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VOCAL SYNCHRONY IN PSYCHOTHERAPY

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Matching of nonverbal behaviors in conversation, known as *synchrony*, is sometimes shown to predict the rapport between conversational partners. The aim of this study was to examine whether synchrony in vocal pitch between psychotherapists and clients is similarly associated with rapport. Recordings of psychotherapy sessions were analyzed to extract the synchrony in pitch of therapist and client speech, and these synchrony measures were then related to measures of the therapy relationship and treatment outcome. Results indicated that pitch synchrony did occur in the sessions but higher levels of synchrony were related to poorer therapeutic relationships and greater distress. These findings suggest that the vocal pitch of therapists and their clients may be of importance in understanding the psychotherapy interaction.

Synchrony is the "degree to which the behaviors in an interaction are nonrandom, patterned, or synchronized in both timing and form" (Bernieri & Rosenthal, 1991, p. 403). Most social interactions

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maintain a subtle, often unconscious (e.g., Chartrand & Bargh, 1999), balance of this synchrony, including courtship (e.g., Ireland et al., 2011), interviews (e.g., Gregory & Webster, 1996; Webb, 1969), team-work (e.g., Kozlowski & Ilgen, 2006), and friendship (e.g., McIntosh, 2006) interactions. Researchers have explored synchrony through both verbal and nonverbal channels of communication such as word use, facial expressions, kinesics, proxemics, and vocal qualities.

Increasing evidence has emerged indicating that greater bodily synchrony is related to more positive perceptions of rapport (e.g., Bernieri, Davis, Rosenthal, & Knee, 1994; Hove & Risen, 2009; Miles, Nind, & Macrae, 2009). Greater levels of synchrony are also linked with other positive perceptions of the interaction such as empathy (e.g., Bavelas, Black, Lemery, & Mullett, 1986), perceived smoothness of the conversation (e.g., Chartrand & Bargh, 1999), and feelings of social connectedness (e.g., Marsh, Richardson, & Schmidt, 2009). Experimental research has demonstrated that synchrony is both the product of and a causal contributor to positive interactions (e.g., Chartrand & van Baaren, 2009; Stel & Vonk, 2010). The majority of this research, however, has measured synchrony based on body movement or positioning alone.

Another important channel of synchrony is vocal pitch. Vocal pitch is how high or low a person's voice sounds (Goldstein, 2007) and is often measured by fundamental frequency, the lowest frequency of the sound wave. Pitch carries information about the speaker (e.g., accent and gender; Breitenstein, Van Lancker, & Daum, 2001). In addition, more extreme pitch levels coincide with greater emotional intensity (Banse & Scherer, 1996). In fact, one of the principal functions of pitch is to communicate the speaker's emotional state (e.g., Bachorowski, 1999; Hammerschmidt & Jürgens, 2007; Mozziconacci, 2001), such as experiencing stress (e.g., Tolkmitt & Scherer, 1986), anxiety and worry (e.g., Scherer, 1986), and clinical depression (Cannizzaro, Harel, Reilly, Chappell, & Snyder, 2004; Ellgring & Scherer, 1996).

Relative to other channels of nonverbal communication, pitch synchrony has received less attention. Some of this work has demonstrated the occurrence of pitch synchrony in conversational partners (e.g., Gregory, 1983, 1990). Importantly, Gregory, Dagan, and Webster (1997) found that, like other nonverbal channels, interac-

tions with higher levels of pitch synchrony were rated more positively.

Given the relational importance of synchrony and the emotional importance of pitch, the pitch synchrony between psychotherapist and client might be especially meaningful as both rapport and emotional distress are thought to be important for the success of therapy. Although synchrony has often been researched in the context of everyday conversations, little is known about the presence of synchrony in psychotherapy interactions. Thus far, research on therapist-client synchrony in therapy has focused on nonverbal body behaviors such as general movement (e.g., Ramseyer & Tschacher, 2008). Although one study failed to observe a relationship between body synchrony and therapeutic alliance (Willis, 1989), the more common finding is that synchrony is related to interpersonal variables in psychotherapy. For example, higher levels of bodily synchrony correlate with more positive ratings of the therapeutic alliance (Ramseyer & Tschacher, 2008; Ramseyer & Tschacher, 2011; Solley, 1988), empathy (Maurer & Tindall, 1983), rapport (Trout & Rosenfeld, 1980), and client self-efficacy (Ramseyer & Tschacher, 2011) as well as more positive, interpersonal, specific, and therapeutically relevant client verbalizations (Charny, 1966). In addition, Ramseyer and Tschacher (2011) found that body movement synchrony also predicted treatment outcomes. To our knowledge, however, pitch synchrony has not yet been investigated in psychotherapy.

If pitch synchrony does occur in therapy, it might be helpful to know who is leading pitch shifts and who is following the other interaction partner. Experimental studies have found that when therapists increase their level of bodily synchrony, the therapeutic relationship is rated more positively (Maurer & Tindall, 1983; Solley, 1988; Trout & Rosenfeld, 1980). Ramseyer and Tschacher's (2008) investigation of a single therapist-client dyad over several sessions concluded that the predominant pattern was the therapist leading the bodily synchrony and that therapist leading was associated with more positive client perceptions of the therapy relationship. Sessions marked by therapist following were associated with greater client perceptions of self-efficacy.

The aim of this study was to examine therapist-client pitch synchrony within psychotherapy sessions. It was hypothesized that (a)

pitch synchrony would be observed in therapy sessions, (b) more often therapists would lead and clients would follow pitch shifts, and (c) sessions with greater pitch synchrony would be perceived more positively and have better outcomes. For the study, recordings of midtherapy treatment sessions were annotated and analyzed using computer software to extract the turn-by-turn vocal pitch of clients and therapists. Indices of pitch synchrony were then related to measures of the therapeutic process and treatment outcome of each case. This design, therefore, allowed for assessments of the spontaneous occurrence of pitch synchrony in session, leading and following patterns, and the relationship between pitch synchrony and treatment measures.

METHOD

CLINICAL SETTING

The study was conducted at a counseling center that provides free services to students at a large urban university. Therapists at the site included counseling graduate students under the supervision of licensed faculty, student interns, and licensed staff psychologists. The mean length of treatment sessions was approximately 50 min.

TARGET DATA SET

Therapists and clients at the counseling center participated in a large exploratory study conducted between 2004 and 2007. For this original study, digital audio recordings and measures were collected for 157 cases.

Inclusion criteria for the final sample (N = 52) for the current study included clients with complete intake and third-session questionnaires and a third-session audio recording. Because outpatient treatment is typically brief with a median length of 6 sessions in outpatient clinics (Garfield, 1994), the third session was selected as an appropriate midpoint in therapy. If postsession measures were not available, measures from the next session were substituted. If third-session audio data were unavailable or inaudible, fourth-session (N = 5) or second session (N = 4) data were examined instead.

THERAPISTS

There were 16 therapists (3 males, 13 females) in this sample. Therapists reported the following cultural identities: 11 Caucasian (69%), 3 Asian or Pacific Islanders (19%), 1 African-American (6%), and 1 not reporting this information (6%). Mean therapist experience was 3.2 years (*SD* = 2.0), ranging from 0 to 7 years. One of the participating therapists was a doctoral-level licensed psychologist. The remaining therapists included 10 graduate students in training and 5 students completing their doctoral internship. One of the student therapists had only a bachelor's degree; all the remaining therapists had a master's degree. Therapists reported their theoretical orientations as 5 cognitive-behavioral (31%), 2 feminist (13%), 2 humanistic (13%), 1 client-centered (6%), 1 constructivist (6%), 1 family systems (6%), 1 multicultural (6%), 1 integrative (6%), 1 eclectic (6%), and 1 not reporting an orientation (6%).

CLIENTS

A total of 52 clients (20 males, 32 females) were included in the current study. All clients were over the age of 18 and seeking individual therapy. The mean age of clients when they began treatment was 26.6 years (range = 18–45 years). Clients reported the following cultural identities: 36 Caucasian (69%), 10 African American (19%), 2 Hispanic (4%), 1 polyethnic (2%), 1 other (2%), and 2 not reporting this information (4%).

PROCEDURE

Praat (Boersma & Weenink, 2012), a phonetics analysis software program, was used to analyze acoustic properties of the session recordings. Because the original recordings were made on one audio channel, annotation of the beginning and end of each therapist or client speech turn was demarcated in Praat so that the software could distinguish between the two speakers. Each speech turn was transcribed verbatim and both speech boundary annotation and text were reviewed for accuracy.

Speech turns lasting less than 1 s in duration—typically consisting of just non-words such as "mm-hmm"—were excluded from the analysis, which also eliminated most instances of overlapping speech. All of these excluded speech turns typically made up a very small portion of the session (M = 101.2 s, SD = 52.6) and the findings were similar whether or not these speech turns were included in the analyses. In addition, segments of the session consisting of nontherapeutic dialogue involving the scheduling of future sessions were excluded from analysis.

MEASURES

Therapeutic Alliance. The 12-item Client Working Alliance Inventory, Short Form (Tracey & Kokotovic, 1989) was used to measure perceptions of the quality of the relationship between therapist and client. A sample item is "My therapist and I agree about the things I need to do in therapy to help improve my situation." Ratings on these items are made on a 7-point scale from *never* (1) to *always* (7).

Symptom Distress. A 5-item version of the Hopkins Symptom Checklist (Tambs & Moum, 1993) was used to measure client symptom distress. A sample item is "I feel blue." Items on this measure are rated on a 4-point scale ranging from *not at all* (1) to *extremely* (4).

Depressive Symptoms. A 7-item version of the Beck Depression Inventory (Beck, Guth, Steer, & Ball, 1997) was used to assess depressive symptoms. Items are rated on a 4-point scale indicating increasing distress.

Relationship Outcome. The 11 interpersonal relationship items of the Outcome Questionnaire 45.2 (Lambert et al., 1996) measured satisfaction and problems with relationships. A sample item is "I am concerned about family troubles." Clients rated the accuracy of the item statements to their current life situations on a 5-point scale ranging from *never* (1) to *almost always* (5).

PRELIMINARY ANALYSES

Synchrony Estimates. Two different types of vocal pitch synchrony between therapist and client were calculated. First, across each therapy session, a *therapist-leading measure* was created by correlating

the mean pitch of each therapist speech turn with the mean pitch of the client speech turn that came immediately afterward. Second, across the therapy session, a *therapist-following measure* was created by correlating the mean pitch of each therapist speech turn with the mean pitch of the client speech turn that came immediately before. The distribution of these correlations was then normalized by converting them to Fisher's *z* scores (Fisher, 1921). Because the therapist-leading and therapist-following measures were correlated moderately, $r = .42$, a mean of the two measures was also calculated to form an overall estimate of pitch synchrony for each therapy session. Analyses were then conducted using the transformed therapist-leading, therapist-following, and overall synchrony estimates.

Unit of Analysis. Therapists in this sample saw between 1 and 11 clients. Because of this, cases involving the same therapist may have been more similar to one another, raising issue independence. Previous researchers (e.g., Crits-Christoph & Mintz, s of statistical 1991; Martindale, 1978) have emphasized the potential for differences between therapists and noted the implications for appropriate analysis. Therefore, a preliminary assessment was conducted comparing variation among cases treated by the same therapist with variation between cases with different therapists. This analysis revealed that measures from sessions involving different therapists were less similar to one another relative to measures from sessions involving the same therapist, therapist-leading synchrony, intraclass $R = .70$, $F(1, 50) = 8.23$; therapist-following synchrony, intraclass $R = .52$, $F(1, 50) = 4.33$; overall synchrony, intraclass $R = .78$, $F(1, 50) = 11.98$.[1] Given this evidence of therapist clustering, measures from cases involving the same therapist were averaged so that therapist became the unit for the following analyses.

Mean Outcome. The three individual measures of therapeutic outcome correlated substantially, mean $r = .52$. Therefore, these measures were standardized and averaged into a single outcome measure. Analysis indicated that this composite outcome measure had high inter-item reliability, Cronbach's $\alpha = .83$.

1. Because the number of clients varied for different therapists, intraclass correlations were computed using the procedure for unequal class membership outlined in Haggard (1958, Chapter 2).

RESULTS

SYNCHRONY IN SESSION

One question is whether the synchrony observed in these therapy sessions occurred at greater than chance levels. Analysis revealed that the degree of overall synchrony ($M = 0.12$, $SD = 0.13$) was greater than zero, $t(15) = 3.79$, $p = .002$.

A second question is whether therapists more often led or followed pitch shifts made by their clients. Analysis revealed greater therapist-leading ($M = 0.15$, $SD = 0.17$) than therapist-following synchrony ($M = 0.09$, $SD = 0.14$); however, this difference was not statistically significant, $t(15) = 1.33$, $p = .2$.

PROCESS AND OUTCOME

Given that synchrony occurred at greater than chance levels, we assessed whether synchrony was associated with client ratings of therapeutic process and outcome. As can be seen in Table 1, greater therapist-leading synchrony was associated with lower ratings of therapeutic alliance. The other measures of synchrony were also negatively correlated with alliance, however they were not statistically significant.

Synchrony was associated with one measure of outcome. Specifically, greater therapist-following synchrony was related to greater reports of depression. Although all the other measures of outcome were also positively associated with therapist-following, therapist-leading, and overall synchrony, these correlations failed to reach statistical significance.

DISCUSSION

Therapists and clients in these psychotherapy sessions exhibited a modest degree of synchrony in vocal pitch. When either the therapist or the client raised or lowered their pitch, there tended to be a corresponding matching of pitch by the other person. On average, the shifting of pitch was not more likely to be initiated by the therapist or the client. However, there were substantial differences

TABLE 1. Correlations of Therapist-Leading, Therapist-Following, and Overall Synchrony with Client-Rated Therapeutic Process and Treatment Outcome

	Type of Synchrony		
Measure	**Leading**	**Following**	**Overall**
Therapeutic Process			
Alliance[a]	–.60*	–.09	–.44
Treatment Outcome			
OQ Relationship[b]	.31	.30	.36
Symptom Distress[c]	.03	.36	.21
Depression[d]	.41	.69*	.64
Mean Outcome[e]	.30	.55	.49

Note. $N = 16$ therapists. Higher values indicated greater distress on all outcome measures. [a]Alliance was based on the Working Alliance Inventory, with higher values indicating greater alliance; [b]OQ relationship was a measure of social relationships; [c]Symptom distress was based on the 5-item Hopkins Symptom Checklist; [d]Depression was based on a brief version of the Beck Depression Inventory; [e]Outcome was a composite of the three outcome measures.
*$p < .05$ using the Sidak-Bonferroni correction (Sidak, 1967).

between therapists in the tendency to initiate shifts in pitch. Analyses indicated that when clients followed the pitch of the therapist, the therapeutic alliance in the session was less likely to be judged positively. And therapists were more likely to mirror the pitch of the client for those clients who subsequently reported more depressive symptoms at the end of the session.

Given that synchrony is observed in other nonverbal channels of communication and across a number of social settings (see review by Chartrand & van Baaren, 2009), pitch synchrony in psychotherapy was expected. Surprisingly, the degree of synchrony occurring was relatively small on average. As pitch synchrony appears to be a relatively subtle phenomenon in psychotherapy, other channels of synchrony, or a more cumulative measure of synchrony across several channels, may be more salient to conversational partners and potentially more related to the psychotherapy interaction.

Although therapists appeared to lead pitch shifts more often than they followed them, this difference was not statistically significant. Previous research with body movement synchrony in psychotherapy (Ramseyer & Tschacher, 2011), however, has found therapists engage in consistently more leading than following. Perhaps the most parsimonious explanation of the findings of this study is that within the channel of pitch, synchrony is a recursive process with no clear leader (Hess, Philippot, & Blairy, 1999) and is better concep-

tualized as a byproduct of the relationship rather than a mechanism of change.

In previous literature examining synchrony, higher degrees of synchrony are typically associated with more positive ratings of the interaction. The unexpected relationships between synchrony and therapeutic process and outcome might be explained in a number of ways. One explanation of why therapist-initiated pitch changes were associated with lower ratings of the therapeutic alliance might be that therapists in the study were attempting to model pitch shifts behaviorally, encouraging clients to move in a different affective direction. Although such a process might eventually help clients, it might have a more immediate effect of causing clients to feel misunderstood and thereby lower their ratings of the therapeutic alliance. If this were the case, though, we might expect to see greater therapist-initiated synchrony to be associated with a reduction in distress; however, the opposite (although not statistically significant) pattern was observed in this study. It also remains possible that pitch synchrony in psychotherapy carries different social meaning than in other social contexts and that a high degree of synchrony has a deleterious effect. Perhaps a more consistent explanation of these findings might then be that an increased number of therapist-led pitch shifts are a sign that the therapeutic alliance is suffering. For example, when clients have decided that their therapist is not fully invested in the same therapeutic goals, he or she might express this to some degree by becoming more passive in the therapeutic process and following their therapist's pitch more, perhaps even in an attempt to mask their discontent. Yet another explanation is that clients might respond in therapy to moments in which they feel the therapeutic alliance is ruptured by engaging in more synchrony with the therapist in an attempt to repair or mend the relationship (Safran, Muran, & Eubanks-Carter, 2011).

Therapist matching of client pitch was associated with greater client depressive symptoms. Previous experimental studies of bodily synchrony indicate that therapist mirroring of the client leads to greater perceptions of empathy (Maurer & Tindall, 1983; Solley, 1988; Trout & Rosenfeld, 1980). Within the channel of pitch, it is possible that therapists responded to clients expressing a high degree of distress by matching the client's pitch in an attempt to express empathy with the client's emotional state. Although it contradicts

conventional therapeutic wisdom and research with body-movement synchrony (e.g., Ramseyer & Tschacher, 2011), it also remains possible that therapist matching of client pitch carries different information that could actually led to poorer outcomes. Within this sample of predominantly novice therapists, for example, clients might have viewed the therapist imitating their pitch as a sign that the therapist lacked confidence or knowledge of how to move forward in the session. Also, therapist mirroring of client pitch may have amplified the emotional distress of the client.

Future research could expand on this study by examining the context of high and low synchrony moments in therapy. As with other processes in therapy, the amount of pitch synchrony might be less important to the success of the session than the appropriate timing of synchrony. For example, if synchrony on the part of the therapist communicates nonverbal agreement or alignment with what the client is saying, imitating the client's vocal pitch while a client is being self-affirming might be more helpful than similar levels of synchrony in response to self-deprecating comments made by the client (Charny, 1966). It might also be that at certain times during a session synchrony is pivotal for the rapport between client and therapist, such as during significant or critical change moments in therapy (Elliot, 1986; Fitzpatrick & Chamodraka, 2007; Timulak, 2010). Future research could explore this by relating each pitch shift event to moment-by-moment ratings of the session rather than postsession ratings of the entire session. Additionally, future investigations of synchrony in psychotherapy might explore the role of therapeutic orientations, particularly those that place an emphasis on vocal cues (e.g., see client vocal quality scale Rice & Kerr, 1986), and participant characteristics such as psychopathology, gender, and culture.

Regardless of the direction of future research, this study was the first to investigate the role of pitch synchrony with regard to psychotherapy process and outcome. The results of the study are suggestive of subtle processes occurring in psychotherapy and adds to our knowledge of synchrony phenomena in general. Future research could expand on pitch as well as other channels of synchrony, potentially yielding findings that might help psychotherapists enhance the effectiveness of treatment.

REFERENCES

Bachorowski, J. (1999). Vocal expression and perception of emotion. *Current Directions in Psychological Science*, *8*, 53–57. doi:10.1111/1467-8721.00013

Banse, R., & Scherer, K. R. (1996). Acoustic profiles in vocal emotion expression. *Journal of Personality and Social Psychology*, *70*, 614–636. doi:10.1037/0022-3514.70.3.614

Bavelas, J. B., Black, A., Lemery, C. R., & Mullett, J. (1986). "I show how you feel": Motor mimicry as a communicative act. *Journal of Personality and Social Psychology*, *50*, 322–329. doi:10.1037/0022-3514.50.2.322

Beck, A. T., Guth, D., Steer, R. A., & Ball, R. (1997). Screening for major depression disorders in medical inpatients with the Beck Depression Inventory for Primary Care. *Behavior Research and Therapy*, *35*, 785–791.

Bernieri, F. J., Davis, J. M., Rosenthal, R., & Knee, C. (1994). Interactional synchrony and rapport: Measuring synchrony in displays devoid of sound and facial affect. *Personality and Social Psychology Bulletin*, *20*, 303–311. doi:10.1177/0146167294203008

Bernieri, F. J., & Rosenthal, R. (1991). Interpersonal coordination: Behavior matching and interactional synchrony. In R. Feldman & B. Rimé (Eds.), *Fundamentals of nonverbal behavior* (pp. 401–432). New York: Cambridge University Press.

Boersma, P., & Weenink, D. (2012). Praat: Doing phonetics by computer Version 5.3.13 [Computer program]. Retrieved from http://www.praat.org/

Breitenstein, C., Van Lancker, D., & Daum, I. (2001). The contribution of speech rate and pitch variation to the perception of vocal emotions in a German and an American sample. *Cognition and Emotion*, *15*, 57–79. doi:10.1080/0269993004200114

Cannizzaro, M., Harel, B., Reilly, N., Chappell, P., & Snyder, P. J. (2004). Voice acoustical measurement of the severity of major depression. *Brain and Cognition*, *56*, 30–35. doi:10.1016/j.bandc.2004.05.003

Charny, E. J. (1966). Psychosomatic manifestations of rapport in psychotherapy. *Psychosomatic Medicine*, *28*, 305–315.

Chartrand, T. L., & Bargh, J. A. (1999). The chameleon effect: The perception–behavior link and social interaction. *Journal of Personality and Social Psychology*, *76*, 893–910. doi:10.1037/0022-3514.76.6.893

Chartrand, T. L., & van Baaren, R. (2009). Human mimicry. In M. P. Zanna (Ed.), *Advances in experimental social psychology* (Vol. 41, pp. 219–274). San Diego: Elsevier Academic Press.

Crits-Christoph, P., & Mintz, J. (1991). Implications of therapist effects for the design and analysis of comparative studies of psychotherapies. *Journal of Consulting and Clinical Psychology*, *59*, 20–26. doi:10.1037/0022-006X.59.1.20

Ellgring, H., & Scherer, K. R. (1996). Vocal indicators of mood change in depression. *Journal of Nonverbal Behavior*, *20*, 83–110. doi:10.1007/BF02253071

Elliot, R. (1986). Helpful and nonhelpful events in brief counseling interviews: An empirical taxonomy. *Journal of Counseling Psychology*, *32*, 307–322.

Fisher, R. A. (1921). On the "probable error" of a coefficient of correlation deduced from a small sample. *Metron*, *1*, 3–32.

Fitzpatrick, M. R., & Chamodraka, M. (2007). Participant critical events: A method for identifying and isolating significant therapeutic incidents. *Psychotherapy Research*, *17*, 622–627.

Garfield, S. L. (1994). Research on client variables in psychotherapy. In A. E. Bergin & S. L. Garfield (Eds.), *Handbook of psychotherapy and behavior change* (4th ed., pp. 190–228). New York: Wiley.

Goldstein, E. (2007). *Sensation and perception* (8th ed.). Belmont, CA: Wadsworth Cengage Learning.

Gregory, S. W. (1983). A quantitative analysis of temporal symmetry in microsocial relations. *American Sociological Review*, *48*, 129–135. doi:10.2307/2095151

Gregory, S. W. (1990). Analysis of fundamental frequency reveals covariation in interview partners' speech. *Journal of Nonverbal Behavior*, *14*, 237–251. doi:10.1007/BF00989318

Gregory, S. W., Dagan, K., & Webster, S. (1997). Evaluating the relation of vocal accommodation in conversation partners' fundamental frequencies to perceptions of communication quality. *Journal of Nonverbal Behavior*, *21*, 23–43. doi:10.1023/A:1024995717773

Gregory, S. W., & Webster, S. (1996). A nonverbal signal in voices of interview partners effectively predicts communication accommodation and social status perceptions. *Journal of Personality and Social Psychology*, *70*, 1231–1240. doi:10.1037/0022-3514.70.6.1231

Haggard, E. A. (1958). *Intraclass correlation and the analysis of variance.* New York: Dryden Press.

Hammerschmidt, K., & Jürgens, U. (2007). Acoustical correlates of affective prosody. *Journal of Voice*, *21*, 531–540. doi:10.1016/j.jvoice.2006.03.002

Hess, U., Philippot, P., & Blairy, S. (1999). Mimicry: Fact and fiction. In P. Philippot, R. S. Feldman, & E. J. Coats (Eds.), *The social context of nonverbal behavior* (pp. 213–241). New York: Cambridge University Press.

Hove, M. J., & Risen, J. L. (2009). It's all in the timing: Interpersonal synchrony increases affiliation. *Social Cognition*, *27*, 949–960. doi:10.1521/soco.2009.27.6.949

Ireland, M. E., Slatcher, R. B., Eastwick, P. W., Scissors, L. E., Finkel, E. J., & Pennebaker, J. W. (2011). Language style matching predicts relationship initiation and stability. *Psychological Science*, *22*, 39–44. doi:10.1177/0956797610392928

Kozlowski, S. J., & Ilgen, D. R. (2006). Enhancing the effectiveness of work groups and teams. *Psychological Science in the Public Interest*, *7*, 77–124. doi:10.1111/j.1529-1006.2006.00030.x

Lambert, M. J., Hansen, N. B., Umpress, V., Lunnen, K., Okiishi, J., Burlingame, G. M. et al. (1996). *Administration and scoring manual for the OQ-45.2*. Stevenson, MD: American Professional Credentialing Services.

Marsh, K. L., Richardson, M. J., & Schmidt, R. C. (2009). Social connection through joint action and interpersonal coordination. *Topics in Cognitive Science*, *1*, 320–339. doi:10.1111/j.1756-8765.2009.01022.x

Martindale, C. (1978). The therapist-as-fixed-effect fallacy in psychotherapy research. *Journal of Consulting and Clinical Psychology*, *46*, 1526–1530. doi:10.1037//0022-006X.46.6.1526

Maurer, R. E., & Tindall, J. H. (1983). Effect of postural congruence on client's perception of counselor empathy. *Journal of Counseling Psychology*, *30*, 158–163. doi:10.1037/0022-0167.30.2.158

McIntosh, D. N. (2006). Spontaneous facial mimicry, liking and emotional contagion. *Polish Psychological Bulletin*, *37*, 31–42.

Miles, L. K., Nind, L. K., & Macrae, C. (2009). The rhythm of rapport: Interpersonal synchrony and social perception. *Journal of Experimental Social Psychology*, *45*, 585–589. doi:10.1016/j.jesp.2009.02.002

Mozziconacci, S. L. (2001). Modeling emotion and attitude in speech by means of perceptually based parameter values. *User Modeling and User-Adapted Interaction*, *11*, 297–326. doi:10.1023/A:1011800417621

Ramseyer, F., & Tschacher, W. (2008). Synchrony in dyadic psychotherapy sessions. In S.Vrobel, O. E. Roessler, & T. Marks-Tarlow (Eds.), *Simultaneity: Temporal structures and observer perspectives* (pp. 329–347). Singapore: World Scientific.

Ramseyer, F., & Tschacher, W. (2011). Nonverbal synchrony in psychotherapy: Coordinated body movement reflects relationship quality and outcome. *Journal of Consulting and Clinical Psychology*, *79*, 284–295. doi:10.1037/a0023419

Rice, L., & Kerr, G. (1986). Measures of client and therapist vocal quality. In L. Greenberg & W. Pinsof (Eds.), *The psychotherapeutic process: A research handbook* (pp. 73–106). New York: Guilford Press.

Safran, J. D., Muran, J. C., & Eubanks-Carter, C. (2011). Repairing alliance ruptures. *Psychotherapy*, *48*, 80–87.

Scherer, K. R. (1986). Vocal affect expression: A review and a model for future research. *Psychological Bulletin*, *99*, 143–165. doi:10.1037/0033-2909.99.2.143

Sidak, Z. (1967). Rectangular confidence regions for the means of multivariate normal distributions. *Journal of the American Statistical Association*, *62*, 636–633. doi:10.2307/2283989

Solley, R. F. (1988). Posture mirroring and therapeutic alliance. *Dissertation Abstracts International*, *49*, 62.

Stel, M., & Vonk, R. (2010). Mimicry in social interaction: Benefits for mimickers, mimickees, and their interaction. *British Journal of Psychology*, *101*, 311–323. doi:10.1348/000712609X465424

Tambs, K., & Moum, T. (1993). How well can a few questionnaire items indicate anxiety and depression? *Acta Psychiatrica Scandinavica*, *87*, 364–367. doi:10.1111/j.1600-0447.1993.tb03388.x

Timulak, L. (2010). Significant events in psychotherapy: An update of research findings. *Psychology and Psychotherapy: Theory, Research, and Practice*, *83*, 421–447.

Tolkmitt, F. J., & Scherer, K. R. (1986). Effect of experimentally induced stress on vocal parameters. *Journal of Experimental Psychology: Human Perception and Performance*, *12*, 302–313. doi:10.1037/0096-1523.12.3.302

Tracey, T. J., & Kokotovic, A. M. (1989). Factor structure of the Working Alliance Inventory. *Psychological Assessment*, *1*, 107–210. doi:10.1037//1040-3590.1.3.207

Trout, D. L., & Rosenfeld, H. M. (1980). The effect of postural lean and body congruence on the judgment of psychotherapeutic rapport. *Journal of Nonverbal Behavior*, *4*, 176–190. doi:10.1007/BF00986818

Webb, J. T. (1969). Subject speech rates as a function of interviewer behaviour. *Language and Speech*, *12*, 54–67.

Willis, C. J. (1989). *The measurement of mutual nonverbal coordination in the psychotherapeutic process: An exploratory study of the development of an index for clinical use*. (Unpublished doctoral dissertation). Department of Education, University of Massachusetts.