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Mathematically Modeling Emotion Regulation Abnormalities During Psychotic Experiences in Schizophrenia

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Abstract
Ecological momentary assessment (EMA) was used to examine emotional reactivity and regulation abnormalities during the presence and absence of psychosis. Participants included 28 outpatients with schizophrenia or schizoaffective disorder (SZ) who completed 6 days of EMA. Mathematical models were applied to the EMA data to evaluate stochastic dynamic changes in emotional state and determine how the presence of psychosis influenced the interaction between emotional reactivity and regulation processes across time. Markov chain analysis indicated that although SZ tried to implement emotion regulation strategies frequently during psychotic experiences, those attempts were ineffective at reducing negative emotion from one time point to the next. Network analysis indicated that patients who were less effective at regulating their emotions during psychotic experiences had more dense connections among individual emotions. Findings indicate that psychotic experiences are associated with abnormally strong connections among discrete emotional states that are difficult to regulate despite efforts to do so.

Keywords
emotion, emotion regulation, psychosis, hallucinations, delusions, paranoia

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Individuals diagnosed with psychotic disorders often experience unwanted positive symptoms (e.g., hallucinations and paranoia) that they must find a means to manage. These symptoms are imbued with negative valence, making attempts to control these symptoms and the distress that accompanies them more difficult (Ford et al., 2014). For example, voices occurring during auditory hallucinations sometimes make commands or comments that are benign or encouraging but often involve threatening or derogatory statements. Likewise, visual hallucinations can sometimes take forms that are more neutral in valence (e.g., floating color patches); however, they also frequently contain negative imagery (e.g., shadow figures, demons). Some delusions, such as paranoia, are also characterized by a negative focus of attention or negative thoughts (e.g., hypervigilance for threat). The negative content accompanying these positive symptoms is often highly distressing and associated with a number of poor clinical outcomes (e.g., suicide, violence; Daalman et al., 2011), highlighting their importance as treatment targets.

Unfortunately, mechanisms contributing to whether hallucinations are negative versus neutral in valence are largely unknown, as are the means by which specific emotion regulation processes go awry when individuals attempt to control distress resulting from psychotic experiences (Ford et al., 2014). To investigate real-world emotion regulation in the context of psychotic symptoms, we adopted the popular conceptual framework developed by James Gross (2015) in the basic affective science literature, the extended process model of emotion regulation. Within this framework, emotion regulation is defined as the ability to control

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the intensity, duration, or frequency of emotional experience using various strategies (Gross, 1998). The model proposes that there are multiple simultaneously active valuation systems and conceptualizes emotion regulation as an interaction between these valuation systems. The first-level valuation system involves emotion generation, which includes four stages: states of the world (W), perceptions of those states (P), valuations of these perceptions depending on the current goal state (V), and actions toward reaching this goal state (A). The second-level valuation system involves emotion regulation and is activated when there is a goal to control emotional experience and the first-level valuation system has a mismatch between the V and A stages. Emotion regulation therefore occurs when the second-level valuation system evaluates input from the first-level emotion generation system and decides whether to act on it according to whether the goal state for emotional experience is met. After the completion of A, a new W is created that can initiate a new WPVA cycle. The second-level valuation system typically unfolds over multiple WPVA cycles that occur in three distinct stages of emotion regulation: identification (i.e., determining whether emotion regulation should be initiated), selection (i.e., deciding which strategy to attempt), and implementation (i.e., executing the selected strategy using contextually appropriate tactics). Five emotion regulation strategies can be implemented, which act on specific stages of the emotion generation sequence: (a) situation selection (i.e., attempts to modify the probability of being in a context that will result in undesirable emotions), (b) situation modification (i.e., efforts intending to alter a situation that one is already exposed to in an effort to control undesirable emotions), (c) attentional deployment (i.e., allocating selective attention toward less arousing content to alter emotional response; e.g., distraction, directed attention), (d) reappraisal (i.e., modifying the interpretation of a situation to reduce its emotional impact; e.g., reappraisal), (e) suppression (i.e., altering the experiential, behavioral, and/or physiological response to an internal or external stimulus after an emotion has occurred; e.g., expressive suppression). Abnormalities at any one of the three stages (identification, selection, implementation) could be expected to contribute to the types of emotion regulation difficulties that occur in relation to psychotic experiences (Sheppes, Suri, & Gross, 2015).

A systematic investigation of the three stages of Gross's model has yet to be conducted in relation to psychotic experiences. Most studies published to date have evaluated self-reported trait emotion regulation strategy use via questionnaires. Inconsistencies exist across studies, with evidence for no group differences between those on the schizophrenia or schizoaffective disorder (SZ) spectrum (schizotypes, clinical high risk for psychosis) and healthy controls in the reported use of various strategies in some studies (Badcock, Paulik, & Maybery, 2011; Henry, Rendell, Green, McDonald, & O'Donnell, 2008; Perry, Henry, & Grisham, 2011; Rowland et al., 2013; van der Meer et al., 2014) and less frequent use of reappraisal and greater use of suppression in SZ-spectrum participants in other studies (Horan, Hajcak, Wynn, & Green, 2013; Kimhy et al., 2012; Livingstone, Harper, & Gillanders, 2009; van der Meer, van't Wout, & Aleman, 2009). Inconsistent findings across questionnaire studies may reflect differences in sample demographics, symptom profiles, antipsychotics, phase of illness, and proportion of schizoaffective versus schizophrenia diagnosis (Kimhy et al., 2012). Lower self-reported use of reappraisal and greater use of suppression has been associated with a range of clinical outcomes in the SZ spectrum, including psychotic experiences (Butler, Gross, & Barnard, 2014; Henry et al., 2008; Kimhy et al., 2012, 2016; Perry et al., 2011; van der Meer et al., 2009; van der Velde et al., 2015; van Rijn et al., 2011). Laboratory-based studies consistently indicate that SZ patients have difficulty using strategies to decrease the neurophysiological response to unpleasant stimuli, consistent with a deficit in implementation (Horan et al., 2013; Morris, Sparks, Mitchell, Weickert, & Green, 2012; Strauss et al., 2013, 2015; Sullivan & Strauss, 2017; van der Meer et al., 2014). However, it is unclear whether these deficits in implementation result from inadequate effort or adequate effort but poor effectiveness of executing a strategy (Strauss et al., 2015). Via trait questionnaires and laboratory-based methods alone, it is impossible to determine which of the stages of Gross's (2015) model are abnormal in those with SZ and contributing to psychotic symptoms; more comprehensive, ecologically valid studies are needed.

The current study addressed these gaps in the literature using ecological momentary assessment (EMA), which is a means of repeatedly sampling emotions, behaviors, and symptoms in the context of everyday life via mobile technology. EMA has demonstrated adequate compliance, reliability, and feasibility when used in individuals with psychotic disorders (Ben-Zeev, 2012; Ben-Zeev et al., 2014; Granholm, Ben-Zeev, Fulford, & Swendsen, 2013; Granholm, Loh, & Swendsen, 2008; Swendsen, Ben-Zeev, & Granholm, 2011). Analyses focused on the three stages of emotion regulation (identification, selection, implementation) in relation to contexts in which psychosis was present versus absent.

The identification stage was evaluated by examining whether psychosis contexts are accompanied by a threshold to regulate (i.e., a level of negative emotion intensity) that is too high (i.e., attempting to control only the most extreme emotional experiences, resulting in very few regulation attempts) or a threshold that is too low (i.e., attempting to control most emotional experiences with high levels of effort, even those that are not very intense, resulting in a high number of regulation attempts). In our prior study, we found that SZ outpatients had a threshold for regulation that was significantly lower than controls (Visser, Esfahlani, Sayama, & Strauss, 2018). Specifically, whereas controls exerted only moderate to high levels of emotion regulation effort at levels of negative emotion intensity that were moderate to high, SZ exerted high levels of emotion regulation effort when negative emotion was absent or low. These findings suggest that SZ is associated with a threshold for identifying the need to regulate that is low (i.e., patients' threshold for regulating occurred at minimal levels of negative emotion, whereas controls required moderate to high levels to make an attempt). Among SZ patients, it is unclear whether contexts in which psychosis is present are associated with a lower threshold than contexts in which psychosis is absent; however, such an association might be expected if psychosis is driving abnormalities at the identification stage.

To evaluate the selection stage, we examined the number and type of strategies that patients attempted when psychosis was present versus absent. Two types of abnormalities might occur at the selection stage: selecting too few strategies in a given context (i.e., an overreliance on a few strategies that may be contextually inappropriate because their toolbox of strategies to choose from is smaller) or selecting too many strategies for a given context (because they are selecting strategies that are contextually inappropriate and ineffective). In our prior study, we found that SZ outpatients attempted more strategies at each survey than healthy controls (Visser et al., 2018). However, it is unclear whether psychosis context influences the number and type of strategies that patients select. It is possible that psychotic experiences are so complex and unusual that they necessitate a larger number of strategies to be selected and that these strategies may not be those that would typically be considered "adaptive" under most contexts (e.g., expressive suppression), although the strategies could be adaptive in the midst of a psychotic experience (e.g., not expressing emotion during a visual hallucination experienced in public).

Implementation was evaluated by repeatedly measuring in-the-moment emotional experience, emotion regulation strategy use, and symptoms at multiple points in the day. Mathematical models were constructed to determine whether stochastic dynamical changes in the emotion system and emotion regulation attempts at a current time point (time t) caused changes in emotional intensity at a later time point (e.g., $t + 1$; i.e., whether emotion regulation efforts were differentially effective at reducing negative emotion across psychosis contexts). Additionally, network analysis was used to evaluate temporal connections among discrete emotional states (e.g., anger, fear, sadness) in the context of psychotic experiences to determine whether the presence of psychosis was associated with changes in the strength of connections among individual emotions. One might expect psychotic experiences to not only increase mean intensity levels of negative emotion but also result in increased strength in the association among multiple discrete emotional states. Perhaps it is not only the maximum intensity of negative emotion reactivity that determines how difficult it is to regulate negative emotions that occur during psychosis but also the extent to which individual negative emotions are highly interconnected with each other and positive emotions. More densely connected emotion-symptom networks may pose greater overall risk for emotion regulation difficulties because the global affective state is more complex.

The following specific hypotheses were made: (a) We hypothesized that psychotic experiences and negatively valenced hallucinations would be associated with abnormalities in emotional reactivity as indicated by increased intensity of negative emotion and decreased intensity of positive emotion; (b) on the basis of our prior study indicating an identification threshold that was too low in SZ compared with controls (Visser et al., 2018), we hypothesized that psychotic experiences would be associated with a lower threshold for when to initiate emotion regulation efforts (i.e., increased emotion regulation effort at lower levels of negative emotion reactivity); (c) on the basis of our prior study indicating that SZ select more strategies than controls (Visser et al., 2018), we hypothesized that psychotic experiences would be associated with a higher number of total strategies attempted at each survey than when psychosis is absent; (d) we hypothesized that psychotic experiences and negative hallucination valence would be associated with abnormalities at the implementation stage such that increased levels of emotion regulation effort at time t would not be associated with effective decreases in negative emotion intensity at time $t + 1$; and (e) we hypothesized that psychotic experiences and negative hallucination valence would be associated with abnormally strong temporal connections among emotions that confer greater risk for emotion regulation failures.

Method

Participants

Participants included 30 individuals meeting the fourth edition of *Diagnostic and Statistical Manual of Mental Disorders, Text Revision* (*DSM–IV–TR*; American Psychiatric Association, 2000) criteria for schizophrenia or schizoaffective disorder. SZ were recruited from outpatient mental health clinics in upstate New York and via advertisements. All patients were evaluated during periods of clinical stability, defined as no change in medication type or dose within the past 6 weeks. Diagnosis was established via a best-estimate approach that relied on psychiatric history and was confirmed via the Structured Clinical Interview (SCID) for the fourth edition of the *Diagnostic and Statistical Manual of Mental Disorders* (*DSM–IV*; American Psychiatric Association, 1994; First, Spitzer, Gibbon, & Williams, 2002). No participants met criteria for substance dependence in the last 6 months, and all denied lifetime history of neurological disorders (e.g., traumatic brain injury, epilepsy). Written informed consent was obtained for all participants for a protocol approved by the Binghamton University Institutional Review Board.

Procedure

The study consisted of three phases: (a) a pre-EMA initial laboratory visit, (b) 6 days of in vivo EMA, and (c) a post-EMA final laboratory visit.

Phase 1: Initial laboratory visit. The first phase consisted of a single day visit to the laboratory, where participants completed diagnostic (SCID I and II; SCID II: Pfohl, Blum, & Zimmerman, 1997) and symptom interviews (patients only), including the Brief Negative Symptom Scale (BNSS; Kirkpatrick et al., 2011; Strauss, Hong, et al., 2012; Strauss, Keller, et al., 2012), Psychotic Symptoms Rating Scale (PSYRATS; Haddock, McCarron, Tarrier, & Farragher, 1999), and Level of Function Scale (LOF; Hawk, Carpenter, & Strauss, 1975).

Participants were then provided with an electronic Palm Pilot Personal Digital Assistant (PDA; version m500) that was preprogrammed with open-source Experience Sampling Program software (ESP; http://www.experience-sampling.org). This software restricted use of the PDA to the researcher-generated EMA-specific questions and allowed participant responses to be stored on the PDA for secure download by the research team during the participant's final lab visit. Participants then received instruction in the use of the PDA, which included an introduction to the functions of the PDA and a demonstration of the questions that would be asked. Participants were also introduced to the vibration and beep emitted by the PDA that signaled survey availability and were given an opportunity to try out the survey function on the PDA to ask questions prior to leaving the laboratory. Follow-up calls were made after this first day to answer participant questions and troubleshoot any problems encountered.

Phase 2: Ecological momentary assessment. During the 6-day EMA period between laboratory visits, surveys were administered four times per day between the hours of 9:00 a.m. and 9:00 p.m. at quasirandomized times within specified epochs (9:00 a.m.–12:00 p.m., 12:01 p.m.–3:00 p.m., 3:01 p.m.–6:00 p.m., 6:01 p.m.–9:00 p.m.). There were a total of 24 surveys across the 6 days. Participants had 15 min to initiate the survey after hearing the beep signaling its availability. Attempts to answer the survey after 15 min were not accepted, but the next survey would initialize as scheduled irrespective of the missed survey. Once initialized, participants were able to take as much time as needed to answer the questions. Surveys prompted between 9:00 a.m. and 6:00 p.m. focused on in-the-moment reports. The evening survey (6:01 p.m.–9:00 p.m.) included questions that required the participant to retrospectively report on experiences throughout the day. Overall, participants were prompted to provide three in-the-moment reports.

EMA surveys probed for the following information:

1. Emotional intensity reports: In-the-moment reports of positive and negative emotional intensity were captured using five positive and five negative emotion items from the modified differential emotions scale (mDES; Fredrickson, Turgade, Waugh, & Larkin, 2003) using a 1 (*not at all*) to 5 (*extremely*) scale. The five positive items included: (a) amused, fun-loving, silly; (b) content, serene, peaceful; (c) happy, joyful, glad; (d) love, closeness, trust; and (e) proud, confident, self-assured. The five negative items included: (a) angry, irritated, annoyed; (b) sad, down-hearted, unhappy; (c) scared, fearful, afraid; (d) ashamed, humiliated, disgraced; and (e) anxious, nervous, pressured. In-the-moment reports were made using a "right now" timeframe.
2. Emotion regulation reports: At each survey, participants were asked to indicate how much they were using each of six emotion regulation strategies using a 0 (*not at all*) to 4 (*extremely*) scale. The six strategies included (actual descriptions shown to participants are shown in quotations): (a) Expressive suppression: "How much were you HIDING EXPRESSIONS (Trying not to show emotions on the outside)"; (b) Reappraisal: "How much were you REAPPRAISING THE SITUATION (Thinking about the situation differently"); (c) Soothing: "How much were you SOOTHING FEELINGS (Trying to calm your body by taking deep breaths or relaxing your muscles"); (d) Distraction: "How much were you DISTRACTING (Turning attention away from what is making you feel emotional"); (e) Interpersonal: "How much were you SHARING FEELINGS (Talking about your feelings to others)"; and (f) Situation modification: "How much were you AVOIDING THE

SITUATION (Removing yourself from the situation that caused the emotion)." Reports were made in relation to the time since the last survey.

3. Context reports: Participants were prompted to provide information about their current activities, whereabouts, and companions at the time of each beep. They were also asked to provide an emotional context for the survey (i.e., if the most emotional event during the past hour was positive, negative, or neutral). Activities assessed included 13 nonexclusive categories that were divided into goal directed (recreation, errands/chores, bathing, socializing, working, exercising, shopping, eating) and not goal directed (nothing, resting/sleeping, using the Internet, watching TV or listening to music, smoking). Possible whereabouts included four nonexclusive categories: home, work, family/friend home, or public place. Possible social companions included five categories: no one (alone), family, friends, coworkers, or strangers.
4. Symptom reports: Participants were asked to indicate if they were experiencing auditory hallucinations ("Are you hearing voices?" and "How negative are the things that the voices say/said?"), visual hallucinations ("Are you seeing things that other people can't see?" and "How distressing is what you see/what you saw?"), paranoia ("How suspicious do you feel right now?"), mind control ("How much are your thoughts being controlled?"), and mind reading ("How much is someone reading your mind or are you reading someone else's mind?").

Phase 3: Final laboratory visit. Participants returned to the laboratory 1 week after the initial study visit to return their PDAs and receive study payment. Neuropsychological functioning was also evaluated at this time via the MATRICS Consensus Cognitive Battery (MCCB; Nuechterlein et al., 2008), which assesses seven cognitive domains: processing speed, attention, working memory, verbal learning, visual learning, reasoning and problem solving, and social cognition (assessed in the MATRICS via the Mayer-Salovey-Caruso Emotional Intelligence Test [MSCEIT]; Mayer, Salovey, Caruso, & Sitarenios, 2003).

Data analysis

Hypothesis 1. Linear mixed modeling (LMM) with an autoregressive (AR1) covariance structure was performed to examine group differences in emotion intensity and emotion regulation strategy use when participants were and were not experiencing psychosis and when hallucination valence was negative versus benign. Analyses were nested within day and within individual.

Hypothesis 2. LMM was used to examine group differences in emotion identification threshold, operationally defined as the interaction between the level of negative emotion intensity and amount of emotion regulation effort exerted. This analysis indicates whether psychosis contexts influenced whether patients exerted differing levels of emotion regulation effort at thresholds of negative emotion intensity that were absent, low, medium, or high. Evidence for higher effort at a lower intensity level would support the hypothesis that psychosis is accompanied by a threshold for identification that is too low, whereas evidence for less effort during psychosis contexts at negative emotion intensity levels that are high would provide evidence for a threshold for identification that is too high.

Hypothesis 3. One-way ANOVA examined the number of strategies reported when participants were and were not experiencing paranoia, auditory hallucinations, and visual hallucinations as well as when hallucination valence was negative versus benign.

Hypothesis 4. Several mathematical models were developed to examine whether emotion regulation strategies implemented at time t were differentially effective at reducing negative emotion at time $t + 1$ on the basis of whether participants were experiencing psychotic symptoms versus not. To examine these questions, first, we developed a stochastic dynamical system (Markov chain) model of transitions in emotional experience from the EMA data based on the level of emotion regulation effort exerted. Markov chain modeling indicates how a system (i.e., patient's emotional behavior) may change its emotional state or remain in the current state over time on the basis of certain probability distributions. Examining the likelihood of transition from one emotional state at time t to another emotional state at time $t + 1$ helps to explain the temporal changes of emotions over time. When viewed in relation to different strategies, this provides an estimate of how effective emotion regulation attempts were and whether effectiveness differed across psychosis contexts. The input data used in model development were the time series data of the emotion intensity and global emotion regulation effort (average of all six strategies at each time point) collected from the subjects over the 6 days of EMA. To obtain a set of all the possible emotional states (state space), the data were first preprocessed to reduce the emotion intensity levels (1–5 scale) into high, moderate, and low intensity levels and the number of emotion regulation efforts (0–4 scale) into high, medium, and low effort levels. Crossing two reduced state sets defines $3 \times 3 = 9$ emotion-effort combined states, ranging from low-low to high-high. Then, the processed data with reduced states were translated into a stochastic Markov chain model of transitions of combined states by measuring transition probabilities from one combined state to another. Next, we constructed a network on the basis of the obtained transition probabilities in which combined emotional states were considered as nodes and the corresponding transition probabilities were considered as the weight between nodes. This model allowed for evaluation of temporal changes in negative emotion from time t to $t+1$ as a function of the amount of emotion regulation effort exerted at time t. Dependent variables used to compare psychosis contexts included network density and PageRank.

Network density reflects the extent to which individual emotions in the network are interconnected and was calculated using the following formula:

$$D = \frac{\sum_{i,j \in N} w_{i \to j}}{N(N-1)},$$

in which i and j represent node (combined state) indexes, N represents the total number of nodes in the network, and $w_{i \to j}$ represents the extent of transition from node i to node j.

PageRank approximates the importance of nodes in the network, which here are the nodes (combined emotional states) that have stronger links to other nodes in the network. In other words, it measures the overall strength of each combined state given the observed transitions between the states over time. PageRank was defined mathematically as

$$C_P(i) = v_i,$$

in which v_i is the ith element of the dominant eigenvector v of the transition probability matrix.

Additionally, to evaluate Hypothesis 4, a linear regression model was built to evaluate the association of implemented emotion regulation strategies at time t with the change of negative emotions from time t to t + 1 over two consecutive time points using the following model equation:

$$x_{t+1} - x_t = A\, y_t + e,$$

in which x is the original (nonreduced) negative emotional vector; y is the vector of emotion regulation strategy; A is an $n \times r$ matrix, which represents the coefficient matrix estimated by regression (n = number of negative emotions, r = number of emotion regulation strategies); and e is an error vector.

Bipartite networks (two-mode networks) were constructed using the obtained coefficient matrices, which have two node sets/types (negative emotions and emotion regulation strategies). To analyze the properties of the constructed bipartite network, the two node sets in the corresponding bipartite matrix were combined into one node set (whose size is $n+r$) as follows:

$$R = \begin{bmatrix} 0 & A \\ A^T & 0 \end{bmatrix},$$

in which the "0" in the first row represents a $(n \times n)$ zero matrix, the "0" in the second row represents a $(r \times r)$ zero matrix, A represents the bipartite matrix, and A^T is the transpose of A. The resulting R matrix is an $((n+r)\times(n+r))$ adjacency matrix, which is also called a block matrix.

Third, another linear regression model was built over two consecutive time points to evaluate the association of two emotional variables at time t and t + 1 using the following model equation:

$$x_{t+1} = B\, x_t + e,$$

in which x is the original (nonreduced) emotional vector obtained experimentally, B is the coefficient matrix estimated by regression, and e is an error vector.

Directed networks were constructed using the obtained coefficient matrices B from the aforementioned linear regression modeling in which nodes consisted of the individual positive and negative emotion variables and edges reflect the strength of connection between individual emotions between two consecutive time points.

Hypothesis 5. Two network variables, harmonic closeness centrality and degree centrality, were calculated (Sayama, 2015). These variables provide an estimate of how interconnected individual emotional states are and whether psychosis context influenced level of connectedness independent of emotion regulation effort. More complex networks would putatively be more difficult to downregulate using emotion regulation strategies.

Harmonic closeness centrality reflects the accessibility of each emotion to other emotions in the network. In other words, the harmonic closeness centrality represents how much a particular node in the network is accessible to the other nodes in the network. Nodes with high closeness centrality can quickly access other nodes in the network. Harmonic closeness centrality is calculated as

$$\text{Harmonic Closeness Centrality for Undirected Networks: } H_i = \sum_{j \in N} \frac{1}{d_{ij}},$$

$$\text{(Out)-Harmonic Closeness Centrality for Directed Networks: } H_i = \sum_{j \in N} \frac{1}{d_{i \to j}},$$

in which i and j represent node indexes, N represents the set of nodes in the network, d_{ij} represents the shortest path length between node i and node j, and $d_{i \to j}$ represents the shortest path length from node i to node j. When calculating the shortest path length between two nodes, first the values in the coefficient matrix were converted into their absolute values and then reciprocated (1 / *absolute value* (*original association value*)) to represent smaller distances for greater coefficient values.

Degree centrality reflects the level of connectivity of a node in the network (sum of the link weights attached to a node), which is calculated as

$$\text{Degree Centrality for Undirected Networks: } k_i = \frac{\sum_{i,j \in N} w_{ij}}{N-1},$$

$$(\text{Out})\text{-Degree Centrality for Directed Networks: } k_i = \frac{\sum_{i,j \in N} w_{i \to j}}{N-1},$$

in which i and j represent node indexes, N represents the set of nodes in the network, w_{ij} represents the weight between node i and node j, and $w_{i \to j}$ represents the weight from node i to node j. Weight refers to the absolute value of the association value between/from node i and/to j in the coefficient matrix.

One-way ANOVAs were used to compare psychosis groups on each network property.

Exploratory Analysis. We also examined whether the individual emotion regulation strategies differed regarding how effective they were at decreasing negative emotion as a function of psychosis context. To answer this question, for each subject, the relationship between the two time series data of each emotion regulation strategy at time t and the difference of the average of negative emotion intensity between t and $t + 1$ were calculated using a simple correlation measure. Next, one-way ANOVAs were used to examine whether different emotion regulation strategies differed in how effectively they downregulated negative emotion across psychosis contexts.

Results

EMA compliance

Two SZ were excluded for not reaching a priori compliance standards defined as responding to less than 25% of surveys administered (according to EMA study by Gruber, Kogan, Mennin, & Murray, 2013). The remaining participants constituted the final sample (n = 28; see Table 1).

Table 1. Participant Demographics and Frequency of Symptom Severity Across Psychosis Contexts

Demographic	*M* (*SD*)
Mean age	41.39 (10.76) years
Parental education	13.45 (2.60) years
Participant education	13.27 (1.94) years
Male	57.1%
Ethnicity	
White	78.6%
African American	3.6%
Biracial	7.1%
Hispanic	7.1%
Asian	0.0%
Other	3.6%

Note: Values in parentheses are standard deviations.

All primary analyses were conducted on this final sample. Among the final sample, EMA compliance was very high (M = 90.2%).

Frequency of psychotic experiences

The frequency of auditory hallucinations, visual hallucinations, and paranoia across all surveys is presented in Table 2, along with the proportion of surveys containing differing levels of negative valence for auditory and visual hallucinations. The proportion of surveys falling in differing severity ranges of paranoia is also reported in Table 2.

Emotional experience across psychosis contexts

As can be seen in Table 3 and Figure 1, compared with instances when SZ were not experiencing symptoms of psychosis, times in which auditory hallucinations, visual hallucinations, and paranoia occurred were reported as resulting in more in-the-moment negative emotion. There was also a significant decrease in positive emotion during instances of paranoia; however, positive emotion did not differ at surveys in which SZ did and did not experience auditory or visual hallucinations.

When auditory or visual hallucinations were characterized as containing negative content, participants reported more in-the-moment negative emotion and less positive emotion compared with when hallucinations were benign (see Table 3 and Fig. 1).

We also examined negative emotion variability across psychosis contexts, calculated as the within-person standard deviation across episodes reported throughout the day (Gruber et al., 2013). Negative emotion variability occurred across both contexts. As would be expected, variability was greater during psychosis than

Table 2. Results of Primary Analyses Examining Emotional Experience, Emotion Regulation Effort, and Mathematical Models of Psychosis and Nonpsychosis Contexts

Symptom	Frequency
Visual hallucinations	18.0%
Auditory hallucinations	22.0%
Paranoia	38.9%
Severity of negative content of visual hallucinations	
Not at all	39.0%
A little	17.1%
Moderate	20.7%
Quite a bit	12.2%
Extreme	11.0%
Severity of negative content of auditory hallucinations	
Not at all	42.0%
A little	12.0%
Moderate	24.0%
Quite a bit	11.0%
Extreme	11.0%
Severity of paranoia	
Not at all	61.1%
A little	23.5%
Moderate	8.4%
Quite a bit	5.3%
Extreme	1.8%

Note: There were 20 patients who had psychotic experiences and 10 who did not have any psychotic experiences during the ecological momentary assessment period.

nonpsychosis contexts (see Supplemental Material available online).

Emotion regulation effort across psychosis contexts

Compared with times when participants did not experience visual hallucinations, instances in which visual hallucinations were present were associated with more effortful use of distraction, soothing, suppression, and situation modification; there were no differences for reappraisal or interpersonal strategies. While experiencing auditory hallucinations, participants reported more effortful use of suppression and soothing compared with times in which they did not have auditory hallucinations. When experiencing paranoia, participants reported more use of distraction, reappraisal, suppression, and soothing (see Table 4 and Fig. 1).

When visual hallucinations contained negative content, only situation modification was attempted more than instances in which visual hallucinations were benign. Auditory hallucinations with negative valence resulted in more effortful use of distraction and situation modification than when auditory hallucinations were benign (see Table 4 and Fig. 1).

Table 3. In-the-Moment Emotional Experience Across Psychosis Contexts

Context	*F* test results
VH vs. no VH	
Positive emotion	1.61
Negative emotion	11.22**
AH vs. no AH	
Positive emotion	1.85
Negative emotion	18.08**
Paranoia vs. no paranoia	
Positive emotion	31.10**
Negative emotion[a]	97.69**
VH: distressing image vs. no distressing image	
Positive emotion	12.02**
Negative emotion	4.02*
AH: negative content vs. benign content	
Positive emotion	6.55*
Negative emotion	5.54*

Note: VH = visual hallucination; AH = auditory hallucination.
[a]Completed using an autoregressive heterogeneous covariance structure. All other analyses used an autoregressive nonhetereogeneous covariance structure.
*$p < .05$. **$p < .01$.

We also evaluated whether current negative emotion and psychosis predicted composite emotion regulation effort. Results indicated that the overall model was significant ($R^2 = .41$, $F = 8.64$, $p < .001$) and that psychosis was a significant predictor ($\beta = 0.4$, $t = 2.17$, $p = .04$) but negative emotion was not ($\beta = 0.33$, $t = 1.82$, $p = .08$).

Number of strategies selected

One-way ANOVAs indicated that participants selected significantly more total strategies at each survey when psychosis was present: any psychosis: absent = 3.32 (1.74), present = 3.83 (1.37), $F = 2.11$, $p < .05$. The number of strategies selected was not significantly associated with MSCEIT performance on the MCCB, indicating that knowledge of which emotion regulation strategies to select from in a given context is not related to how many strategies are selected at a given survey.

Consistency of emotion regulation strategy use was evaluated using the intraclass correlation coefficient (ICC). Patient values were relatively low ($\alpha = .49$), suggesting that patients' strategies are not fixed over time and that they demonstrate some variability in selection. It is unclear whether this reflects adaptive "flexibility" or less deliberate and more reactive selection of strategies based on the context/stressor.

Identification threshold

The Emotional Intensity × Psychosis Context interaction was nonsignificant for auditory hallucinations, visual hallucinations, and paranoia. Thus, emotion regulation effort increased linearly as a function of increasing negative emotion intensity regardless of whether psychosis was present, failing to support the hypothesis of an abnormality at the identification stage during psychotic experiences.

Effectiveness of emotion regulation efforts across psychosis contexts

Data from all SZ participants were used in the time-lagged analyses. Because each daily prompt per subject

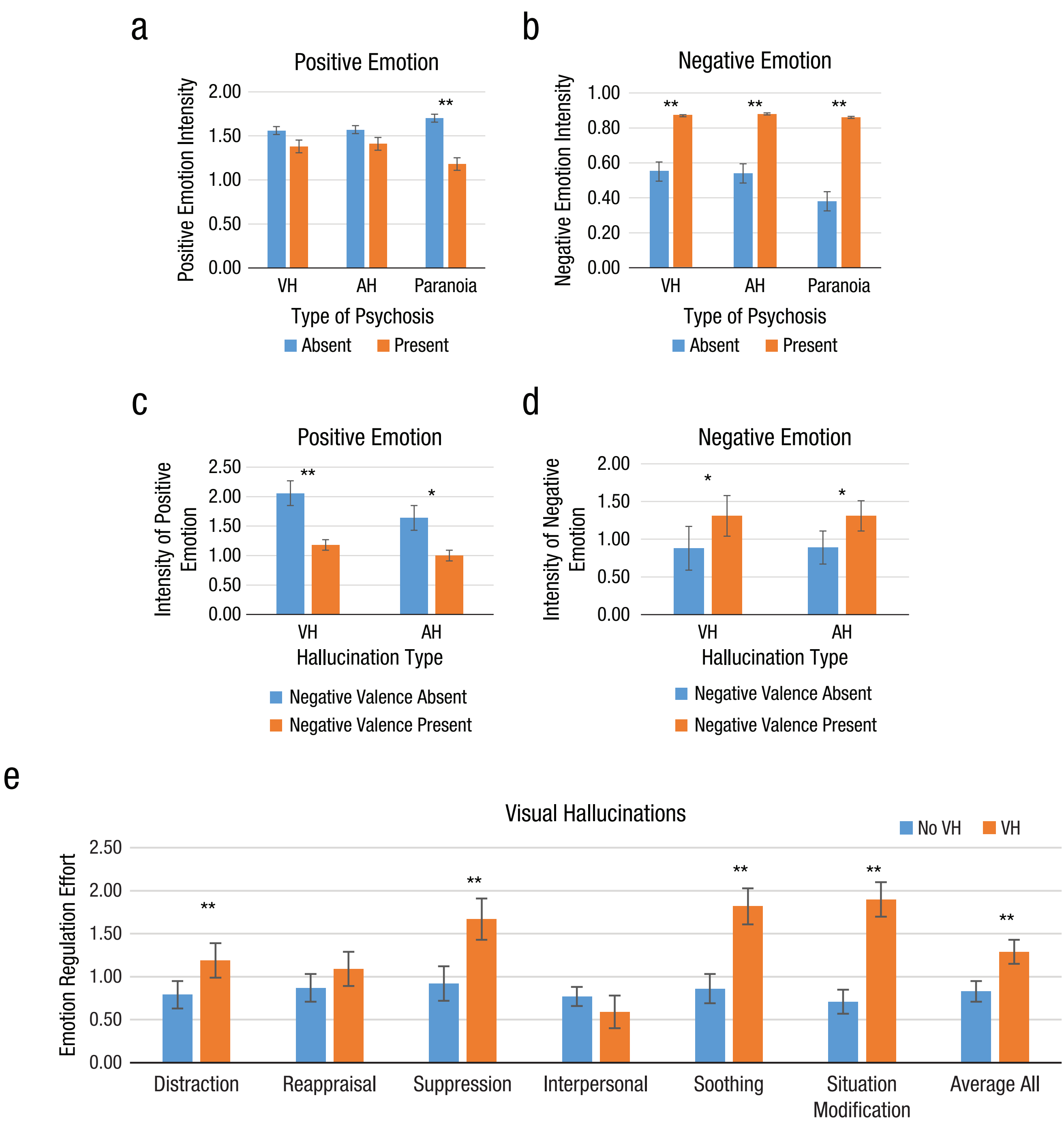


Fig. 1. *(continued on next page)*

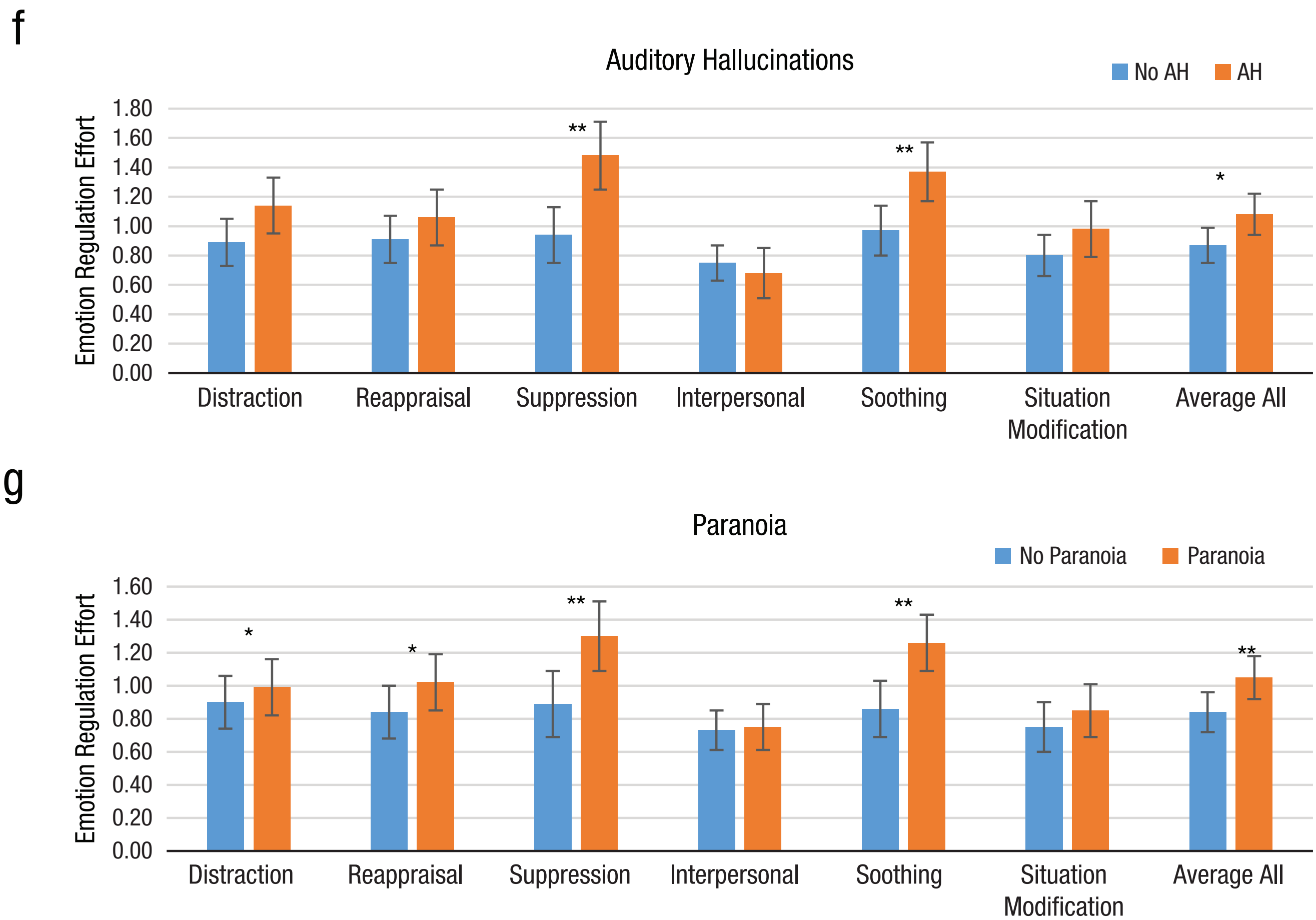


Fig. 1. Linear mixed modeling results of emotional intensity and emotion regulation effort across psychosis contexts. Graphs show positive (a) and negative (b) emotion intensity in the presence and absence of psychosis; positive (c) and negative (d) emotion intensity in the presence and absence of negative valence during hallucinations, and emotion regulation effort during visual hallucinations (e), auditory hallucinations (f), and paranoia (g). VH = visual hallucinations; AH = auditory hallucinations. Asterisks (* $p < .05$, ** $p < .01$) indicate significant difference between presence and absence of psychosis (a and b); significant difference between presence and absence of negative valence during hallucinations (c and d); and significant difference between presence and absence of visual hallucinations (e), auditory hallucinations (f), and paranoia (g).

was considered individually for experiencing psychosis versus not, there was overlap between subjects for instances with and without psychosis. There was a total of 455 daily prompts analyzed, 216 with psychosis and 239 without. There was a total of 243 consecutive prompts (117 with psychosis, 126 without) that were used in the time-lagged analyses. Twenty of the patients experienced psychosis during the EMA period, and 10 did not. As can be seen from these values, there was a sufficient number of consecutive prompts to ensure reliability for the time-lagged analyses. Additionally, the amount of data included in the analyses was similar between contexts with and without psychosis.

As can be seen in Figure 2a, Markov chain analysis indicated that psychosis context predicted whether emotion regulation efforts exerted in response to negative emotions at time t were effective at producing lasting changes in negative emotion at time $t + 1$. Emotion regulation efforts were less effective at leading to lasting decreases in negative emotion when psychosis was present (see Fig. 2). This was demonstrated quantitatively via the negative emotion Pagerank metric, which was higher when psychosis was present versus when it was absent, $F(1, 36) = 3.94$, $p = .05$.

In addition, the results of linear regression–based network analysis indicated that there was a significant difference in harmonic closeness/degree centrality values of negative emotions between SZ patients experiencing psychosis versus not (see Table 5 for the analysis and Fig. 2b). Higher Pagerank scores were associated with more negative auditory hallucination voice valence ($r = .56$, $p < .04$) but not greater negative valence content of visual hallucinations ($r = .28$). Additionally, negative emotion variability was significantly associated with Pagerank in the absence ($r = .50$, $p < .01$) and presence of psychosis ($r = .54$, $p < .02$). These findings suggest that negative

Table 4. Emotion Regulation Across Psychosis Contexts

	F test results				
Emotion regulation strategy	VH vs. no VH	AH vs. no AH	Paranoia vs. no paranoia	VH: distressing image vs. no distressing image	AH: negative content vs. benign content
Distraction	7.50**[a]	2.94	4.48*[a]	2.77	11.33**
Reappraisal	2.43[a]	1.15	4.22*[a]	0.14	2.40
Suppression	17.80**	12.51**	12.76**	0.12	0.80
Interpersonal	0.87	0.20	0.02	0.13	0.42
Soothing	44.78**[a]	7.43**	15.56**[a]	2.22	0.52
Situation modification	20.00**	1.38	0.95[a]	4.48*	4.10*
Emotion regulation average	27.55**[a]	6.55*[a]	12.33**[a]	0.01	2.30

Note: VH = visual hallucination; AH = auditory hallucination.
[a]Completed using an autoregressive heterogeneous covariance structure. All other analyses used an autoregressive nonhetereogeneous covariance structure.
*$p < .05$. **$p < .01$.

emotion variability significantly predicts difficulty decreasing negative affect from time t to $t + 1$ in both contexts.

Collectively, these results indicate that (a) high levels of emotion regulation effort at time t do not result in decreased negative emotion at time $t + 1$ when patients are experiencing psychosis and (b) instances with more negative auditory hallucination valence are particularly difficult to successfully downregulate.

The results of the time-lagged correlational analyses indicated that the individual strategies did not differ in their effectiveness at decreasing negative emotion between psychosis and nonpsychosis contexts. However, within each context, there were differences among the individual strategies regarding how effectively they decreased negative emotion. During psychosis contexts, suppression and soothing were the most effective strategies, resulting in greater decreases in negative emotion when implemented than interpersonal or situation modification. Interpersonal and reappraisal strategies led to increases in negative emotion from time t to $t + 1$ during psychosis contexts. In contrast, during nonpsychosis contexts, distraction and reappraisal were the most effective strategies, although these effects were at a trend level (see Fig. 2b and Supplemental Material).

Connectedness of discrete emotions across psychosis contexts

Network analysis also indicated that networks of emotional states were denser (i.e., more interconnected) when patients experienced psychosis versus when they did not, $F(1, 36) = 3.97$, $p = .05$ (see Fig. 2c).

Greater density of connections among emotions was also associated higher Pagerank scores ($r = .64$, $p < .001$), suggesting that more dense networks are more difficult to downregulate.

Discussion

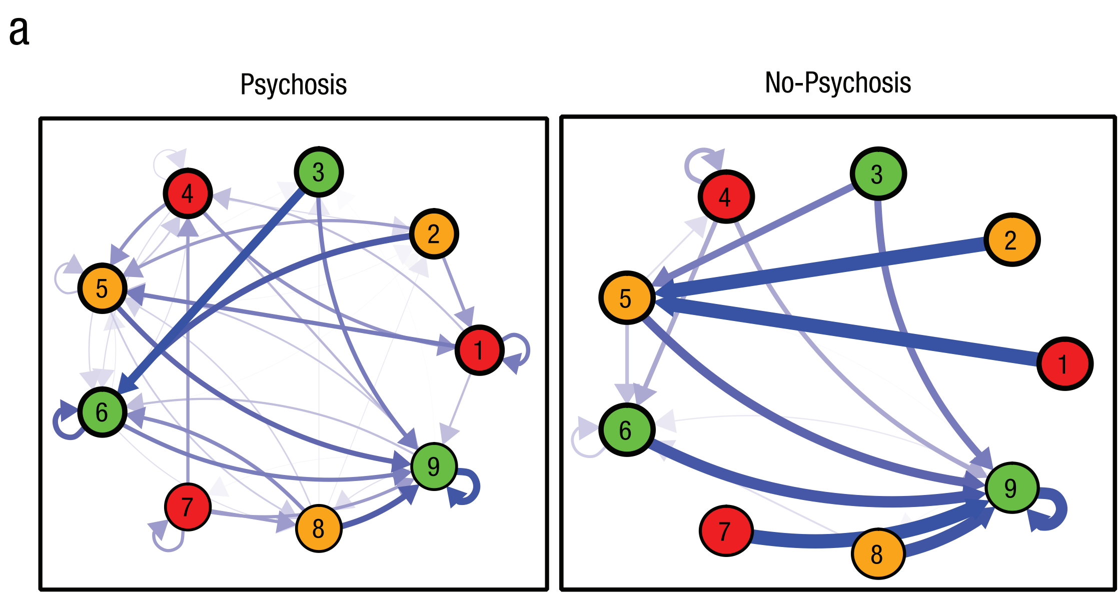
The current study evaluated emotion regulation abnormalities in the context of psychotic experiences using mathematical models applied to EMA data. James Gross's (2015) extended process model of emotion regulation provides a useful framework for interpreting the findings. The following sections discuss results as they occurred in relation to the three stages of Gross's model: identification, selection, and implementation.

Identification

The first stage, identification, involves a determination of whether attempts should be made to regulate emotion. Results indicated that the threshold for when to initiate regulation did not differ across psychosis contexts. This result is informative given results of our prior EMA study showing that schizophrenia patients had a significantly lower threshold for initiating emotion regulation attempts than healthy controls (Visser et al., 2018). Thus, while abnormalities at the identification stage may be relevant for distinguishing psychotic and nonclinical populations, this stage may not be a core contributor to the emotion regulation abnormalities that are specific to positive symptoms above and beyond those related to diagnosis.

Selection

The second stage of Gross's (2015) model, selection, involves choosing which strategy or strategies to attempt in a given context. Two types of abnormalities can occur: selecting too many or too few strategies for the context at hand. Our findings indicated that the presence of psychosis and negative valence experienced during hallucinations were both associated with an



	Emotion Regulation: High	Emotion Regulation: Moderate	Emotion Regulation: Low
Negative: High	1	2	3
Negative: Moderate	4	5	6
Negative: Low	7	8	9

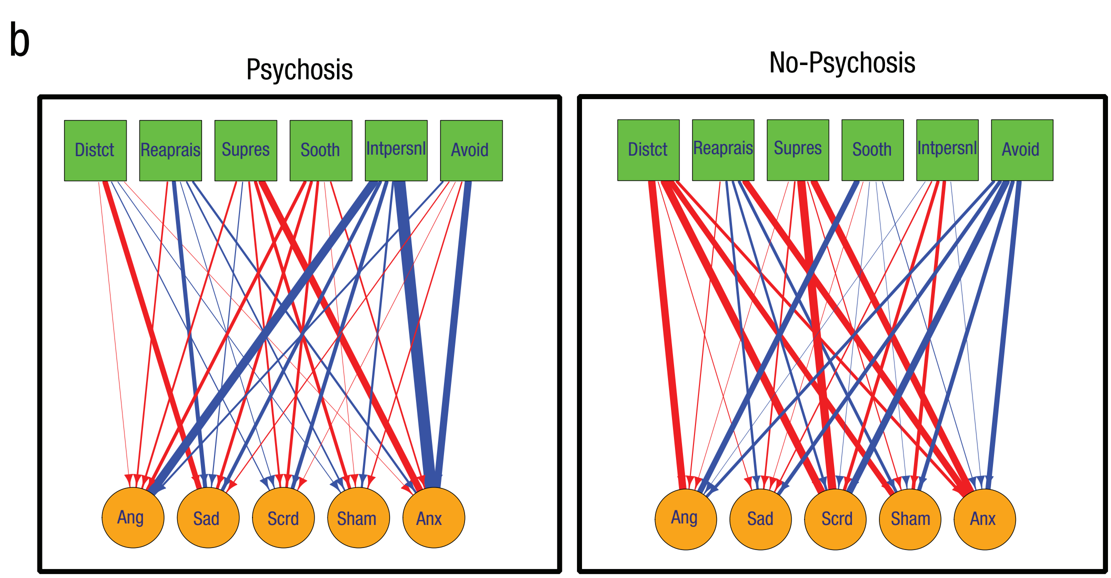


Fig. 2. *(continued on next page)*

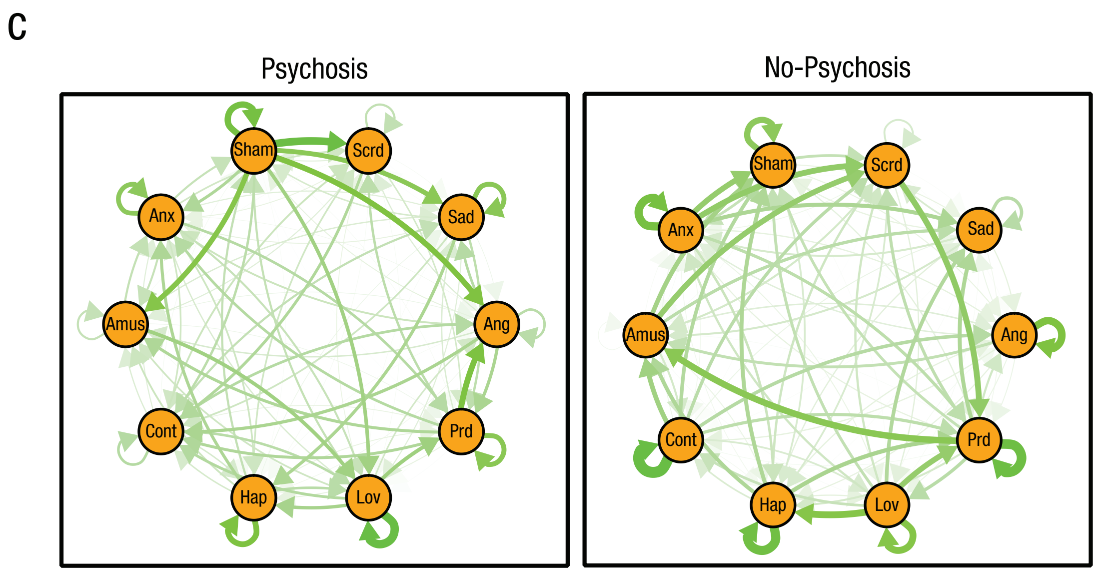


Fig. 2. Markov chain and network analysis plots evaluating effectiveness of implementation and density of emotion networks in psychosis and nonpsychosis contexts. (a) Plot of temporal transitions among negative emotional states as a function of emotion regulation (ER) effort during psychosis contexts (Markov chain analysis). This figure features a Markov chain transition matrix. Nodes represent emotional-emotion regulation states. Arrows represent transitions from one state at time *t* to another at time *t* + 1 within day. Arrow thickness represents transition strength. Numbers correspond to these states: 1 = negative high/ER high, 2 = negative high/ER moderate, 3 = negative high/ER low, 4 = negative moderate/ER high, 5 = negative moderate/ER moderate, 6 = negative moderate/ER low, 7 negative low/ER high, 8 = negative low/ER moderate, and 9 = negative low/ER low. Node (circle) color represents the level of emotion regulation effort (red = high, orange = moderate, green = low). Node border thickness represents the intensity of negative emotions. (b) Topographic map of the temporal connections among emotion regulation strategies and negative emotions during psychosis contexts (network analysis). This figure features a network analysis topographic map of connections among emotion regulation strategies and negative emotions. The nodes represent various emotional states and emotion regulation strategies (squares = emotion regulation strategies, circles = negative emotions). The edges represent the association between implemented emotion regulation strategy at time *t* and the change of negative emotion from time *t* to *t* + 1. Edge thickness represents the strength of association, and edge color represents the direction of effect (blue edge = positive association, red edge = negative association). (c) Topographic map of the temporal connections among emotional states during psychosis contexts (network analysis). This figure features a network analysis topographic map of connections among positive and negative emotions. The nodes (circles) represent various emotional states. The edges represent the connection between two emotions at two consecutive time points. Edge thickness represents the strength of connection. Distct, distract; Reaprais, reappraise; Supres, suppress; Sooth, soothe; Intpersnl, interpersonal; Ang, angry; Scrd, scared; Sham, shame; Anx, anxious; Amus, amused; Cont, content; Hap, happy; Lov, love; Prd, proud.

increase in the number of emotion regulation strategies selected. The problem at the selection stage therefore appears to result from selecting too many rather than too few strategies.

This finding raises several important questions regarding the nature of the abnormality at the selection stage. First, are the strategies being selected contextually appropriate and the most adaptive strategies that could be selected from the potential toolbox of options? Here, the data may suggest that the answer is no. Paranoia was associated with greater use of distraction, reappraisal, suppression, and soothing. Visual hallucinations were associated with increased use of distraction, soothing, suppression, and situation modification, and auditory hallucinations were associated with increased use of suppression and soothing. Furthermore, negative valence during hallucinations was associated with increased use of situation modification and distraction. These findings suggest that symptoms of psychosis are so complex that they require individuals to attempt multiple strategies to combat the level of distress that accompanies them. For example, a visual hallucination may require use of situation modification to physically remove oneself from the perceived visual stimulus, distraction to try to look at other objects within the environment, expressive suppression to prevent others from noticing that something unusual has been perceived, and soothing to try to calm oneself in the presence of the experience. Understanding which strategies patients are selecting during the presence and absence of psychotic experiences has important implications for adapting psychosocial emotion regulation therapies (Mennin, 2004) for use with psychotic disorder populations.

Table 5. Emotion Regulation Across Psychosis Contexts

	F test results	
Parameter	Model 1	Model 2
Degree centrality		
Distract	3.69	
Reappraise	4.32*	
Suppress	0.17	
Soothe	1.82	
Interpersonal	2.88	
Situation modification	4.75*	
Amused		1.56
Content		0.57
Happy		1.29
Love		2.17
Proud		0.53
Angry	0.05	3.55
Sad	8.90*	4.55*
Scared	5.77*	1.26
Shame	3.00	2.73
Anxious	3.19	2.90
Harmonic centrality		
Distract	3.40	
Reappraise	2.40	
Suppress	0.10	
Soothe	1.07	
Interpersonal	3.67*	
Situation modification	2.41	
Amused		2.89
Content		0.22
Happy		1.84
Love		1.52
Proud		1.98
Angry	0.37	3.17
Sad	7.50*	7.04*
Scared	5.73*	4.03*
Shame	3.00	2.45
Anxious	3.80	5.02*

Note: Degree centrality = the level of connectivity of each emotion; harmonic centrality = the accessibility of each emotion to other emotions in the network. A first linear regression model was built to evaluate the association of implemented emotion regulation strategies at time t with the change of negative emotions from time t to $t + 1$ over two consecutive time points using the following model equation: $x_{t+1} - x_t = A\, y_t + e$, in which x is the original (nonreduced) negative emotional vector, y is the vector of emotion regulation strategy, A is an $n \times r$ matrix that represents the coefficient matrix estimated by regression (n = number of negative emotions, r = number of emotion regulation strategies), and e is an error vector. A second linear regression model was built over two consecutive time points to evaluate the association of two emotional variables at time t and $t + 1$ using the following model equation: $x_{t+1} = B\, x_t + e$, in which x is the original (nonreduced) emotional vector obtained experimentally, B is the coefficient matrix estimated by regression, and e is an error vector. $^{*}p < .05$.

Second, are the increased number of strategies selected the result of poor emotion regulation knowledge? Contrary to this possibility, we did not observe a significant correlation between the MSCEIT subtest of the MCCB and number of strategies attempted during experiences of psychosis.

Third, do participants have low emotion regulation self-efficacy (i.e., do they select more strategies because they believe that they cannot effectively implement them)? We do not have data to address this question, but we believe it is an important future direction, especially because scales now exist to measure the construct of emotion regulation efficacy (Gross, 2015).

Implementation

To evaluate implementation, we developed mathematical models of emotion regulation efforts attempted in the context of psychotic experiences. Specifically, Markov chain analysis was used to evaluate the transition in negative emotion intensity from time t when psychosis was or was not experienced to time $t + 1$ on the basis of whether emotion regulation effort was low, moderate, or high. Markovian models indicated that in the absence of psychosis, high or moderate levels of negative emotion at time t were met with moderate to high levels of emotion regulation effort that effectively resulted in decreased negative emotion intensity at time $t + 1$. In contrast, when psychosis was present, moderate to high emotion regulation efforts were unsuccessful at decreasing negative emotion from time t to $t + 1$. Thus, although participants tried to control their level of distress in the midst of psychotic experiences, these efforts were unsuccessful, suggesting a deficit at the implementation stage.

Time-lagged correlational analyses examining the effectiveness of individual strategies at decreasing negative emotion from time t to $t + 1$ indicated that suppression and soothing were the most effective strategies during psychosis contexts and that reappraisal and interpersonal strategies actually increased negative emotion across time. During nonpsychosis contexts, distraction and reappraisal were the most effective strategies, and there were no strategies that resulted in an increase in negative emotion across time. The observation that reappraisal and distraction were effective during nonpsychosis contexts may not be surprising because these strategies have been shown to be effective at decreasing negative affect at subjective and neurophysiological levels of analysis in many studies (Ochsner et al., 2012). However, evidence that reappraisal and interpersonal strategy implementation resulted in an increase in negative emotion across time is perhaps surprising given that these strategies are generally effective at reducing negative emotion. Psychotic experiences may be too complex or cognitively demanding for typical reappraisal tactics, such as reinterpretation, to be effectively implemented. Many psychotic experiences involve interpersonal interactions (e.g., persecutory delusions), and interpersonal strategies may not be the most ideal choice depending on the specific context of psychosis. It was also interesting that suppression was a moderately effective strategy during psychosis contexts because this strategy is thought to be maladaptive and even associated with an increase in negative emotion when implemented in healthy individuals (Gross, 2015). Perhaps suppression is more effective during psychotic experiences because it is more contextually appropriate for individuals with psychotic disorders to hide these experiences from others. Concealing the experience of psychosis may become habit after years of experiencing the illness and may thus be a more practiced strategy that gains effectiveness over time. Importantly, reducing negative affect may not be the only valid marker of a strategy's effectiveness. In some instances, simply maintaining one's level of negative emotion and not experiencing an increase in negative emotion could be considered a success. For example, in psychosis contexts like paranoia, a more realistic goal might be to prevent negative emotion from spiraling out of control rather than decreasing it quickly during the context of the symptom itself.

Network analysis indicated that the presence of psychosis was associated with densely interconnected emotion networks. Discrete negative emotions (e.g., anger, fear, sadness) were highly interconnected. This may pose a problem for emotion regulation efforts because more densely connected negative emotion networks are fundamentally more complex, requiring a strategy not just to decrease intensity of several emotional states but also to explain how those states dynamically interact and fuel one another.

These modeling findings are consistent with those obtained during laboratory-based studies indicating that SZ have greater difficulty implementing various strategies (e.g., reappraisal, directed attention) to decrease the neurophysiological response to unpleasant stimuli (Horan et al., 2013; Morris et al., 2012; Strauss et al., 2013, 2015; Sullivan & Strauss, 2017; van der Meer et al., 2014). However, results contradict previous pupillometry findings indicating that patients exert inadequate effort while implementing strategies (Strauss et al., 2015), potentially signifying a disconnect between subjective and objective emotion regulation effort in SZ. Our EMA findings also extend the literature by indicating that emotion regulation effort may be especially high during psychotic experiences with negative valence.

Finally, although both negative affect and psychosis predicted emotion regulation abnormalities (and were correlated with each other), only psychosis held as a significant predictor of emotion regulation effort when both were entered into a regression equation. This suggests that psychosis was accounting for emotion regulation abnormalities beyond those related to elevated negative emotion alone.

Conclusions and Limitations

The current findings extend the literature on emotion regulation in schizophrenia by conducting an in vivo comparison of instances when participants were and were not experiencing psychosis. A primary finding was that high levels of emotion regulation effort were not successful at reducing negative emotions that accompanied hallucinations and delusions, particularly hallucinations with negative valence. The primary advance of the current article was examining the association between psychosis and stages of emotion regulation proposed in Gross's (2015) model. When viewed through the lens of this model, emotion regulation failures appear to result from problems at the selection and implementation stages but not identification. More dense connections among individual emotions that patients experience may make it particularly difficult to implement strategies effectively.

Despite these advances in understanding emotion regulation abnormalities in the context of psychotic experiences, several limitations should be considered when interpreting the current findings. First, the number of EMA surveys obtained throughout the day was not optimized for Markov chain analyses to evaluate transitions in emotional state in conjunction with emotion regulation efforts. Future studies can extend these results, which should be considered preliminary, using a higher number of surveys (e.g., 10–12), which would have more power to evaluate temporal dynamics of emotion response. Second, we investigated only a subset of the most common psychotic symptoms. Other types of delusions (e.g., guilt, grandiosity) and hallucinations (e.g., olfactory, gustatory, tactile) may yield different associations with emotion regulation. Third, our sample consisted of outpatients who have had the illness for a number of years. Inpatients, individuals in the first episode, prodromal stage, or those experiencing nonclinical psychosis may evidence a different pattern of associations between emotion regulation processes and psychosis. Fourth, results relied solely on self-report. It is now possible to obtain psychophysiological recordings during real-world contexts via mobile technology, which can be paired with EMA self-reports in real time. Combining these methods may provide a deeper mechanistic understanding of how abnormalities occur at different stages of emotion regulation. Fifth, emotional awareness has been found to predict emotion regulation in past studies (Baslet, Termini, & Herbener, 2009; Kimhy et al., 2012). By providing participants with emotion labels and strategies that they did not have to self-generate, emotion regulation abnormalities driven by emotional awareness may have been minimalized. Future studies should examine the role of emotional awareness across the stages of Gross's (2015) model. Finally, our study design did not allow for evaluation of emotion regulation "processing dynamics" identified in Gross's model (i.e., stopping, switching). Future studies should evaluate these processes and how they contribute to abnormalities at the different stages of emotion regulation. Indeed, it may be that stopping the emotion regulation process too soon or too late or switching strategies too often prevents distress resulting from experiences of psychosis to be effectively managed by even the most well-selected strategies.

Action Editor

Michael F. Pogue-Geile served as action editor for this article.

Author Contributions

G. P. Strauss and H. Sayama designed the study. H. Sayama and F. Z. Esfahlani conducted network and Markov chain analyses. Other analyses were conducted by K. F. Visser. G. P. Strauss wrote the first draft of the manuscript. All other authors contributed to subsequent drafts of the manuscript. All the authors approved the final manuscript for submission.

Declaration of Conflicting Interests

The author(s) declared that there were no conflicts of interest with respect to the authorship or the publication of this article.

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Supplemental Material

Additional supporting information can be found at http://journals.sagepub.com/doi/suppl/10.1177/2167702618810233

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