Running head: INTERPERSONAL COORDINATION IN PSYCHOTHERAPY

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Appendix 1: Additional Details of Included Studies

Table S1. Additional Details for All Included Studies.

Reference	Sample/Gender Composition	Therapy Type	Diagnoses/Patient Issues	Length of Time Included in Analyses	Modality	Coordination Calculation
Ahmed et al. (2012)	17 dyads (4 male patients; 4 unique therapists two male, two female)	Cognitive Behavioral Therapy (CBT)	Generalized anxiety disorder (GAD)	6 weekly 2 hour sessions (14 hours total per patient)	*Interpersonal behaviors* measured by application of codes from the Structural Analysis of Social Behavior	A given unit defined as complementary if it met certain criteria. Then the percentage of complementary units was calculated by dividing by the total number of units.
Altenstein et al. (2013)	20 dyads (12 female patients, 8 male patients; 12 unique therapists, 8 female, 4 male	Exposure-based cognitive therapy for depression	Major depression	A single session from a mid phase of treatment that on average was 64 minutes	*Interpersonal behaviors* using moment-to-moment expression of affiliation and dominance with a joystick	Pearson correlations between therapist and patients ratings of dominance and affiliation. **Reciprocity** was calculated as the absolute value of patient dominance plus therapist dominance. **Correspondence** was calculated as patient affiliation minus therapist affiliation. Values range from 0-2000 and 0 is absolute **complementarity**

Reference	Sample/Gender Composition	Therapy Type	Diagnoses/Patient Issues	Length of Time Included in Analyses	Modality	Coordination Calculation
Bar-Kalifa et al. (2019)	31 clients (and 10 therapists)	Cognitive-behavioral and imagery-based	Anxiety	5 of 6 sessions from each patient with a focus on the imagery-based work done in the session (*M*=19.8 min)	Electro-dermal Activity	Autocorrelated components were first removed from each signal. Then Cross Correlation Functions (CCFs) computed within 10s lags on dyads' residualized EDA time-series, and used the maximal correlation as the synchrony level index. To account for possible nonstationarity effects in physiological data over time, they computed the CCF in consecutive temporal windows of 120 seconds, and then averaged across windows to obtain an aggregated index of synchrony for each session's imagery segment.

Reference	Sample/Gender Composition	Therapy Type	Diagnoses/Patient Issues	Length of Time Included in Analyses	Modality	Coordination Calculation
Borelli et al. (2019)	7 dyads (3 therapist)	Psychodynamic	Substance Abuse	4 session of a 12 session treatment (1,3,9,11)	*Language style matching* - Based on transcriptions, words were assigned to functional categories and then assessed for synchrony	Frequency is operationalized as the proportion of word function use compared to total word use. Verbal synchrony is calculated by subtracting the respective proportions of word function use for client and therapist. This score is standardized by taking the absolute value and subtracting it from 1, yielding a range of 0 to 1, where higher numbers indicate greater synchrony. These operations are carried out for each of the nine categories of word function and then averaged, yielding one total verbal synchrony score.
Bos et al. (2002)	51 dyads (25 women and 16 men, 6 interviewers (3 female, 3 male))	Remission interviews	Diagnosed with depression, but were not currently depressed	First 15 minutes of interview	*Nonverbal involvement behavior Patients* - Gesticulating, looking at the interviewer, head movements, looking while listening *Interviewers* - Frequencies of yes-nodding, verbal utterances during patients speaking (mmhmm)	An interaction term in a multiple regression model of patient and interviewer involvement behaviors.

Reference	Sample/Gender Composition	Therapy Type	Diagnoses/Patient Issues	Length of Time Included in Analyses	Modality	Coordination Calculation
Bouhuys et al. (2000)	50 dyads (22 patients suffered from a first time episode of depression) 33 women, 17 men) 5 interviewers	Discharge interviews from inpatients	Unipolar depression	15 min of interview	*Nonverbal involvement behavior Patients* - Gesticulating, looking at the interviewer, head movements, looking while listening *Interviewers* - Frequencies of yes-nodding, verbal utterances during patients speaking (mmhmm)	Attunement - Absolute difference between patient and therapists involvement factors for each 3 min epoch of interview. High difference is low attunement.
Bryan et al. (2018)	54 active duty soldiers (5 clinicians)	Suicide risk assessment interview and the intervention	Active suicide ideation	2 sessions	Vocally encoded emotional arousal (Fundamental frequency of the voice - f0)	Coefficients in the Actor-Partner Interdependence Models
Coleman et al. (1956)	1 dyad (both male)	Psychotherapeutic interview	Productivity and achievement dissatisfaction	44 interviews over a six month period	Heart-rate through Electrocardiogram	Visualization
DiMascio et al. (1955)	1 dyad (both male)	Psychiatric interview	Schizophrenia	1 session of about 45 minutes	Heart-rate through Electrocardiogram	Correlation
DiMascio et al. (1957)	1 dyad	Intensive psychotherapy	Not specified	1 session	Heart-rate and Skin temperature	Cross-modal coordination only examined through correlation analysis of physiological measures with social behavior measured through Bales interaction rating scale

Reference	Sample/Gender Composition	Therapy Type	Diagnoses/Patient Issues	Length of Time Included in Analyses	Modality	Coordination Calculation
Galbusera et al. (2016)	16 dyads (13 male patients)	Body-oriented psychotherapy (BPT)	Schizophrenia (15 with paranoid and 1 with schizoaffective)	The first 15 minutes of three interviews (pre-therapy, post-therapy, and symptom evaluation)	*Nonverbal whole body movements* - Derived using motion energy analysis that reflects changes in gray-scales pixels from one frame to next in video	Rolling time window cross-correlation of plus/minus 5 seconds. Averaged the absolute values of these CCFs to establish overall cross-correlation for each minute and then averaged the one minute to give a synchrony measure for entire interview.
Gaume et al. (2019)	412 dyads	Alcohol brief motivational interventions with young adults, N = 208; General practice consultations, N = 204)	Not specified	1 session	Vocally encoded emotional arousal (Fundamental frequency of the voice - f0)	Terms in the Actor-Partner Interdependence Models
Geerts & Bouhuys (1998)	26 dyads (8 males)	Hamilton Clinical interview	Major depression	15 minutes	*Nonverbal speaking effort (patients) and encouragement (interviewers)* - as specified by rating of vocalizations, head movements, looking, and hand movements	Attunement - Absolute difference between patient and therapists involvement factors for each 3 min epoch of interview. High difference is low attunement.

Reference	Sample/Gender Composition	Therapy Type	Diagnoses/Patient Issues	Length of Time Included in Analyses	Modality	Coordination Calculation
Geerts et al. (1996)	32 dyads (8 males, 23 females patients)	Hamilton Clinical interview with a psychiatrist	Unipolar major depression or bipolar depression in a depressed phase	20 minutes	*Nonverbal support seeking (patients) and nonverbal support giving (interviewers)* - as specified by rating of vocalizations, head movements, looking, and hand movements. These were also referred to as speaking effort and encouragement factors	Attunement - Absolute difference between patient speaking effort and therapists encouragement for each 4 min epoch of interview. High difference is low attunement.
Geerts et al. (2000)	60 dyads (43 female patients, male therapists)	Hamilton Clinical interview 3 days prior to treatment	Seasonal affective disorder	15 minutes	*Nonverbal speaking effort (patients) and encouragement (interviewers)* - as specified by rating of vocalizations, head movements, looking, and hand movements	Attunement - Absolute difference between patient and therapists involvement factors for each 3 min epoch of interview. High difference is low attunement.
Geerts et al. (2006)	101 dyads (61 females, 40 males, 3 interviewers	Hamilton Rating Scale for Depression interview	Recently remitted from a major depressive episode or dysthymia	First 15 minutes	*Nonverbal involvement behavior Patients* - Gesticulating, looking at the interviewer, head movements, looking while listening *Interviewers* - Frequencies of yes-nodding, verbal utterances during patients speaking (mmhmm)	**Similarity** (the absolute differences between Patient Speaking Effort and Interviewer Encouragement) **Convergence** (subtracting the absolute difference between patients and interviewers' behavior during the last 3 minutes of the interview from the absolute difference during the first 3 minutes. Positive scores indicate high levels of convergence.

Reference	Sample/Gender Composition	Therapy Type	Diagnoses/Patient Issues	Length of Time Included in Analyses	Modality	Coordination Calculation
Imel et al. (2014)	89 dyads (89 unique therapists, 85% female)	Motivational interview training sessions with real and standardized patients (people who portray a recently referred client)	Standardized patients that portrayed patient with substance abuse	20 minutes	Vocally encoded emotional arousal (Fundamental frequency of the voice - f0)	Using multilevel modeling, correlations of mean f0 of patient and therapist were examined across sessions and minutes within a session.
Kykyri et al. (2016)	1 dyad (female patient, therpaist not described). A psychology student also observed	Not specified	Depression and personal relationship issues	6 sessions altogether, this study examined only parts of the third session.	Electro-dermal Activity	Correlations were calculated between the participants' skin conductance responses (SCR). SC recordings were down-sampled to a 1s sampling interval, slopes for successive values were calculated, and each value was replaced with a 5s moving average in order to remove small amounts of amplitude noise from the signal. Pearson correlations were then calculated between the participating pairs (client to therapist, client to student, therapist to student).

Reference	Sample/Gender Composition	Therapy Type	Diagnoses/Patient Issues	Length of Time Included in Analyses	Modality	Coordination Calculation
Lord et al. (2015)	122 sessions (with 122 unique therapists; 81% female)	Motivational interview training sessions with real and standardized patients (people who portray a recently referred client)	Substance abuse	20 minutes	*Language Style* (11 categories including I, we, you, impersonal pronoun, article, auxiliary verb, adverb, preposition, conjunction, negations, quantifiers	Cohesion statistic between categories applied to adjacent talk turn pairs. Like a proportion of total talk turns between therapist and patient sharing a given language style category.
Marci & Orr (2006)	20 dyads (11 male patients, one male therapist)	A brief semi-structured question and answer session regarding local events occurring just prior to regularly schedule psychotherapy session where the therapist was either acting emotionally neutral (10 cases) or emotionally distant (10 cases)	Various mood and anxiety disorders	5-10 minutes	Skin conductance level (SCL)	Windowed slopes of SCL over 5 seconds iterated by one second. Correlation with lag-zero between patient and therapist SCL slopes in 15 second windows (15 slope averages). Single session index calculated as ratio of the sum of positive to negative correlations across whole session with transformations.

Reference	Sample/Gender Composition	Therapy Type	Diagnoses/Patient Issues	Length of Time Included in Analyses	Modality	Coordination Calculation
Marci et al. (2007)	20 dyads (11 male patients, 8 male therapists)	Psychodynamic psychotherapy	15 had a mood disorder, and 5 had an anxiety disorder	45 minute session	Skin conductance level (SCL)	Windowed slopes of SCL over 5 seconds iterated by one second. Correlation with lag-zero between patient and therapist SCL slopes in 15 second windows (15 slope averages). Single session index calculated as ratio of the sum of positive to negative correlations across whole session with transformations.
Marci et al. (2004)	10 dyads (5 male patients, 5 female patients, all unique therapists, seven male, 3 female)	Psychodynamic psychotherapy	6 with major depression, 2 bipolar disorder, 2 anxiety disorder	45 minute session	Skin conductance response (SCL)	Difference between mean level of SCL for 5 second prior to each laugh episode and first 5 seconds of laugh episode for each patient and therapist compared when laughing alone versus simultaneous laughter.
Messina et al. (2013)	39 dyads (13 unique pseudo patients, paired with 13 therapists, 13 psychologists, and 13 non-therapists)	Pseudo therapy session with specific prompts to discuss problems with different relationships	Patients were pseudo patients with no history of issues	20 minutes	Electro-dermal activity	Windowed slopes of EDA over 5 seconds iterated by one second. Correlation with lag-zero between patient and therapist SCL slopes in 15 second windows (15 slope averages). Single session index calculated as ratio of the sum of positive to negative correlations across whole session with transformations.

Reference	Sample/Gender Composition	Therapy Type	Diagnoses/Patient Issues	Length of Time Included in Analyses	Modality	Coordination Calculation
Orsucci et al. (2016)	1 dyad (male therapist, female patient)	Cognitive-based therapy	Bipolar affective disorder	Not specified	Language and galvanic skin response	Cross-recurrence analysis applied in epochs with recurrence rate extracted.
Palmieri et al. (2018)	18 dyads (18 therapist, and 18 pseudo patients)	Psychodynamic therapist performing an interview	Not specified	20 minutes	Skin conductance	Marci's et al.'s (2006) Concordance Index, also with lags from 0s to 5s in both directions. Ran a mixed model that included -5 to +5 lag with quadratic trend.
Paulick et al. (2018)	143 patients treated by 27 therapists	Cognitive-behavioral therapy (CBT)	76 Affective disorder, 41 Anxiety disorder, 11 Adjustment disorder, 4 Eating disorder, 1 Personality disorder, 10 Other	First 15 minutes of one session in the early phase of therapy	Movements analyzed using motion energy analysis	Cross-correlation within window segments of a 1-min duration (for each window, cross-correlations were computed for positive and negative time lags up to 5 seconds in steps of 0.1 seconds). Subsequently, these cross correlations were standardized with Fisher's z and their absolute values aggregated to a global value of nonverbal synchrony for each 15-min video sequence.

Reference	Sample/Gender Composition	Therapy Type	Diagnoses/Patient Issues	Length of Time Included in Analyses	Modality	Coordination Calculation
Paulick et al. (2018)	93 patients (25 with anxiety, and 68 with depressive disorder) - 23 therapists	Cognitive-behavioral therapy (CBT)	Anxiety or depression	First 15 minutes of two sessions (one in early phase and one in late phase therapy)	Movements analyzed using motion energy analysis	Cross-correlation within window segments of a 1-min duration (for each window, cross-correlations were computed for positive and negative time lags up to 5 seconds in steps of 0.1 seconds). Subsequently, these cross correlations were standardized with Fisher's z and their absolute values aggregated to a global value of nonverbal synchrony for each 15-min video sequence.
Ramseyer & Tschacher (2011)	70 dyads (70 unique patients and 42 unique therapists). Same gender only	Cognitive-behavioral psychotherapy	34% anxiety disorders, 29% affective disorders, 37% other diagnoses (11.4% adjustment disorders, 8.6% personality disorders, 17% other disorders). Comorbidity was predominantly found in anxiety disorders (58% comorbid patients) and affective disorders (24%)	First 15 minutes of two sessions (one in first third last third of treatment)	*Nonverbal upper body movements* - Derived using motion energy analysis that reflects changes in gray-scales pixels from one frame to next in video.	Cross-correlation analysis - Calculated for 1 min intervals at lag +/-50. Average absolute value of standardized correlations for whole 15 minute period used as synchrony measure.

Reference	Sample/Gender Composition	Therapy Type	Diagnoses/Patient Issues	Length of Time Included in Analyses	Modality	Coordination Calculation
Ramseyer & Tschacher (2014)	70 dyads (37 female same sex dyads, 33 male same sex dyads)	Cognitive-behavioral psychotherapy	34% anxiety disorders, 29% affective disorders, 37% other diagnoses (11.4% adjustment disorders, 8.6% personality disorders, 17% other disorders). Comorbidity was predominantly found in anxiety disorders (58% comorbid patients) and affective disorders (24%)	First 15 minutes of sessions	*Nonverbal upper body movements and nonverbal head and neck movements* - Derived using motion energy analysis that reflects changes in gray-scales pixels from one frame to next in video.	Cross-correlation analysis - Calculated for 1 min intervals at lag +/-50. Average absolute value of standardized correlations for whole 15 minute period used as synchrony measure.
Ramseyer & Tschacher (2016)	1 dyad (female same sex)	Psychodynamic therapy	Depressive symptoms and interpersonal problems	27 sessions over 1 year. Only minutes 10-50 minute period for each session. 40 minutes total for each	*Nonverbal hand movements* (with accelerometer on each wrist summed to equal total hand movement magnitude)	Cross-correlation analysis - Calculated for 1 min intervals at lag +/-5 seconds. Average absolute value of correlations for whole 40 minute period used as synchrony measure.

Reference	Sample/Gender Composition	Therapy Type	Diagnoses/Patient Issues	Length of Time Included in Analyses	Modality	Coordination Calculation
Rasting & Beutel (2005)	20 dyads (10 successful, and 10 unsuccessful). 2 Therapists	Intake interviews for inpatient treatment exploring current symptoms, interpersonal functioning, life and work situation, and biographical background. Psychodynamic treatment.	Anxiety, somatoform, adjustment, and depressive disorders. Three patients had an additional diagnosis of a personality disorder	Interview on average lasted 43 minutes, range 22-69 minutes. Only first 10 and last 5 minutes were analyzed.	*Affective facial displays* analyzed using the Emotional Facial Action Coding System put into categories of aggressive affective signals (anger, disgust, contempt), submissive affective (fear and sadness), and hedonic affective (happiness and social smiles).	Calculated the proportion of each of these categories (hedonic, aggressive, submissive) as part of the overall affectivity in the defined time frame. *Reciprocal* when both of the interactants had the highest proportion in the same category.
Reich et al. (2014)	52 dyads (52 unique clients (32 female), 16 unique therapists (13 female))	Counseling sessions at large university with free services to students	Not listed	One ~50 minute session occurring at the midpoint of treatment (3rd session)	Vocal pitch	*Therapist leading* - correlating mean pitch for each therapist turn with mean pitch of subsequent client turn *therapist following* - correlating mean pitch for each therapist turn with mean pitch of preceding client turn *overall synchrony* - mean of the above two measures.

Reference	Sample/Gender Composition	Therapy Type	Diagnoses/Patient Issues	Length of Time Included in Analyses	Modality	Coordination Calculation
Reuzel et al. (2013)	19 dyads (all unique)	In home daily life counseling	Intellectual disability	Average length was 14.6 min (SD = 6.2, Range = 7.2–29.7 min)	*Gaze direction* - dichotomous coding for client and staff indicating whether they were looking at the other person or elsewhere. Matching gaze is considered when both look at each other and *Speech pattern* - dichotomous coding for client and staff indicating whether they were talking at that point or not. Matching of speech pattern is considered when one person speaks and the other is silent.	Cross-recurrence analysis
Robinson et al. (1982)	21 dyads; 10 female counselors,16 female clients	Counseling interviews discussing actual concerns	Not specified	~20-30 minutes	Skin temperature and skin conductance	Pearson product-moment correlation coefficient
Rocco et al. (2016)	2 patients	Psychodynamic	Patient A exhibited issues with somatization. Patient B exhibited issues with OCD, depression, anxiety, and hostility.	2 sessions	*Speech Rate* - Each transcription segmented into idea units. Speech rate calculated by dividing the total number of syllables by the number of seconds taken to produce them.	Verbal attunement index calculated as the patient speech rate divided by therapist speech rate. Values closer to 1 indicate high attunement.

Reference	Sample/Gender Composition	Therapy Type	Diagnoses/Patient Issues	Length of Time Included in Analyses	Modality	Coordination Calculation
Schoenherr et al. (2019)	267 patients (dyads) and 119 therapists	Integrative CBT approach or short-term manual-guided psychodynamic-oriented psychotherapy	Social anxiety disorder (SAD)	1 session (third in treatment)	Movements analyzed using motion energy analysis	Windowed cross-lagged correlation (WCLC) with a window width of 5 s (125 frames) and maximum time lag of 5 s (125 frames) in steps of 0.04 s (one frame) with overlapping windows. synchronization intervals were identified by connecting neighboring peaks with an equal time lag (one frame tolerance) and reducing overlapping intervals based on the size of the cross-correlation function. Third, the ratio of synchronous time to total time, multiplied by 100, was used as a global value, in contrast to the averaged cross-correlation as a measure of average interrelatedness in Ramseyer and Tschacher (2011).
Stratford et al. (2009)	15 dyads (8 female clients, 5 clinical psychotherapists)	Integrative-client centered psychotherapy	Anxiety	6 45-60 minutes sessions	Skin conductance response	Single session index calculated as ratio of the sum of positive to negative correlations across whole session with transformations.

Reference	Sample/Gender Composition	Therapy Type	Diagnoses/Patient Issues	Length of Time Included in Analyses	Modality	Coordination Calculation
Stratford et al. (2012)	30 dyad (15 male patients) 3 women and 3 men therapists	Process oriented psychotherapy included different backgrounds of gestalt, psychodynamic, psychosynthesis, person centered, and somatic.	Medium to high level anxiety	6 45-60 minutes sessions	Skin conductance response and electroencephalography	Windowed slopes of EDA over 5 seconds iterated by one second. Correlation with lag-zero between patient and therapist SCL slopes in 15 second windows (15 slope averages).
Stratford et al. (2014)	30 dyad (15 male patients) 3 women and 3 men therapists	Psychodynamic	Not specified	6 weekly 1 hour sessions	Heart rate variability and electro-dermal activity	Windowed slopes of EDA over 5 seconds iterated by one second. Correlation with lag-zero between patient and therapist SCL slopes in 5 second windows (5 slope averages). Natural log of the ratio of the sum of positive skin conductance resonance values divided by the absolute sum of negative values. Then the highest values across 3 minute segments were used.

Reference	Sample/Gender Composition	Therapy Type	Diagnoses/Patient Issues	Length of Time Included in Analyses	Modality	Coordination Calculation
Thomas et al (2014)	3 dyads (1 female patient, 3 different male psychotherapists)	Each therapist had a different approach: Ellis rational-emotive, Perls gestalt, Rogers client-centered	Personal issues with family, history of divorce and problems with daughter	1st session was 18 min 2nd session was 23.5 minutes 3rd session was 31.75 minutes	*Interpersonal behaviors* using moment-to-moment expression of affiliation and dominance with a joystick	*Rhythmicity* - the proportion of variance in the time series accounted for by frequencies longer than 30s. *Average weighted coherence* - weighting the coherence value at each frequency band in the cross-spectral analysis with the univariate spectral analysis (0 to 1 indicating degree of cyclical attunement) *Average weighted phase* - weighting the phase values at each frequency band in the cross-spectral analysis with the univariate spectral analysis (-.5-.5 with 0 indicating in phase and the others as anti-phase or leading in between.

Reference	Sample/Gender Composition	Therapy Type	Diagnoses/Patient Issues	Length of Time Included in Analyses	Modality	Coordination Calculation
Tomicic et al. (2017)	1 dyad (female patient, male therapist)	Psychoanalysis	Relationship and family issues, coping with emotions related to health problem	12 episodes derived from 31 sessions (6 were change episodes, 6 were stuck episodes as defined by GCIs) Samples were derived from three phases.	Vocalization-Silence Dynamic Patterns	Pattern identification of vocalization-silence dynamics
Tracey et al. (1999)	20 dyads (4 unique therapists, 2 male) 17 female clients	Cognitive-behavioral therapy	Relationship issues, personal concerns, stress, eating disorder, or grief loss	Six sessions over four weeks	*Interpersonal complementarity* - This is a turn by turn assessment of the degree to which a given interpersonal dimension is complementary (opposite on the interpersonal circumplex)	Session by session base-rate corrected transition matrices for total therapist complementarity, total patient complementarity, and both friend and hostile complementarity for both.

Reference	Sample/Gender Composition	Therapy Type	Diagnoses/Patient Issues	Length of Time Included in Analyses	Modality	Coordination Calculation
Tschacher & Meier (2019)	4 patients (1 therapist)	Psychodynamic	Not specified	55 sessions (~51 minutes each)	Heart rate, heart rate variability, respiration, electrocardiogram	*Cross-correlations* computed segment-wise and across a range of 5 lags L the Fisher Z transformed. Synchrony in any segment i is then defined as the mean of all m cross-correlations of this segment. Absolute Z values are averaged over all lags in each segment, then aggregated over all n segments of the session to obtain a value of synchrony for the therapist-client dyad *Surrogate Concordance* slopes are determined in windows (e.g. window size 2 s) of the time series, and the time series are again partitioned in segments (of 30 s duration). The linear slopes are computed for all windows of all segments. The slopes are then correlated. These correlations then undergo Fisher's Z transforms yielding Zi , which allows arriving at the mean absolute and non-absolute correlations of a session.

Appendix 2: Results Showing Coordination within a Modality

Physiology. In psychotherapy, interpersonal coordination in various physiological modalities has been examined. The results from our review focusing on coordination in physiology are shown in Table S2. Overall, only measures relating to the autonomic nervous system including heart rate and skin conductance-based measures have been examined in the studies included by this review. However, other physiological measures such as EEG have also been investigated, but their coordination results were not detailed as they were examined only with regard to their relationship with other variables (see Table S2).

Taken together, these results suggest that during psychotherapy there are instances in which autonomic measures are coordinated between therapist and patient. However, there is a lot of variation with regard to the topics under discussion and behavior occurring (Kykyri et al., 2017; Marci et al., 2004). Additionally, this association changes both within sessions (Di Mascio et al., 1955) and across sessions (Stratford et al., 2014), or is only evident during certain periods within a session (Orsucci et al., 2016) and its dynamics can be affected with an attachment-based priming session (Palmieri et al., 2018). Furthermore, there is a lack of clear information on the directionality of the association. For example, many of the analyses used absolute values (Marci et al., 2007; Marci et al., 2004; Marci & Orr, 2006) that occlude our ability to gain a sense of the form of coordination that is most prevalent. Those that do account for positive and negative associations have found that over time the association may switch from positive to negative (Di Mascio et al., 1955). Nonetheless, the studies present some evidence of coordination in autonomic measures between therapist and patient in therapeutic interaction.

Table S2. Results by Modality: Physiology

Reference	Purpose of Study	Sample	Measure	Results
Bar-Kalifa et al. (2019)	Expected to find significant synchrony within segments devoted to both imagery and cognitive–behavioral work and that synchrony would show significant variability both at the between-dyad level and at the between-session level.	31 clients (and their 10 therapists)	EDA	During Imagery work and cognitive behavioral component, EDA synchrony was greater than chance (on average) and there was no difference between the two types of therapeutic work.
Di Mascio et al. (1955)	Advanced socio-physiology as an area of study.	1 therapist-client dyad	HR	HR of therapist and patient often co-varied. The data showed that during minutes 17-24 of the session, the association was strongly positive, but in minutes 30-42 the associated was moderately negative.
Kykyri et al. (2017)	Examined the relationship between soft prosody and embodied attunement during an emotionally intense psychotherapy episode.	1 therapist-client dyad	EDA	During a 90s emotionally intense episode, there was initially no synchrony in EDA. Then, there is a period of negative correlation between patient and therapist EDA. Lastly, there was conversational silence and patient use of soft prosody with a positive correlation between EDAs.
Marci et al. (2004)	Examined the relationship between laughter and arousal during psychotherapy.	10 therapist-client dyads	SCL	Concomitant changes in SCL were significantly greater when the therapists and patients laughed together than when they laughed alone suggesting a shared physiological response to laughter.
Marci & Orr (2006)	Examined the relationship between emotional distance, physiological concordance, and empathy.	20 therapist-client dyads	SCL	SCL was significantly higher during an emotionally neutral condition than an emotionally distant condition.

Reference	Purpose of Study	Sample	Measure	Results
Marci et al. (2007)	Examined the relationship between physiological concordance, perceived therapist empathy, and social-emotional processes.	20 therapist-client dyads	SCL	Physiological concordance in SCL was significantly greater in observed therapist-client dyads when compared to virtual dyads that did not interact.
Messina et al. (2013)	Examined the relationship between EDA concordance and empathy in trained and untrained therapists.	39 dyads (13 unique pseudo patients, paired with 13 therapists, 13 psychologists, and 13 non-therapists)	EDA	Psychologists had higher same-time EDA concordance with the patients than therapists and non-therapists.
Orsucci et al. (2016)	Advanced a multidimensional method for analyzing human dynamics with a focus on synchronization.	1 therapist-client dyad	GSR	There was evidence of synchronization in GSR primarily in a particular epoch beyond the midpoint of the psychotherapy session.
Palmieri et al. (2018)	Examined the effects attachment based priming on physiological synchrony.	18 dyads (18 therapist, and 18 pseudo patients)	SCL	Attachment-security priming was related to therapist leading more in the physiological synchrony, but the overall amount of synchrony was not related.
Stratford et al. (2009)	Examined changes in physiological concordance across therapy sessions and in relationship to brain activity.	15 therapist-client dyads	SCR	Physiological concordance in SCR increased across the first four therapy sessions and decreased in sessions 5 and 6.
Stratford et al. (2014)	Examined links between physiological concordance, heart-rate variability, therapeutic alliance, and anxiety/mood.	30 therapist-client dyads	EDA	Across the six sessions, the physiological concordance in EDA is at its highest value in session 1, which drops until session 3, then rises until session 5, and then drops to its lowest value at the last session.

Reference	Purpose of Study	Sample	Measure	Results
Tschacher & Meier (2019)	To arrive at proof-of-principle for physiological synchrony by evaluating a physiological dataset with modern statistical methodology in order to determine the extent of physiological synchrony manifested in these psychotherapy sessions.	4 patients (1 therapist)	HR, HRV, ECG, Respiration	HR synchrony was significant for absolute and anti-phase cross-correlations (SUSY), and the clients' and therapist's HRV was also synchronized using the cross-correlational approach of SUSY, but synchrony was not significant using the concordance index. Results suggest that clients' and therapist's respiration activity showed significant signatures of in-phase synchrony using both approaches.

Note: ECG = Electrocardiogram; EDA = Electrodermal activity; GSR = Galvanic Skin Response; HR = Heart Rate; SCL = Skin Conductance Level; SCR = Skin Conductance Response

Body movement and non-verbal behaviors. A range of studies included in this review examined the coordination of bodily movements in psychotherapy (results shown below in Table S3). This modality includes hand gestures, head movements and upper-body movements made by therapists and patients during interaction. Overall, the studies including measures of body movement coordination report significant results pointing to synchronization and attunement patterns in bodily behaviors in psychotherapy. However, the studies that examined this modality vary substantially and, thus, for clarity, they can be grouped into two clusters: 1) studies that focus exclusively on coordination of movement in different specified parts of the body; and 2) studies that investigate a range of behaviors concatenating different modalities within a framework of "Non-verbal Involvement Behaviors" (NIB). Thus, the latter group of studies concatenated body movement with other more vocal and conversational behaviors such as, for example, the vocalization "mhm" and eye-gaze. Due to this difference in methodology, only the studies belonging to the first cluster of studies provide clear results on the coordination of

specific body movement patterns in isolation. However, the second group is included here because these studies add to the investigation of bodily engagement in psychotherapy.

The studies that focused exclusively on bodily movements, reported that upper-body movement synchrony (Ramseyer & Tschacher, 2011, 2014), hand movement synchrony (Ramseyer & Tschacher, 2016) and head and neck synchrony in various psychotherapeutic settings were significantly greater than chance (Ramseyer & Tschacher, 2014). Furthermore, one of these studies reported results that synchronization of body movement in real psychotherapeutic interaction was greater than synchrony derived from "pseudo-interactions" (Ramseyer & Tschacher, 2011, 2016). Additionally, a study examining an intervention method of Body-Oriented Psychotherapy showed that whole-body movement synchrony increased from pre-therapy interviews to post-therapy interviews (Galbusera et al., 2016).

Within the second group of studies reporting on synchronization in body movement in psychotherapy that concatenated body movement with other conversational behaviors characterized as "Nonverbal Involvement Behavior" (NIB), a further division can be made between 1) studies that investigated therapist – patient interactional behavior employing a *symmetric paradigm*, i.e. examining the same behaviors for therapist and patient, and 2) studies adopting an *asymmetric paradigm*, examining different behaviors in the two participants. An example of the latter would be measuring a predefined range of behaviors coded as pertaining to specific "nonverbal support-seeking" behaviors in patients while measuring behaviors identified as "nonverbal support-giving" behaviors in therapists. Of the studies investigating symmetric NIB, one study reported results of significant attunement between therapist and patient (Bouhuys & Sam, 2000), whereas another study reported non-significant results of coordination (Bos et al., 2002). With regards to the studies that adopted an asymmetric paradigm to the measure of NIB

coordination, all studies reported changes in the degree of attunement over time (Geerts & Bouhuys, 1998; Geerts et al., 1996; Geerts et al., 2000; Geerts et al., 2006). However, it should be noted that these studies do not report the particular values of attunement, thus prohibiting our ability to gauge more specifically the degree of attunement from these studies.

Table S3. Results by Modality: Body Movements and Non-verbal Behaviors

Reference	Purpose	Sample	Measure	Results
Bos et al. (2002)	Examined the relation between patient involvement and severity of depression symptoms.	51 therapist – patient dyads	NIB – Symmetric	The interaction between patient involvement and interviewer involvement was not significant, although it was used as a predictor of depression symptoms.
Bouhuys & Sam (2000)	Examined the relation between attunement of nonverbal involvement and severity of depression comparing patients with first and recurrent depression episodes.	50 therapist – patient dyads	NIB – Symmetric	The study reported significant attunement in both patient groups.
Galbusera et al. (2016)	Examined the effects of a body-oriented psychotherapy intervention.	16 therapist – patient dyads	Body movements	Synchrony significantly increased from the pre-therapy interview to post-therapy interviews and symptom interviews.
Geerts et al. (1996)	Investigated attunement of patients' nonverbal support-seeking and therapists' nonverbal support-giving in relation to the subsequent course of the depression.	32 therapist – patient dyads	NIB – Asymmetric	The study reported evidence of some trends in the degree of attunement.
Geerts & Bouhuys (1998)	Examined the relation between nonverbal interpersonal interactions and nonverbal behavior and short-term outcome of depression.	26 therapist – patient dyads	NIB – Asymmetric	The study reported evidence for attunement and change in attunement.
Geerts et al. (2000)	Examined whether personality and nonverbal interpersonal processes predicted responsiveness to light treatment in seasonal affective disorder.	60 therapist – patient dyads	NIB – Asymmetric	The study reported evidence of attunement that varied significantly over time and across participants.

Reference	Purpose	Sample	Measure	Results
Geerts et al. (2006)	Examined the hypotheses that 1) convergence of nonverbal involvement behavior between interviewers and patients and patient satisfaction with interview negatively predict recurrence of depression and 2) that convergence of nonverbal behavior is positively associated with patients' satisfaction with interviews.	101 therapist – patient dyads	NIB – Asymmetric	The study reported evidence of attunement.
Ramseyer & Tschacher (2011)	Examined the hypothesis that nonverbal synchrony in psychotherapy would be positively correlated with relationship quality and outcome of therapy and greater than expected due to chance.	70 therapist – patient dyads	Upper body movements	Synchrony was significantly greater than surrogate synchrony.
Ramseyer & Tschacher (2014)	Explored the expectation that coordination in different body regions would differ in their associations with therapy outcome measures including synchrony of head, neck, and upper body movements.	70 therapist – patient dyads	Head and neck movements	Head and neck movement synchrony was greater than expected due to chance. Head synchrony was higher than body synchrony and they were also correlated.
Ramseyer & Tschacher (2016)	Examined the expectation that nonverbal hand movement synchrony was present in psychotherapy and that these findings would support previous findings linking relationship quality and synchrony.	1 therapist – patient dyad	Hand movements	Hand movement synchrony was significantly higher than pseudo-synchrony. However, this varied as a function of time lag. Synchrony increased across sessions.
Reuzel et al. (2013)	Investigated the extent to which staff and clients with mild to borderline intellectual disability achieved interactional synchrony in a daily life counseling session.	19 client – staff dyads	Eye-Gaze Direction	The study reported that eye gaze directions were not coordinated greater than chance levels.

Note: NIB = Non-verbal Involvement Behaviors

Interpersonal processes. Table S4 summarizes the different ways in which coordination of interpersonal processes were examined in various types of psychotherapy based on the

interpersonal process circumplex (Wiggins, 1996). While many of the other modalities could be considered interpersonal processes or behaviors, the studies here focus on those that that examine relationships between displays of interpersonal control and affiliation. Generally, the focus in these studies was on how specific and identified interpersonal displays were complementary and sufficiently met by matching displays. For example, within this framework, it is proposed that an affiliative behavior should be met with an affiliative behavior, but a dominant behavior should be met with a submissive behavior, and the specifics of what constitutes such behaviors are thus identified and investigated. The studies included in this review that examined these interpersonal processes reported findings that interpersonal complementarity is a pattern of interaction extant in psychotherapy (Tracey et al., 1999) that has dimensions such as affiliation and control that differentially relate to each other and, furthermore, that relationship changes over time (Altenstein et al., 2013; Thomas et al., 2014). Finally, these studies propose that expectations about treatment efficacy affect the coordination of such interpersonal processes (Ahmed et al., 2012).

Table S4. Results by Modality: Interpersonal Processes

Reference	Purpose	Sample	Measure	Results
Ahmed et al. (2012)	Examined whether client-therapist dyads would exhibit less positive (affiliative) complementarity in responding to the other's interpersonal bids.	17 client-therapist dyads	Interpersonal processes	During periods of interpersonal resistance, dyads with high expectation of treatment success had a high percentage of complementarity, compared to those with low treatment expectations.

Reference	Purpose	Sample	Measure	Results
Altenstein et al. (2013)	Examined how the moments-to-moment expressions of affiliation and dominance between patient and therapists were related to each other and how these change over the duration of a session.	20 patient-therapist dyads	Interpersonal reciprocity and correspondence	Patient and therapist's dominance were negatively correlated whereas their affiliation was positively correlated with peak correlations at lag 0. Both reciprocity and correspondence were characterized by a cubic pattern of change. Reciprocity increases, decreases, and increases again. Correspondence appears as a U shape over the session.
Thomas et al. (2014)	Examined the degree to which patterns of variability in interpersonal processes were evident in psychotherapy sessions and what that meant for the interaction.	3 patient-therapist dyads (same patient, different therapists)	Expressions of affiliation and dominance	For control (the dominance-submissive dimension), the patient exhibited high rhythmicity with each of the therapists conveying a notion of cyclical entrainment. For affiliation, the patient exhibited high rhythmicity with each of the therapists. Whether these were positive or negative associations varied based on therapist.
Tracey et al. (1999)	Examined whether the curvilinear model of complementarity was related to outcome of cognitive-behavioral therapy.	20 client-therapist dyads	Interpersonal complementary	There was overall evidence that all dyads and sessions exhibited a high level of complementarity.

Language/voice/speech. In psychotherapeutic contexts, communicative coordination has been investigated in relation to language, speech, and voice. These phenomena include measures derived from acoustical signals such as extraction of vocal pitch (Imel et al., 2014; Reich et al., 2014) and vocalization-silence dynamics (Tomicic et al., 2016), measures focused on categories of language applied to transcriptions (Lord et al., 2015), and measures related to patterns of speech (Reuzel et al., 2013). We include the results from our review focusing on these modalities together in Table S5 below.

In relation to pitch, the studies reported evidence for vocal pitch synchrony between therapist and client (Imel et al., 2014; Reich et al., 2014). In relation to language and language style, the studies presented results that showed that language style synchrony was notably higher in high empathy versus low empathy sessions (Lord et al., 2015). With regard to speech patterns, the studies presented evidence of a variety of conversational characteristics such as coordination of turn-taking dynamics (Reuzel et al., 2013), attunement of speech rates (Rocco et al., 2016), change of synchronization in speech patterns within a session (Orsucci et al., 2016), and varying conversational patterns across sessions (Tomicic et al., 2016).

Table S5. Results by Modality: Language/Voice/Speech

Reference	Purpose	Sample	Measure	Results
Borelli et al. (2019)	Examine the trajectory of Linguistic Style Matching over the course of treatment as a function of conflict, support, treatment outcomes and relational characteristics.	7 dyads (3 therapist)	Language Style Matching	LSM ranged from .84 to .91, which is a range comparable to values found in many published studies of LSM. Over time, LSM declined significantly from session 3 to 11.
Imel et al. (2014)	Examined whether therapist–standardized patient synchrony in vocally encoded arousal within interview sessions would be associated with higher ratings of therapist empathy.	89 therapist-standardized patient dyads	Vocal pitch	There were strong positive associations between therapist and patient synchrony at the session level and at the minute level whereas synchrony in virtual pairs was near zero.
Lord et al. (2015)	Examined the hypotheses that high-empathy sessions would demonstrate greater language style synchrony with clients relative to low-empathy sessions and moreover, that synchrony in language style would be predictive of empathy.	122 therapist – client dyads	Language measure/style (automated categorization)	There was evidence of language style synchrony across 11 language style categories.

Reference	Purpose	Sample	Measure	Results
Orsucci et al. (2016)	Advanced a multidimensional methodology to analyze synchronization during human interactions.	1 therapist – client dyad	Language measure/style (transcripts)	There was evidence of patient-therapist synchronization in language during the early part of psychotherapy and the third quarter of the session.
Reich et al. (2014)	Examined the evidence of vocal pitch synchrony and its relationship with therapeutic alliance and outcomes.	52 therapist – client dyads	Vocal pitch	There was evidence of vocal pitch synchrony and higher instances of therapist leading than following.
Reuzel et al. (2013)	Investigated the extent to which staff and clients with mild to borderline intellectual disability achieved interactional synchrony in a daily life counseling session.	19 client – staff dyads	Speech pattern	Speech patterns were synchronized, although because matching was considered one person speaking while the other is silent, this implies more of a coordinated turn-taking. The staff had longer response times and initiated more speech turns than clients on average.
Rocco et al. (2016)	Examined the hypothesis that in good-outcome sessions, attunement facilitates coordination in patient and therapist ruptures and resolutions, which in turn relate to adaptive mental functioning.	2 therapist – client dyads	Speech rate	There was evidence of speech rate attunement between therapist and client that varied systematically based on session outcome.
Tomicic et al. (2017)	Investigated vocal coordination patterns in dialogues conducted in a psychotherapeutic setting and examined the association between vocal coordination patterns and positive relational outcomes.	1 therapist – client dyad	Speech pattern	Four vocal coordination patterns emerged: 1) short vocalizations followed by short silences; 2) short vocalizations followed by long silences; 3) long vocalizations followed by short silences; 4) long vocalizations followed by long silences.