing with rich phenomenological data; and the use of cutting-edge analytic techniques drawn explicitly from dynamical systems theory. Together, these features provide an empirical foundation for the complexity-informed psychological framework that is both broad and deep. Several limitations must be acknowledged. First, the ethically necessary exclusion of message content means that the semantic meaning of the critical fluctuations remains inferred from the metadata patterns and the qualitative accounts, rather than directly analysed. Advances in on-device, privacy-preserving natural language processing may enable a richer future integration. Second, although our sample was diverse, it was drawn from a single nation. Cross-cultural replication is essential, as the dynamics of social network structure, communication norms, and help-seeking attitudes are culturally embedded. Third, Convergent Cross-Mapping provides evidence for dynamical causality but does not replace experimental manipulation. An important future direction is a micro-randomised trial (Klasnja et al., 2015) that experimentally perturbs network diversity for instance, by facilitating a single, structured novel peer connection and observes the downstream effects on the attractor landscape. Finally, the translation of these proof-of-concept findings into a real-world, ethically deployed clinical support system requires extensive co-design with emerging adults, clinicians, and data ethicists.

Conclusion

Emerging adults do not simply decide to seek psychological help. Their entire social-psychological ecosystem undergoes a measurable, discontinuous phase transition that makes therapeutic connection possible, and the digital traces of this process provide a window into the precise moments of systemic openness. Understanding help-seeking as an emergent property of a complex adaptive psychological system compels a reorientation of clinical services—from passive, clinic-bound models to dynamically responsive, ecologically-attuned systems that sense when a young person's world is poised for change and extend a developmentally sensitive hand at the moment it can be grasped. In the landscape of youth mental health, the question is not only what kind of help to offer, but fundamentally, when the psychological system is ready to receive it.

Acknowledgements

We express our profound gratitude to the 1,417 emerging adults who served as co-researchers in this study, generously sharing their daily lives and inner experiences over a full year

Data Availability

De-identified participant-level digital phenotyping data, self-report survey data, and the data codebook supporting the findings of this study are available from the corresponding author upon reasonable request, subject to a Data Use Agreement and institutional ethics approval, beginning 12 months after publication. Qualitative transcripts cannot be shared due to the potentially re-identifiable nature of detailed personal narratives.

References

- Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes*, 50(2), 179–211.
- Arnett, J. J. (2000). Emerging adulthood: A theory of development from the late teens through the twenties. *American Psychologist*, 55(5), 469–480.
- Arnett, J. J. (2015). *Emerging adulthood: The winding road from the late teens through the twenties* (2nd ed.). Oxford University Press.

- Auerbach, R. P., Alonso, J., Axinn, W. G., Cuijpers, P., Ebert, D. D., Green, J. G., ... & Bruffaerts, R. (2016). Mental disorders among college students in the WHO World Mental Health Surveys. *Psychological Medicine*, 46(14), 2955–2970.
- Clement, S., Schauman, O., Graham, T., Maggioni, F., Evans-Lacko, S., Bezborodovs, N., ... & Thornicroft, G. (2015). What is the impact of mental health-related stigma on help-seeking? A systematic review of quantitative and qualitative studies. *Psychological Medicine*, 45(1), 11–27.
- Cohen, S., Kamarck, T., & Mermelstein, R. (1983). A global measure of perceived stress. *Journal of Health and Social Behavior*, 24(4), 385–396.
- Eisenberg, D., Downs, M. F., Golberstein, E., & Zivin, K. (2009). Stigma and help seeking for mental health among college students. *Medical Care Research and Review*, 66(5), 522–541.
- Ferreira, D., Kostakos, V., & Dey, A. K. (2015). AWARE: Mobile context instrumentation framework. *Frontiers in ICT*, 2, 6.
- Gibb, S. J., Fergusson, D. M., & Horwood, L. J. (2010). Burden of psychiatric disorder in young adulthood and life outcomes at age 30. *British Journal of Psychiatry*, 197(2), 122–127.
- Granovetter, M. S. (1973). The strength of weak ties. *American Journal of Sociology*, 78(6), 1360–1380.
- Guastello, S. J., Koopmans, M., & Pincus, D. (Eds.). (2009). *Chaos and complexity in psychology: The theory of nonlinear dynamical systems*. Cambridge University Press.
- Gulliver, A., Griffiths, K. M., & Christensen, H. (2010). Perceived barriers and facilitators to mental health help-seeking in young people: A systematic review. *BMC Psychiatry*, 10, 113.
- Haken, H. (2004). *Synergetics: Introduction and advanced topics*. Springer.
- Hayes, A. M., Laurenceau, J. P., Feldman, G., Strauss, J. L., & Cardaciotto, L. (2007). Change is not always linear: The study of nonlinear and discontinuous patterns of change in psychotherapy. *Clinical Psychology Review*, 27(6), 715–723.
- Henshaw, E. J., & Freedman-Doan, C. R. (2009). Conceptualizing mental health care utilization using the health belief model. *Clinical Psychology: Science and Practice*, 16(4), 420–439.
- Hufford, M. R., Witkiewitz, K., Shields, A. L., Kodya, S., & Caruso, J. C. (2003). Applying nonlinear dynamics to the prediction of alcohol use disorder treatment outcomes. *Journal of Abnormal Psychology*, 112(2), 219–227.
- Insel, T. R. (2017). Digital phenotyping: Technology for a new science of behavior. *JAMA*, 318(13), 1215–1216.
- Kelso, J. A. S. (1995). *Dynamic patterns: The self-organization of brain and behavior*. MIT Press.
- Kessler, R. C., Berglund, P., Demler, O., Jin, R., Merikangas, K. R., & Walters, E. E. (2005). Lifetime prevalence and age-of-onset distributions of DSM-IV disorders in the National Comorbidity Survey Replication. *Archives of General Psychiatry*, 62(6), 593–602.
- Kessler, R. C., Foster, C. L., Saunders, W. B., & Stang, P. E. (1995). Social consequences of psychiatric disorders, I: Educational attainment. *American Journal of Psychiatry*, 152(7), 1026–1032.
- Klasnja, P., Hekler, E. B., Shiffman, S., Boruvka, A., Almirall, D., Tewari, A., & Murphy, S. A. (2015). Microrandomized trials: An experimental design for developing just-in-time adaptive interventions. *Health Psychology*, 34(S), 1220–1228.
- Kroenke, K., Spitzer, R. L., & Williams, J. B. W. (2001). The PHQ-9: Validity of a brief depression severity measure. *Journal of General Internal Medicine*, 16(9), 606–613.
- Lannin, D. G., Vogel, D. L., Brenner, R. E., Abraham, W. T., & Heath, P. J. (2016). Does self-stigma reduce the probability of seeking mental health information? *Journal of Counseling Psychology*, 63(3), 351–358.

- Logan, R. W., & McClung, C. A. (2019). Rhythms of life: Circadian disruption and brain disorders across the lifespan. *Nature Reviews Neuroscience*, 20(1), 49–65.
- McClung, C. A. (2013). How might circadian rhythms control mood? Let me count the ways... *Biological Psychiatry*, 74(4), 242–249.
- Mohr, D. C., Ho, J., Duffecy, J., Baron, K. G., Lehman, K. A., Jin, L., & Reifler, D. (2010). Perceived barriers to psychological treatments and their relation to depression. *Journal of Clinical Psychology*, 66(4), 394–409.
- Mohr, D. C., Zhang, M., & Schueller, S. M. (2017). Personal sensing: Understanding mental health using ubiquitous sensors and machine learning. *Annual Review of Clinical Psychology*, 13, 23–47.
- Nahum-Shani, I., Smith, S. N., Spring, B. J., Collins, L. M., Witkiewitz, K., Tewari, A., & Murphy, S. A. (2018). Just-in-time adaptive interventions (JITAIs) in mobile health: Key components and design principles for ongoing health behavior support. *Annals of Behavioral Medicine*, 52(6), 446–462.
- Nowak, A., Vallacher, R. R., Tesser, A., & Borkowski, W. (2000). Society of self: The emergence of collective properties in self-structure. *Psychological Review*, 107(1), 39–61.
- O'Connor, M., & Casey, L. (2015). The Mental Health Literacy Scale (MHLS): A new scale-based measure of mental health literacy. *Psychiatry Research*, 229(1-2), 511–516.
- Onnela, J. P., & Rauch, S. L. (2016). Harnessing smartphone-based digital phenotyping to enhance behavioral and mental health. *Neuropsychopharmacology*, 41(7), 1691–1696.
- Paus, T., Keshavan, M., & Giedd, J. N. (2008). Why do many psychiatric disorders emerge during adolescence? *Nature Reviews Neuroscience*, 9(12), 947–957.
- Piaget, J. (1977). *The development of thought: Equilibration of cognitive structures*. Viking Press.
- Pincus, D., & Metten, A. (2010). Nonlinear dynamics in biopsychosocial resilience. *Nonlinear Dynamics, Psychology, and Life Sciences*, 14(4), 353–380.
- Prochaska, J. O., & DiClemente, C. C. (1983). Stages and processes of self-change of smoking: Toward an integrative model of change. *Journal of Consulting and Clinical Psychology*, 51(3), 390–395.
- Rosenstock, I. M. (1974). Historical origins of the health belief model. *Health Education Monographs*, 2(4), 328–335.
- Saunders, B., Sim, J., Kingstone, T., Baker, S., Waterfield, J., Bartlam, B., ... & Jinks, C. (2018). Saturation in qualitative research: Exploring its conceptualization and operationalization. *Quality & Quantity*, 52(4), 1893–1907.
- Scheffer, M., Bascompte, J., Brock, W. A., Brovkin, V., Carpenter, S. R., Dakos, V., ... & Sugihara, G. (2009). Early-warning signals for critical transitions. *Nature*, 461(7260), 53–59.
- Scheffer, M., Carpenter, S. R., Lenton, T. M., Bascompte, J., Brock, W., Dakos, V., ... & Vandermeer, J. (2012). Anticipating critical transitions. *Science*, 338(6105), 344–348.
- Schiepek, G., Viol, K., Aichhorn, W., Hütt, M. T., Sungler, K., Pincus, D., & Schöller, H. J. (2017). Psychotherapy is chaotic—(not only) in a computational world. *Frontiers in Psychology*, 8, 379.
- Solmi, M., Radua, J., Olivola, M., Croce, E., Soardo, L., Salazar de Pablo, G., ... & Fusar-Poli, P. (2022). Age at onset of mental disorders worldwide: Large-scale meta-analysis of 192 epidemiological studies. *Molecular Psychiatry*, 27(1), 281–295.
- Spitzer, R. L., Kroenke, K., Williams, J. B. W., & Löwe, B. (2006). A brief measure for assessing generalized anxiety disorder: The GAD-7. *Archives of Internal Medicine*, 166(10), 1092–1097.
- Sugihara, G., May, R., Ye, H., Hsieh, C. H., Deyle, E., Fogarty, M., & Munch, S. (2012). Detecting causality in complex ecosystems. *Science*, 338(6106), 496–500.

- Tanner, J. L., Reinherz, H. Z., Beardslee, W. R., Fitzmaurice, G. M., Leis, J. A., & Berger, S. R. (2007). Change in prevalence of psychiatric disorders from ages 21 to 30 in a community sample. *Journal of Nervous and Mental Disease*, 195(4), 298–306.
- Thelen, E., & Smith, L. B. (1994). *A dynamic systems approach to the development of cognition and action*. MIT Press.
- Timmermans, S., & Tavory, I. (2012). Theory construction in qualitative research: From grounded theory to abductive analysis. *Sociological Theory*, 30(3), 167–186.
- Wang, P. S., Berglund, P., Olfson, M., Pincus, H. A., Wells, K. B., & Kessler, R. C. (2005). Failure and delay in initial treatment contact after first onset of mental disorders in the National Comorbidity Survey Replication. *Archives of General Psychiatry*, 62(6), 603–613.