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Social Psychology

How Emotion Contagion Changes as Strangers Become Acquainted: A Longitudinal Conversation Study

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People's emotional states often become more similar after social interactions, a process known as emotion contagion. Emotion contagion is considered both a by-product of shared goals and a tool for strengthening social bonds. Although cross-sectional evidence suggests emotion contagion is positively related to bond strength, few studies have investigated this relationship longitudinally as people become acquainted. Perhaps emotion contagion increases as people become closer (a within-dyad effect), reflecting relationship closeness. Or perhaps some dyads have a stable mutual liking and a tendency towards emotion contagion that does not change over time (a between-dyad effect). Our study disentangled these two accounts. Pairs of unacquainted participants had conversations weekly for six weeks over Zoom. Participants reported pre- and post-conversation emotion states and closeness to their partner after each conversation. Emotion contagion, measured in three different ways, *declined* over time as dyads became interpersonally closer (evidence for a within-dyad effect). This decline may indicate increased comfort with emotional divergence. Notably, dyads that reported greater average interpersonal closeness exhibited larger changes in emotion states during their conversations, aligning with previous between-dyad findings. Thus, the association between emotion contagion and feelings of interpersonal closeness depends on whether we consider change within a dyad or compare between dyads.

People's emotional states often become more similar after social interactions, a phenomenon known as *emotion contagion* (Hatfield et al., 1993). Emotion contagion occurs across situations (Barsade et al., 2018; Chartrand et al., 2006; Hsee et al., 1992) and time scales (Bizzego et al., 2020; Meredith et al., 2020). It can happen in various dyadic relationships, including between parent and child (Harrist & Waugh, 2002), romantic partners (Anderson et al., 2003), or two strangers in a laboratory (Hsee et al., 1992).

Interaction partners who feel close to each other often exhibit greater emotion contagion than partners who do not feel close (Kimura et al., 2008; Wróbel, 2018). However, limited past work examines how emotion contagion covaries with interpersonal closeness over time within a single relationship. As two people become acquainted, do they increase (or decrease) emotion contagion? Does the amount of emotion contagion during an interaction reflect the current state of the relationship? Or is the tendency to share emotions (or not) a stable aspect of the relationship? Relationships among dyads are constantly developing and changing, including their levels of interdependence (Clark & Reis, 1988). With the knowledge that emotions are not stable, but are instead dynamical processes (Frijda, 1986), emotion contagion processes in dyads should also be studied at various points within relationships. In this study, we aim to explore how emotion contagion changes over time and whether it is associated with the evolution of a relationship.

The Bidirectional Association Between Emotion Contagion and Relationship Closeness

Increased emotion contagion between two people can indirectly lead to them liking each other more (daSilva & Wood, 2024; Wood et al., 2021). Contagion can serve as a signal of empathy or agreement, letting the partners know that they appraise a situation in a similar way (Fischer & Manstead, 2008). Synchrony and coordination from convergence are rewarding because they reduce cognitive effort, making people evaluate the other person and the situation more favorably (Kret & Akyüz, 2022). Since people

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like those that are more similar to them (McPherson et al., 2001), emotion contagion can lead to greater liking. People prefer strangers who feel similar emotions (Gibbons, 1986), as shared emotional responses reveal shared goals and, possibly, shared identities (Rossignac-Milon et al., 2020).

Yet people do not indiscriminately pick up the emotions of everyone they meet. Goals to affiliate, even on an unconscious level, lead to more emotional mimicry (Hess & Fischer, 2022). People are more prone to catching the feelings of those they like (Likowski et al., 2008; Wróbel et al., 2015) and those they feel more similar to (Gump & Kulik, 1997; Wróbel et al., 2015). People also mimic their ingroup members more than their outgroup members (Bourgeois & Hess, 2008; McHugo et al., 1991). In some contexts, emotion contagion has been shown to correlate with relationship closeness. People are more likely to catch both positive and negative moods of friends compared to strangers (Kimura et al., 2008; Wróbel, 2018). The association between emotion contagion and closeness is also observed in studies focused on romantic couples (Butler, 2011). Couples that have more emotion contagion on average also have greater marital satisfaction (Mazzuca et al., 2019).

However, relationship closeness does not always positively correlate with emotion contagion across studies and methods of emotion contagion measurement. Some studies have found that emotion contagion is not related to interpersonal closeness (McIntosh, 2006; van der Schalk et al., 2011) or marital satisfaction (Sels, Cabrieto, et al., 2020).

Contradictory results from prior studies may arise, in part, from different operationalizations of emotion contagion. Emotion contagion has been related to, and sometimes used interchangeably with, other similar constructs such as "emotion similarity" (Goldenberg et al., 2020; Sels, Ruan, et al., 2020; Townsend et al., 2014), "emotional convergence" (Anderson & Keltner, 2004; Parkinson, 2020), or "emotion matching" (Parkinson, 2020). These also have different operationalizations associated with them. Work on primitive emotion contagion (Hatfield et al., 1992) typically used unidirectional sender-receiver paradigms, in which only one person has the ability to adopt the emotion state of a partner who is or is not physically present. However, in dyadic naturalistic settings, both partners can act as senders and receivers (Petitta & Naughton, 2015). In the present work, we used natural emotion states, rather than induced emotions, to allow for bidirectional transference. Findings in prior work may also depend on whether the study used a repeated-measure (versus cross-sectional) design, a distinction we consider next.

Emotion Contagion and Relationship Closeness over Time: Beyond Single Interactions

Examining whether and how emotion contagion correlates with relationship closeness requires differentiating between-dyad and within-dyad effects. It is possible that some dyads always share one another's emotions, while other dyads do not. Those same dyads might also feel closer to each other, even when they first meet, leading to a positive between-dyad correlation between relationship closeness and emotion contagion. It is also possible that emotion contagion varies from interaction to interaction, within-dyad, and covaries with how close partners feel *in the moment,* relative to other moments. Many studies use a single event cross-sectional design, confounding state and trait emotion contagion (see Hatfield et al., 2014, for a review).

Separating between- and within-dyad correlations between emotion contagion and relationship closeness would provide indirect insight into the possible function of emotion contagion. If a dyad *increases* their emotion contagion as they grow closer, it suggests that emotion contagion is a consequence of increased interdependence. As two people become more invested in each other's lives, their emotions become more relevant to each other. If, on the other hand, a dyad *decreases* their emotion contagion as they get to know each other, it suggests that early emotion contagion helps partners establish an initial connection and signal interpersonal similarity. Finally, if emotion contagion is a stable property of a dyad—some dyads consistently match each other's emotion states, and others do not—then we can ask whether a dyad "clicking" in this way is predictive of their long-term relational success.

A majority of the longitudinal work on emotion contagion in dyads is focused on romantic couples rather than platonic relationships (Rogers et al., 2018; Schoebi & Randall, 2015). Some studies have found that couples that showed greater amounts of similarity in emotion responses to stimuli were more cohesive and less likely to dissolve the relationship (Anderson et al., 2003). However, emerging research has also shown that healthy couples do not always exactly match emotions; rather, emotion independence and co-regulation are important as well (Parkinson & Simons, 2012). When one person feels negative affect, the other helps them regulate their affect to become more positive, bringing them back towards a more stable, neutral state (Butler & Randall, 2013). Schoebi and Randall (2015) studied couples over a period of 10 days and found that men felt more positive affect after their partners expressed feelings of hurt or fear, and women felt less hurt and fear after their partner felt more.

There are two issues with focusing exclusively on romantic couples. First, couples are self-selected rather than randomly assigned, so we cannot rule out the possibility that partners chose each other because of their emotional similarity. Second, romantic partners are presumably already very close. These studies are unlikely to capture large changes in relationship status—the type of change that we might expect to see as people go from complete strangers to friendly acquaintances.

One study that did involve changes in relationship status examined college roommates' reactions to emotionally evocative events at two time points and found that, after a year of living together, they had more similar emotional reactions (Anderson et al., 2003). At the second time point, emotion similarity further predicted relationship closeness. While this study might suggest increased emotion similarity with time, we note that the researchers did not control for the amount of time dyads spent together over the

course of the year. Time spent together could be a common cause of both closeness and having similar emotional responses, and closeness of a relationship often determines interaction frequency (Baym et al., 2004). Further, because the emotions measured were elicited by experimental paradigms (e.g., an embarrassing task), it is unclear whether the dyads were "catching" each other's emotions or having parallel emotion responses. Finally, the analyses did not separate the within-dyad association between relationship closeness and emotion contagion from the between-dyad association. Since dyads were not created with random assignment, participants may have selected roommates based on other variables that simultaneously predict closeness and future emotion contagion (e.g., interpersonal similarity). The present study complements this work by randomly matching partners, having them converse alone so any emotionality is more likely to be a direct response to each other, and controlling how much time they spend with each other.

The Present Work

Our study examined the within-dyad and between-dyad associations between relationship closeness and emotion contagion as participants became acquainted with a partner. We randomly matched pairs of unacquainted college students to talk to each other once a week for six weeks. Because this study occurred during the COVID-19 pandemic, all interactions occurred on Zoom, as per the guidelines of the university's general policies and laboratory study protocols. While online interactions are less rich than offline face-to-face ones, many studies, including ones conducted before the rise of social media or the COVID-19 pandemic, show that friendships can emerge from purely or mostly online interactions (Chan & Cheng, 2004; Parks & Floyd, 1996), and can be just as deep and meaningful as in-person friendships (Walther, 1992). Connecting with others on video calling platforms was more normative and relied upon during the pandemic (Brown & Greenfield, 2021; Juvonen et al., 2021), especially for university students who had limited access to meeting friends in-person (classes and extracurriculars were exclusively online).

During the study, participants reported their emotion valence and arousal before and after each conversation and how close they felt to each other after each conversation. Emotion contagion can be (and has been) measured in numerous ways, so we calculated it in three ways to ensure our results were not dependent on a single metric. Participants indicated their emotion states before and after each conversation by clicking on an affect grid plot of valence-by-arousal (Russell et al., 1989). From these responses, we calculated three emotion contagion measures for each interaction, designed to capture different aspects of dyads' emotion states, based on conceptually similar measures employed in previous research: (1) *emotion movement* (how much a person's emotion changes over the course of the interaction (Goldenberg et al., 2020; Hennig-Thurau et al., 2006), (2) *emotion distance post-conversation* (how similar two partners' emotions were to each other after each conversation, Verhofstadt et al., 2008), and (3) *emotion convergence* (how much more similar partners become to each other over the course of the interaction; Anderson et al., 2003; see Figure 1). Each measure of contagion captures a different aspect of interpersonal emotion dynamics, so we include all three to paint a fuller picture of how conversations influenced partners' emotions, and how this influence changed as they became more familiar with each other. Including all three measures also allows for direct comparisons with other studies.

As a follow-up analysis, we asked whether changes in emotion contagion over the six weeks were accompanied by changes in the semantic content of the conversations. We measured semantic markers of affiliation to behaviorally quantify their increasing interpersonal closeness. We also extracted the valence of their speech to see if the semantic content changed in emotionality as participants got to know one another. For similar reasons, we measured the semantic markers of authenticity and politeness of their speech based on the post hoc prediction that participants became more genuine (and less polite), allowing themselves to discuss more emotionally complex topics with time.

The longitudinal aspect of our study design allowed us to ask how emotion contagion and relationship closeness covary over time, while the randomized pairing eliminated possible partner selection effects. We also controlled for how much time partners spend together by holding constant the length of their conversations in the lab. Thus, exposure time was not confounded with relationship closeness, as would occur with more naturalistic dyads. The repeated measures design also enables the separation of the within-dyad and between-dyad associations between relationship closeness and emotion contagion.

This work provides correlational data on the social function of emotion contagion in the understudied early stage of friendship initiation. By separating within- and between-dyad processes and calculating emotion contagion in three ways, this work also highlights how different study design choices might lead to different conclusions about interpersonal processes.

Method

Study materials, data and code are available online: (https://osf.io/b6xs9/). Additional information about measures (including personality measures not analyzed here) and secondary analyses are included in supplemental materials. This study was not preregistered.

Participants

We recruited a total of 118 undergraduate students (M_{age} = 18.88, SD_{age} = 1.26, female = 83%) to participate in our longitudinal study in exchange for course credit or pay. Out of the total 59 dyads, 52 completed all 6 sessions and 7 stopped after 4 sessions. The data from all 59 dyads were included in analyses. In our final sample, 55% identified as white, 32% Asian, 4% Black/African American, and 9% as mixed race or other.

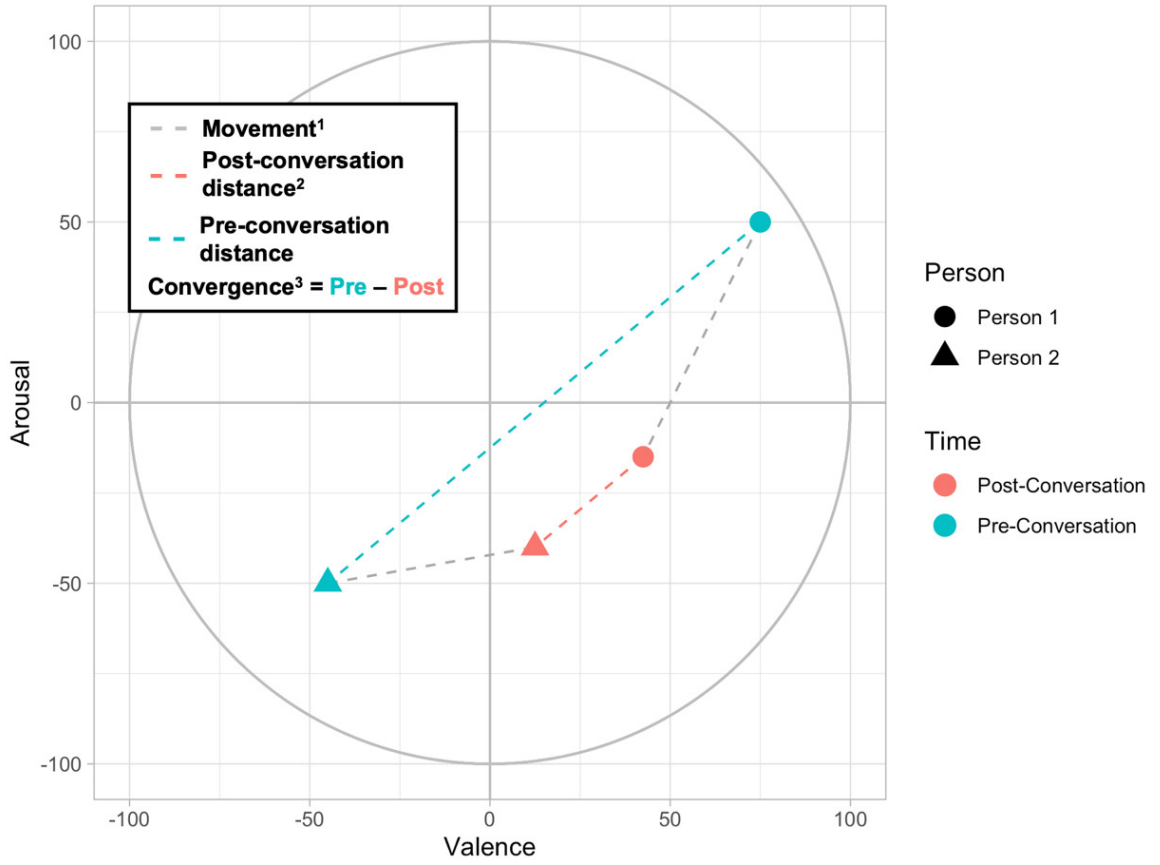

Figure 1. Emotion self-report tool and three emotion contagion measures with hypothetical data. Before and after each conversation, participants clicked on their current position in the Valence-by-Arousal emotion space. Person-level *emotion movement* (1) is the absolute difference between each person's pre- and post-conversation emotion states. Dyad-level *post-conversation distance* (2) is the absolute difference between partners' emotion states at the end of the conversation. Dyad-level *emotion convergence* (3) is how much closer participants became over the course of the conversation (pre-conversation distance minus post-conversation distance).

We justify our current sample size because of resource constraints (recruiting as many participants as possible) and guidance from previous literature. Determining the sample size required for longitudinal dyadic studies, such as ours, typically involves simulations that rely on plausible a priori estimates for parameters including means, variances, and coefficients (e.g., covariances, ICCs), which we did not have specific hypotheses or existing theories for (Lane & Hennes, 2018). For dyadic data using multilevel modeling, Du and Wang (2016) recommend a minimum of 50 dyads to detect robust estimates using multi-level modeling with a single time point. While we cannot determine a specific level of power, nor did we conduct an a priori power analysis, our study had more than the recommended 50 dyads, and incorporated repeated time points, further increasing our statistical power.

Procedure

After providing verbal consent, participants were paired with the same randomly matched partner for the entirety of the study. Experimenters confirmed that partners were strangers at the start of the study. Every dyad had a 10-minute conversation once a week for 6 weeks. In each session, the dyad and the research assistant met over Zoom. Participants were told they could join the meeting from any location as long as they were alone and somewhere where they would not be interrupted. At the beginning of each session, participants privately reported their current emotion (see "Emotion state measure"). The experimenter then left the participants alone in the Zoom meeting to converse. Participants were told, "You can converse freely about anything you want for 10 minutes". The conversations were recorded with the participants' consent. After 10 minutes, the experimenter returned to the Zoom call. After each conversation, the participants privately reported their current emotion state using the same measure as before, as well as how much they liked their partner, how similar they felt to their partner, and how close they felt to their partner.

Measures

Background Measures. In the first session, participants reported their gender, age, year in school, and race, as well as other self-report personality measures of extroversion, self-monitoring, and flexibility (described in SOM; data available online).

Emotion State Measure. Immediately before and after every conversation, participants indicated how they were currently feeling on a Cartesian coordinate plane plot with valence on the x-axis (negative to positive) and arousal on the y-axis (mild to intense, Heffner et al., 2021; Russell et al., 1989). To make sure participants understood this measure, we gave them the instructions, "Below is a graph with examples of emotions plotted to give you an idea of where you might fall in terms of how PLEASANT and how INTENSE your emotional state could be. Using the plot below, please describe your emotional state as you felt 5 minutes ago/before the beginning of the session." They saw an example plot with some emotions labeled at different parts of the plot, and then were asked to indicate their emotion on a blank plot (Figure SM1). They were instructed to click on a point within the circle. Possible valence and arousal values ranged from -100 to +100. We used their pre- and post-conversation responses to calculate the following emotion contagion variables (see Figure 1):

Emotion Movement. First, we captured individual-level emotional reactivity or responsiveness to a partner, or emotion movement. We defined emotion movement as the Euclidean distance between a person's emotion state from before the conversation to after:

$$Emotion\ movement = \sqrt{(x_{pre} - x_{post})^2 + (y_{pre} - y_{post})^2}$$

where x_{pre} and y_{pre} are the participant's pre-conversation valence and arousal, respectively, and x_{post} and y_{post} are their post-conversation valence and arousal, respectively. Each person in a dyad has their own emotion movement score per conversation. These indicate how much the conversation influenced their emotion state—how much they were "swayed" by their partner in any direction in the two-dimensional emotion space. Higher scores indicate more emotion movement, while lower scores indicate less movement. Note that a high movement score does not require that the participant became more similar to their partner, nor does the score reflect the direction of the movement.

Emotion Distance Post-Conversation. Next, we quantified dyad-level emotional similarity after each conversation. To calculate emotion distance post-conversation, we took the Euclidean distance between the two partners in the emotion space after their conversation:

$$Emotion\ distance\ post\text{-}conversation = \sqrt{(x_{1,post} - x_{2,post})^2 + (y_{1,post} - y_{2,post})^2}$$

where $x_{1,post}$ and $x_{2,post}$ are two participants' self-reported post-conversation valence scores, respectively, and $y_{1,post}$ and $y_{2,post}$ are their post-conversation arousal, respectively. Each dyad has a single emotion distance score per conversation. These indicate how similar the partners' emotions were by the end of the conversation, regardless of where they started or how much they changed. Emotion distance post-conversation is not correlated with emotion movement, r = -.004, p = .919.

Emotion Convergence. Lastly, we quantified how much two partners became more similar to each other. We calculated how much partners' emotions converged over the course of each conversation. We calculated the change in the Euclidean distance between the partners' emotion states pre-conversation and post-conversation:

$$Emotion\ convergence = \sqrt{(x_{1,pre} - x_{2,pre})^2 + (y_{1,pre} - y_{2,pre})^2} - \sqrt{(x_{1,post} - x_{2,post})^2 + (y_{1,post} - y_{2,post})^2}$$

Each dyad has a single emotion convergence score for each conversation. Higher values indicate the partners became more emotionally similar over the course of the conversation. Emotion convergence correlates with emotion movement, r = .181, p < .001, and with emotion distance post-conversation, r = -.528, p < .001.

Since the three emotion measures are not highly correlated, they should be treated as separate aspects of emotion contagion. Emotion movement captures individual-level emotional reactivity or responsiveness to a partner, but not necessarily emotion similarity. Emotion distance post-conversation captures dyad-level emotion similarity regardless of starting emotion states, so some variance is likely due to partners being in similar emotion states before they interact. Emotion convergence captures how much they collectively become more similar, but since it is at the dyad level, it does not ask who converges to whom. Additionally, partners who start in emotionally similar states will have a low ceiling on how much closer they can get. Thus, each measure captures a unique aspect of dyadic emotion contagion.

Relationship Closeness. To assess relationship closeness, we asked, "If you were to 'rate' your relationship with your conversation partner in terms of how close you feel to him/her, how would you do it?" (0 = *basically strangers,* 100 = *close friends;* see Table 1 for summary statistics). Participants also reported how much they liked their partner on a 7-point scale (1 = "not at all", 7 = "a great deal") and how much they had in common with and felt similar to their partner on 5-point scales (1 = "not at all", 5 = "a great deal"). Even after the first session, partner liking was at the ceiling (M = 6.23, SD = 0.76) and only one participant at one time point was ever below the scale midpoint. While participants were closer to scale midpoints on the common (M = 2.46, SD = 0.88) and similar items (M = 2.32, SD = 0.89), the restricted range of the scales resulted in limited variance. Before running any analyses, we therefore decided to use relationship closeness (M = 44.63, SD = 23.77) as our measure of relationship status.

Contact Outside of the Study. After each session, excluding the first, we asked participants if they had any interactions with their conversation partner during the week outside of the experiment and if so, how much (1 = *less than an hour*, 2 = *1-2 hours*, 3 = *2-4 hours,* 4 = *4-6 hours*, 5 = *6+ hours*). Only 14.4% of participants reported ever talking to their partner outside of the study, and among those that did, the majority (93.6%) of them reported talking for "less than an hour." Since most dyads interacted for approximately the same amount of time, our analyses separated the effect of objective exposure time and subjective relationship closeness on emotion contagion.

Content Analysis of Conversations. We transcribed each conversation and analyzed them using the Linguistic Inquiry and Word Count (LIWC-22, Boyd et al., 2022).

Table 1. Means and standard deviations of emotion variables of interest and emotion plot raw scores.

	Dependent variables of interest							
	Relationship closeness		Emotion movement		Post conversation emotion distance		Emotion convergence	
Session #	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
1	33.56	24.17	60.68	32.09	38.23	25.37	24.78	40.06
2	39.13	22.52	53.20	34.07	40.58	25.43	22.13	36.72
3	44.10	22.04	49.18	33.41	43.85	27.01	10.86	40.25
4	47.01	22.55	51.45	35.13	42.14	23.55	22.16	42.05
5	50.76	22.44	50.70	35.41	53.15	27.54	12.67	34.36
6	55.12	22.83	46.13	33.15	52.62	33.56	8.54	39.66

	Emotion plot variables							
	Pre-conversation valence (x)		Pre-conversation arousal (y)		Post-conversation valence (x)		Post-conversation arousal (y)	
Session #	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
1	27.23	33.42	-16.32	35.17	53.01	20.49	18.34	28.35
2	22.37	35.28	-18.65	36.61	51.02	23.10	9.54	30.36
3	23.84	37.08	-11.75	37.43	47.91	24.65	7.78	32.13
4	24.61	31.86	-19.85	39.05	46.66	23.28	10.50	31.10
5	17.08	39.18	-9.35	40.12	43.96	27.96	13.21	33.22
6	22.04	39.98	-14.38	39.94	39.58	32.80	7.18	35.43

LIWC-22 is a validated dictionary-based method for assessing numerous social and emotional dimensions of conversation. Each dimension is estimated from a dictionary of hundreds of words. For each conversation, LIWC-22 counts the occurrence of all words from a given dictionary and divides the count by the total number of words in the conversation. It takes negations into account, for instance differentiating "not good" from "good." For each conversation, we extracted the following dimensions (with the most common words from their respective dictionaries in parentheses): affiliation (*we, our, us help*), negative emotionality (*bad, hate, hurt, tired*), positive emotionality (*good, love, happy, hope*), politeness (*thank, please, thanks, good morning*), and authenticity, which is a summary variable of the perceived honesty and genuineness of the conversation (Newman et al., 2003). Authenticity language is characterized by a composite index of "honest, personal, and disclosing" and reflects breadth and depth of self-disclosure and degree of self-monitoring (Newman et al., 2003). Texts where a person is being socially cautious or prepared texts (e.g., written speeches) tend to be lower in Authenticity, while spontaneous conversations (e.g., transcripts) tend to be higher in Authenticity. We chose affiliation as a semantic marker of increased relationship closeness, positive and negative valence as markers of changes in emotional content of speech, and politeness and authenticity as markers of shifts in participants' willingness to disclose their feelings (we expected politeness to potentially decrease and authenticity to increase).

Data Analysis Plan

We ask whether partners' emotion contagion changed over the course of repeated interactions, and whether subjective relationship closeness predicted emotion contagion. For our longitudinal data analysis, we used linear mixed-effects models with the lme4 (Bates et al., 2015) and lmerTest packages (Kuznetsova et al., 2017) in R. When the outcome variable was at the individual level (e.g., emotion movement), we included random effects for participants nested within dyads. When the outcome variable was at the dyad level (e.g., emotion distance post-conversation and emotion convergence), we included random effects for dyads. We aimed for maximal random effects structure by including random slopes for any within-subject or within-dyad variable (Barr et al., 2013). The Supplementary Online Materials include models comparing the post-conversation emotion distance and emotion convergence of pseudo-dyads to real dyads. These analyses show that real dyads' post-conversation emotional closeness and convergence was not simply the by-product of participating in the study but instead reflected the unique effect of interacting with their actual partner.

Results

Change in Relationship Closeness and Emotion State over Time

Before turning to the central analyses with the three emotion contagion outcome variables, we first asked how relationship closeness and post-conversation emotion state

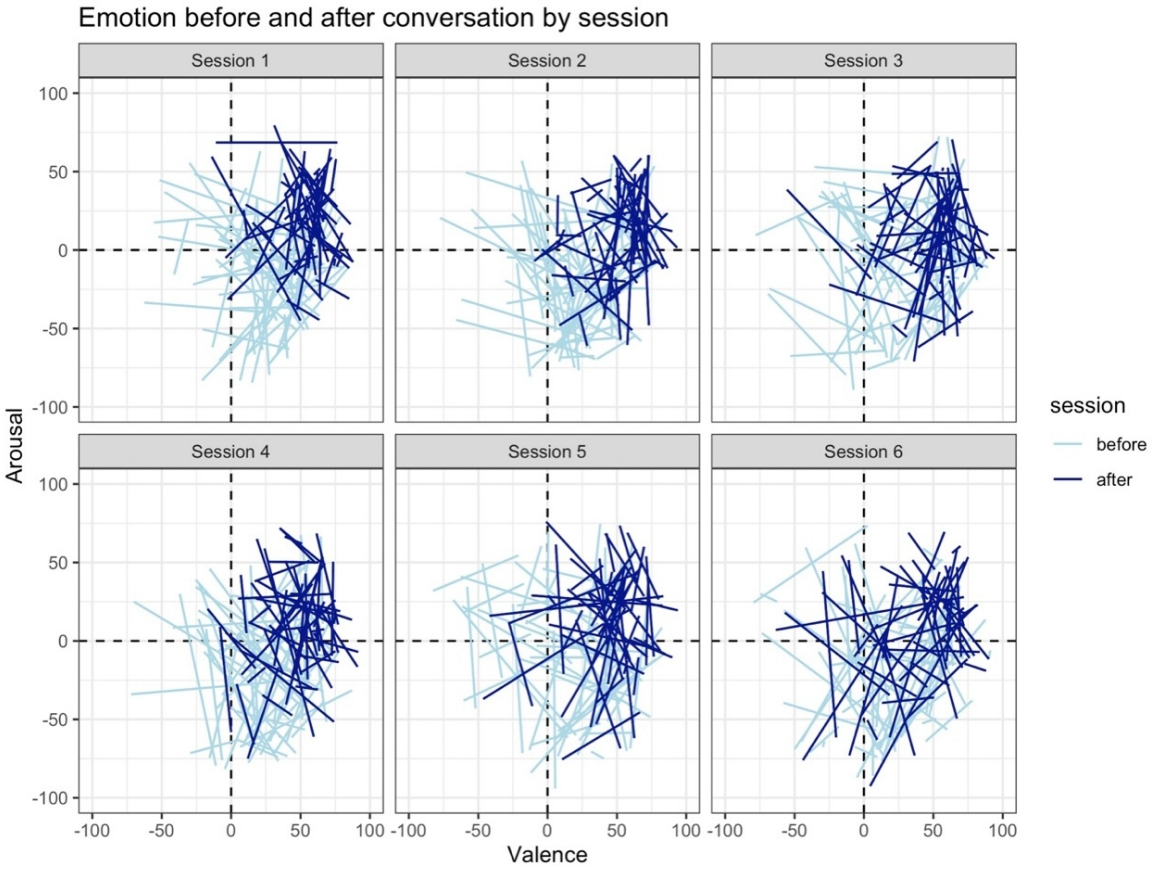

Figure 2. Plot of dyads' emotions before and after each session. In this plot, each dyad is represented by a line, with one partner at one end of the line, and the other partner at the other end. Light blue lines represent emotion before the conversation, while dark blue lines represent emotion after the conversation. Longer lines indicate greater emotion distance.

changed over the six sessions. We fitted 3 mixed-effects models predicting 1) untransformed relationship closeness scores, 2) post-conversation emotion valence, and 3) post-conversation emotion arousal, with session number (centered) as a predictor and a random slope for participants nested within dyads.

Relationship closeness increased over the six sessions, b = 4.12, *SE* = 0.31, *t*(58.56) = 13.19, *p* < .001, 95% CI [3.51, 4.74], β = 0.29 (see Table 1 for means and standard deviations for each session). Given this (unsurprising) increase in closeness over time, it is important to include both session number and relationship closeness in our subsequent models, enabling us to separate out whether relationship closeness itself predicts emotion contagion, or whether it only appears to do so because both contagion and closeness change with time.

Post-conversation emotion valence decreased over the 6 sessions, b = -2.20, *SE* = 0.57, *t*(56.37) = -3.84, *p* < .001, 95% CI [-3.33, -1.08], β = -0.14. Post-conversation emotion arousal also decreased over the 6 sessions, b = -1.28, *SE* = 0.62, *t*(109.04) = -2.05, *p* = .043, 95% CI [-2.50, -0.05], β = -0.07. Note that the average valence remained positive throughout the study and the average arousal remained above the midpoint (Figure 2).

Predicting Emotion Contagion from Time and Relationship Closeness

We examined the effect of time and relationship closeness on three emotion contagion variables: emotion movement (how much one person changed their emotion state during the interaction), post-conversation emotion distance (how close a dyad's emotions were after interacting), and emotion convergence (how much closer they became compared to before the conversation). We included a between-subject relationship closeness predictor, which was each participant's average reported relationship closeness across all sessions. We also included an orthogonal within-subject relationship closeness predictor, which was each participant's deviation from their average at a given session. These two predictors separate stable and dynamic associations between relationship closeness and emotion contagion.

Emotion Movement. First, we regressed the individual-level emotion movement scores on average relationship closeness (between-subjects trait level variable) and session-level relationship closeness deviation from the mean (within-subject state level variable). Both relationship closeness variables predicted emotion movement, but in opposite directions: participants who *generally* felt close to their partners (stable between-subject closeness) showed

more emotion movement from pre- to post-conversation, b = 0.29, *SE* = 0.09, *t*(105.89) = 3.16, *p* = .002, 95% CI [0.11, 0.47], β = 0.19. But on days when participants felt *closer than their average*, they exhibited *less* emotion movement than usual, b = -0.31, *SE* = 0.11, *t*(558.23) = -2.78, *p* = .006, 95% CI [-0.53, -0.09], β = -0.09 (see Table 2 for regression outputs of models).

However, the within-subject effect was suppressed by adding session number – i.e., time – to the model. Over the course of the six sessions, people's emotion movement *decreased*, b = -2.17, *SE* = 0.92, *t*(557.83) = -2.35, *p* = 0.019, 95% CI [-3.98, -0.36], β = -0.11. Participants were less emotionally swayed by the conversations at the end of the study than they were at the beginning. Even with session number in the model, average relationship closeness (between-subject variable) still positively predicted emotion movement, b = 0.29, SE = 0.09, *t*(105.86) = 3.16, *p* = 0.002, 95% CI [0.11, 0.47], β = 0.19. Thus, people who were more emotionally responsive also tended to feel close to their partners, but as people increased their closeness over the course of the study, interacting with their partners influenced their emotions relatively *less*.

Post-Conversation Emotion Distance. Next, we regressed post-conversation emotion distance on the two relationship closeness variables. The between-subject tendency to feel close to one's partner did not predict how similar participants' emotions were post-conversation. Within-subject variability in relationship closeness, on the other hand, did: the closer dyads felt during a conversation compared to their average, the *further* their post-conversation emotion states, b = 0.47, *SE* = 0.20, *t*(31.04) = 2.39, *p* = .023, 95% CI [0.08, 0.86], β = 0.15.

When we added in the variable for time, the effect of relationship closeness again was suppressed (we also removed the random slope for relationship closeness to achieve model convergence). Session number again predicted emotion contagion, this time when computed as post-conversation distance: over the course of the six sessions, participants' emotions became *less similar*, b = 4.21, *SE* = 1.48, *t*(96.91) = 2.84, *p* = 0.006, 95% CI [1.29, 7.13], β = 0.25. Thus, when emotion contagion is defined as the ending emotion state after an interaction, emotion contagion decreased as participants got to know each other, mirroring the effect of session number on emotion movement.

Emotion Convergence. We next regressed emotion convergence on the two relationship closeness variables. Again, within-person variability in relationship closeness predicted emotion convergence: when dyads felt closer to each other than usual, they had *less* convergence, b = -0.51, *SE* = 0.23, *t*(275.56) = -2.19, *p* = .029, 95% CI [-0.97, -0.05], β = -0.11. When we added session number to the model, none of the predictors were significant.

To summarize the associations between emotion contagion, relationship closeness, and session number: dyads became closer over time and displayed *less* emotion contagion over time: they had less emotion movement, greater post-conversation emotion distance, and less convergence (see Figure 3). Participants who tended to be emotionally responsive (high in movement) tended to feel closer to their partners. But contrary to expectations based on prior work, on days when dyads felt closer to each other than usual, they had *less* emotion contagion compared to days when they felt less close, a pattern that held across all 3 emotion contagion measures. These within-dyad effects disappeared once we controlled for session number. The within-dyad covariation between relationship closeness and emotion contagion is therefore likely attributable to a third variable: amount of exposure to one's partner.

Content Analysis of the Transcribed Conversations (Exploratory Analyses)

To explore possible conversational mechanisms to explain the decrease in emotion contagion, we examined how the linguistic features of the conversations changed with time. We chose to examine how word-based indicators of affiliation, politeness, negative emotionality, positive emotionality, and authenticity changed across the six conversations. We regressed each variable on time (session number, centered), session-level relationship closeness deviation from a dyad's mean (within-subject state level variable), and average relationship closeness (between-subjects trait level variable).

We found significant changes over time for authenticity and positive emotionality, but not the other categories. Authenticity language increased over time across sessions b = 0.71, *SE* = 0.31, *t*(554.45) = 2.62, *p* = 0.022, 95% CI [0.10, 1.31], β = 0.12, and was higher for dyads that had greater average relationship closeness, b = 0.07, *SE* = 0.02, *t*(229.49) = 2.80, *p* = .006, 95% CI [0.02, 0.11], β= 0.15 (there was no significant effect of session-level relationship closeness deviation from the mean). Positive emotionality language also increased over time b = 0.11, *SE* = 0.03, *t*(508.3) = 4.09, *p* < 0.001, 95% CI [0.06, 0.17], β = 0.22.

Discussion

The present study examined the change in emotion contagion over time in pairs of strangers as they got to know one another. Converging with prior cross-sectional findings (Kimura et al., 2008; Wróbel, 2018), we found a positive between-dyad effect for one of the contagion measures: participants who report higher average feelings of relationship closeness also overall tended to be more emotionally influenced by conversations with their partners (emotion movement). That this between-subject positive association was only found for emotion movement, and not post-conversational emotional distance or emotional convergence, may reflect a Type II error. Or it may suggest that what is most predictive of stable between-dyad differences in feelings of closeness is the partners' overall emotional responsiveness, not necessarily their tendency to match each other's exact emotions. This corroborates the idea that optimal co-regulation of emotions often involves diverging, rather than converging, emotional responses to one's partner (daSilva & Wood, 2024).

The analyses that examine the covariation between familiarity and emotion contagion measures *within-dyads*, however, complicate matters. We found that as dyads spent

Table 2. Regression analysis: Predicting relationship closeness from emotion contagion variables

	Emotion movement (no time)			Emotion movement (w/time)			Post-conversation emotion distance (no time)			Post-conversation emotion distance (w/time)			Emotion convergence (no time)			Emotion convergence (w/time)		
	b	*p*	*SE*	b	*p*	*SE*	b	*p*	*SE*	b	*p*	*SE*	b	*p*	*SE*	b	*p*	*SE*
Intercept	38.94	<.001	4.59	38.97	<.001	4.59	42.01	<.001	5.03	41.60	<.001	5.03	15.98	.031	7.23	16.12	.030	7.22
Average closeness	0.29	**.002**	0.09	0.29	**.002**	0.09	0.06	.584	0.10	0.07	.529	0.10	0.02	.894	0.15	0.02	.909	0.15
Session-level closeness	-0.31	**.006**	0.11	-0.05	.766	0.16	0.47	**.023**	0.20	-0.29	.306	0.29	-0.51	**.029**	0.23	0.002	.997	0.40
Session number				-2.17	**.019**	0.92				4.21	**.006**	1.48				-3.25	.120	2.08

Note. DVs are unstandardized. Average closeness is the between-subjects trait level variable of how close each dyad felt relative to the other dyads. Session-level closeness is the within-subject state level variable of how close each dyad felt relative to their average. Session number is the effect of time, which is centered. "No time" models did not include the effect of time, while "w/time" models included the effect of time.

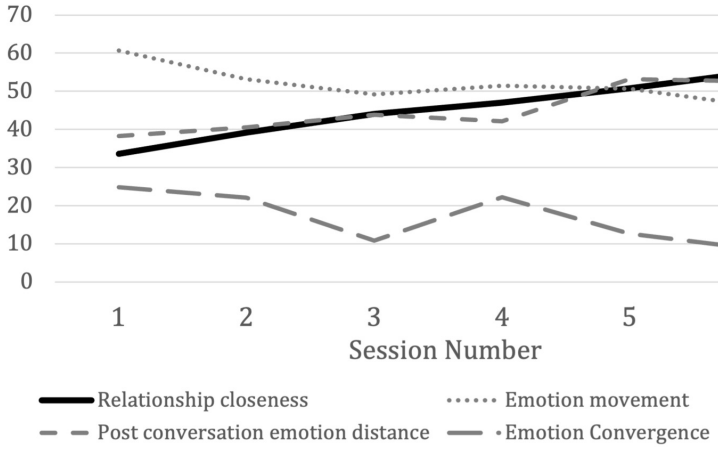

Figure 3. Graph of trends over the six sessions of relationship closeness, and the three emotion measures: emotion movement, post-conversation emotion distance, and emotion convergence. See Table 1 for means and standard deviations.

more time with each other, they: (1) were less emotionally moved by their partners, (2) had less similar emotions to their partners post-conversation, and (3) emotionally converged less. This decrease in emotion contagion over time was accompanied by an increase in relationship closeness, so it cannot be explained by partners growing to dislike each other.

We can speculate why dyads unexpectedly had *less* emotion contagion over time even as they report feeling increasingly close to each other. First, previous research suggests that emotion contagion is an affiliation tool (Koban et al., 2019; Wood et al., 2021). It could be that at first, when people do not know each other, they emotionally align to bond with their partner. However, when people feel like they know each other more and have an established friendship, there is less of a need to signal affiliation.[1] It is also possible that as partners became more comfortable with each other, they engaged in less emotionally neutral small talk, instead venturing into emotional topics that produced different emotions in each partner. Indeed, participants' language increasingly indicated "authenticity" and "positive emotionality" as the study progressed. Alternatively, perhaps partners became less interested in the conversations after getting used to the regular meetings or the progression of the study and felt more bored and were less attentive to the conversation (although this explanation is difficult to reconcile with the increase in positive language). Thus, the decrease in emotion contagion over the course of friendship formation may reflect shifting interpersonal goals, a change in the topics and form of conversation, or both.

Our study is not the first to find a lack of emotion contagion in more established relationships (Madhyastha et al., 2011; Steele et al., 2014). Some work has documented emotional *divergence*, which is considered evidence of emotion coregulation (Randall et al., 2013; Reed et al., 2013; Sels, Cabrieto, et al., 2020). That is, when one partner is feeling negative affect, the other might demonstrate more positive affect to help them return to a neutral baseline. Perhaps as our dyads grew closer, they engaged in more interpersonal emotion regulation rather than contagion.

Our study combined the careful controls of a laboratory design examining contagion in strangers with the repeated measures design and naturally occurring emotions typical of research on existing couples (Butler, 2011). By examining the dynamics of emotion contagion during friendship formation, we contribute to a literature that has largely focused on established close relationships (Sels, Cabrieto, et al., 2020). We controlled partner interaction time, unlike experience sampling or cross-section approaches, to prevent the confounding of exposure time with liking or closeness (Baym et al., 2004).

The limitations of the present study indicate several other future directions. First, our sample consisted of undergraduate students who might already be motivated to make friends (Campbell et al., 2015). Second, the relatively short duration of the dyads' interactions may have restricted familiarity and interdependence, and effortful relationship building. Future studies could employ longer and more naturalistic interactions with random assignment. For example, a study could examine randomly assigned roommates, as done by Anderson et al. (2003) controlling for time spent together to separate exposure and subjective feelings of closeness. Such a study should also separate the trait and state associations between emotion contagion and relationship measures. Next, we can only speculate the

1 Although we make references to interpersonal "goals" and describe participants changing their emotion contagion levels, we cannot know how conscious these processes are. We suspect both intentional and unintentional interpersonal alignment may be occurring, but that it is all in the service of the goal of finding common ground and building rapport.

specific emotions that participants felt more or less over time and how it affected emotion contagion (such as if they felt more bored). Future studies can disentangle these explanations by explicitly asking about certain emotions or by using physiological measures. Additionally, we did not conduct an a priori power analysis, so another study can replicate our methods with a larger sample size. Finally, future work should examine whether the negative within-dyad association between emotion contagion and relationship closeness holds for other emotion measures, such as nonverbal and physiological measures.

A major constraint of the generalizability of the findings is using a video calling platform instead of having in-person face-to-face interactions. Due to the circumstances of the COVID-19 pandemic, we could not have participants interact in-person. Norms and affordances differ in video calling (Bleakley et al., 2022), and it is possible that these emotion processes appear differently in offline interactions. However, conversations on video calling platforms are also becoming increasingly common, so understanding how emotions transmit through these media is still relevant and important. Future work is needed to further understand the association between emotion contagion and relationship formation in different modalities.

In sum, we contribute to growing evidence (Sels, Cabrieto, et al., 2020) that emotion contagion is not inevitably associated with the quality of a newly-formed relationship. Although people who feel closer at a trait level to their partners are more emotionally swayed by interactions with them, the within-dyad pattern that emerged was in the opposite direction. As dyads grew closer and spent more time talking, they showed *less* emotion contagion. Among acquaintances whose goals and outcomes are not intertwined, we speculate that emotion contagion is a tool for building connection and signaling affiliation (Wood et al., 2021). Once the seed of friendship has been planted, partners are then free to experience more independent emotions as the relationship grows.

Contributions

Contribution to conception and design: ST, SK, AW
Contribution to acquisition of data: ST, SK
Contribution to analysis and interpretation of data: ST, XT, AW
Drafted and/or revised the article: ST, SK, XT, AW
Approved the submitted version for publication: ST, SK, XT, AW

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Competing Interests

On behalf of all authors, the corresponding author states that there are no competing interests, including financial, to declare.

Supplemental Material

Supplementary online materials for this manuscript contain information about measures and additional analyses.

Ethics Approval

All procedures were approved by the Institutional Review Board at the University of Virginia.

Informed Consent

Informed consent was obtained from all individual participants included in the study.

Data Accessibility Statement

Study materials, data and code for this study can be found here: https://osf.io/b6xs9/.

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