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Do people with schizophrenia experience more negative emotion and less positive emotion in their daily lives? A meta-analysis of experience sampling studies

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ABSTRACT

Research on emotion experience in response to valenced stimuli has consistently shown that people with schizophrenia have the capacity to experience emotion. Specifically, people with schizophrenia report similar experiences to both positive and negative emotion-eliciting stimuli as individuals without the disorder. However, it is less clear if people with schizophrenia experience similar levels of positive emotion and negative emotion outside of standardized laboratory contexts, as in their daily lives. One reliable method for assessing emotion experience in schizophrenia has been the Experience Sampling Method (ESM), or Ecological Momentary Assessment (EMA). Using the PRISMA guidelines for meta-analysis, we reviewed the literature for all studies that included people with and without schizophrenia, and that included a positive or negative emotion assessment during participants' daily lives. The current study is a meta-analysis of 12 EMA studies of emotion experience, which included a total of 619 people with schizophrenia and 730 healthy controls. Results indicate that people with schizophrenia consistently report more negative and less positive emotion than healthy control participants. These findings differ from laboratory-based studies, which may be due to several factors, including environmental differences, effects of the disorder that appear more clearly in daily life, or additional concerns, such as depression, which has been shown to be related to negative emotion in schizophrenia. Importantly, these findings are in line with questionnaire-based measures of emotion experience, lending some support for their use in research and clinical settings.

1. Introduction

Emotion impairment has long been considered one of the prominent, core features of schizophrenia (Bleuler, 1911; Kraepelin, 1919; Meehl, 1990). As the field of affective science has developed, researchers have begun to test specific questions about what aspects of emotion are impaired in the disorder. For example, researchers have tested whether people with schizophrenia have a similar capacity to experience emotion in the presence of valenced (i.e., positive and negative) stimuli.

In dozens of studies, researchers have presented standardized stimuli to people with and without schizophrenia, such as pictures and film clips. Results indicate that while people with schizophrenia tend to facially and vocally express less emotion (Berenbaum and Oltmanns, 1992; Kring et al., 1993; Kring and Neale, 1996), they show similar psychophysiological responses to emotion-eliciting stimuli as healthy control participants (Berenbaum and Oltmanns, 1992; Horan and Blanchard, 2003; Kring et al., 1993; Kring and Neale, 1996). In addition, people with schizophrenia consistently report similar positive and negative emotional experiences to valenced stimuli as healthy individuals (for a meta-analysis see Cohen and Minor, 2010). Thus, people with schizophrenia do not appear to differ in their emotional experience and clearly do not have a diminished capacity to experience emotion.

While the research on emotion capacity has been informative, it is unclear whether these findings translate to the daily life experience of emotion in people with this disorder. That is, people with schizophrenia may not differ from healthy controls in their capacity to experience emotion, but they could still experience more or less positive and negative emotion in their everyday lives. Identification of these potential differences would be informative for better understanding the phenomenology of the disorder, as well as for identifying emotion-focused treatment targets.

One method to assess affect in the daily lives of people with schizophrenia is to utilize standardized self-report measures of emotion experience. For example, in the Positive and Negative Affect Scales (PANAS;

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Watson et al., 1988), participants rate their emotion experience, either over a specific time frame (e.g., past week), or in general, on several emotion adjectives. Interestingly, the findings in this area of research contrast with the findings of the research in emotion capacity. In these studies, people with schizophrenia have consistently reported lower PA (positive affect) and higher NA (negative affect) using the PANAS (Barch et al., 2008; Cohen et al., 2012; Strauss et al., 2011; Strauss et al., 2013). Similarly, the Multidimensional Personality Questionnaire (MPQ; Tellegen, 1982) is also a self-report, which measures overall trait positive and negative emotion, and people with schizophrenia have also consistently indicated lower PA and higher NA than healthy individuals (Cohen et al., 2005; Blanchard et al., 1998). One drawback to these studies is that they often require participants to accurately assess (and calculate) their overall emotion experience retrospectively. Given the ubiquitous cognitive deficits in schizophrenia, these findings of lower PA and higher NA could be an inaccurate representation of actual emotion experience. Thus, it is unclear whether questionnaire-based measures or in-the-moment laboratory-based paradigms with high experimental control (which show no impairment in emotion experience) are a better representation of emotion experience in schizophrenia.

One way to minimize retrospective reports in schizophrenia is through the use of in-the-moment sampling of behavior and experience. The Experience Sampling Method (ESM), or Ecological Momentary Assessment (EMA), is a method that utilizes technology (e.g., pagers, cell phones) to collect participant report of experiences as they are occurring (Csikszentmihalyi and Larson, 1987; Oorschot et al., 2009). Typically, researchers will prompt participants multiple times a day over several days in order to gather variable data. Several EMA studies have been completed in schizophrenia, including studies on symptoms, stressors, medication adherence, social functioning, cannabis use, and others (e.g., Collip et al., 2011; Collip et al., 2013; Granholm et al., 2013; Henquet et al., 2009; Janssens et al., 2012; Lataster et al., 2011; Lataster et al., 2013; Murray et al., 2007; Oorschot et al., 2009; Peters et al., 2012). In addition to avoiding retrospective bias, EMA also allows for a more ecologically-valid view of participants' experience, since that experience is not occurring in a laboratory, but instead is reported in the immediate daily life of the participant. Thus, EMA/ESM offers a methodology with high external validity that can generalize to the daily lives of individuals with schizophrenia.

Given that EMA typically avoids the bias of retrospective report, and is an in-the-moment report of the daily lives of participants, we completed a meta-analysis of studies that included positive and/or negative emotion assessment with both schizophrenia and healthy control participants. If the laboratory-based research were an accurate reflection of the amount of positive and negative emotion that people with schizophrenia experienced, we would expect no group differences in overall PA or NA experienced in daily life. However, if the self-reported questionnaire-based measures are an accurate measure of patient emotional experience, we would expect lower PA and higher NA in patient experience.

2. Method

2.1. Literature search

The primary aim for this meta-analysis of EMA/ESM studies was to examine if people with schizophrenia experience and report in-the-moment positive or negative emotion differently from people without schizophrenia in their daily lives, and whether the emotion experience of people with schizophrenia was best reflected in the findings of laboratory studies or self-report questionnaires. In this meta-analysis, we limited our search to studies that included unipolar negative or positive emotion ratings only (e.g., How happy are you right now- 0 = not at all, 5 = extremely). We excluded studies that exclusively measured a valenced spectrum of emotion (e.g., 'mood' or 'How unhappy to happy are you on a scale of 0–5'). We did this 1) to directly compare our results to the vast majority of emotion capacity studies, and self-report questionnaire studies (such as the PANAS) in schizophrenia, and 2) because research has shown that unipolar measures of positive and negative emotion experience have provided the most nuanced representation of emotion experience in schizophrenia (Cohen and Minor, 2010).

2.2. Search strategy

In line with previous research, we used the Preferred Reporting Items for Systematic reviews and Meta-Analysis (PRISMA; Moher et al., 2009) guidelines. The electronic databases of PubMed and PsycINFO were primarily searched for any combinations of the following search key word terms: "schizophrenia", "psychotic disorder", "ecological momentary assessment", "experience sampling method", "EMA", "ESM", "mood", "affect", and "emotion". The search was limited to the studies published between January 1995 and July 2016.

In addition, the reference sections of each manuscript that qualified for inclusion were also added into our search in order to find studies that might have been inadvertently excluded from the database search. Google scholar was used as a supplemental search engine. Finally, we contacted authors who co-authored on multiple qualified studies in order to remove studies with repeated samples.

Our initial search yielded 533 potential study matches. For each study, we reviewed the title and abstract and eliminated those that included a different clinical group (e.g., major depressive disorder), or used methods of data collection other than EMA or ESM (e.g., daily diary studies). A total of 84 studies remained from this initial pool of 533.

2.3. Eligibility criteria

For inclusion, studies must have: 1) been written or translated in English; 2) used the EMA or ESM procedure to assess emotion; 3) an adult patient population with a psychotic disorder (e.g., schizophrenia, schizoaffective disorder); 4) an adult healthy control comparison group; 5) the emotion (e.g., negative or positive) rating measured on a unipolar scale (e.g., from 1 indicating not happy at all to 7 indicating extremely happy; as opposed to a 'negative to positive' bipolar scale); and 6) have collected and reported the mean and standard deviation values to be used for analysis. If there were no values reported in the manuscript but the data for emotion ratings were clearly collected, we contacted the corresponding authors to request the values for our analysis.

2.4. Study selection and data extraction

With the 84 studies remaining, each study was screened and full text was reviewed to confirm that all eligibility criteria were satisfied. Seventy-two of the 84 studies were not included for a variety of reasons, including a lack of a clear diagnostic or healthy comparison group, a lack of a unipolar measure of emotion, or where data overlapped with previously published studies. From the remaining 12 studies, we extracted all means and standard deviations of positive and/or negative emotion ratings (see Table 1). All 12 studies included utilized language about the emotion experience that referenced the current moment - and not retrospective report (e.g., "right now", "immediately after the cue/beep", "at the moment", and "current"). The details of the selection procedure for the studies are demonstrated in the PRISMA diagram (Fig. 1).

2.5. Data coding

Although there was some variability, most of the emotion ratings were measured on a 7-point Likert scale assessing positive (e.g., happy, content, cheerful) and/or negative (e.g., anxious, sad, guilty) emotions. An average of the positive or negative emotion ratings

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Table 1
Values of means and standard deviations of affect ratings for the studies that met the inclusion criteria.

Study	Year	Method (EMA/ESM)	Rating scale	Patients				Controls			
				Positive affect		Negative affect		Positive affect		Negative affect	
				Mean	SD	Mean	SD	Mean	SD	Mean	SD
Ben-Zeev et al.	2012	ESM	Unipolar NA & PA	1.27	0.86	0.46	0.44	2.07	0.72	0.21	0.24
Collip et al.	2011	ESM	Unipolar NA	N/A	N/A	1.92	0.95	N/A	N/A	1.34	0.36
Frissen et al.	2014	ESM	Unipolar NA	N/A	N/A	1.75	0.75	N/A	N/A	1.29	0.32
Gard et al.	2007	ESM	Unipolar NA & PA	1.70	1.17	0.94	0.76	1.57	1.08	0.61	0.51
Glaser et al.	2008	ESM	Unipolar NA & PA	4.40	1.00	1.80	0.70	5.50	0.80	1.20	0.40
Johnson et al.	2009	ESM	Unipolar NA	N/A	N/A	2.54	1.48	N/A	N/A	1.85	1.28
Kuepper et al.	2013	ESM	Unipolar NA & PA	4.40	1.24	1.89	1.04	5.24	1.11	1.37	0.62
Myin-Germeys et al.	2000	ESM	Unipolar NA & PA	4.14	1.22	2.34	1.12	5.01	0.65	1.42	0.39
Myin-Germeys et al.	2001	ESM	Unipolar NA & PA	4.40	1.00	1.70	0.70	5.50	0.80	1.20	0.30
Pishva et al.	2014	ESM	Unipolar NA & PA	4.50	0.90	1.70	0.70	5.00	0.60	1.20	0.30
Reininghaus et al.	2016	ESM	Unipolar NA	N/A	N/A	3.04	1.23	N/A	N/A	1.91	0.70
Sanchez et al.	2014	EMA	Unipolar NA & PA	2.23	1.47	0.83	0.93	2.39	1.32	0.47	0.64

NA: negative affect; PA: positive affect; M: mean; SD: standard deviation.

(when there were multiple emotions) was used. Given that all studies did not use the same anchored scale, standardized mean difference (effect sizes *d*) and variance were calculated between the patient group and the healthy control group following the procedure demonstrated in Borenstein et al. (2009). We used these standardized mean differences comparing the emotion ratings of people with schizophrenia and healthy controls for each individual study and for positive and negative emotion, respectively.

2.6. Statistical analysis

Meta-analysis was conducted with the R statistical software version 3.2.3 for Mac Os X, using the metafor package (Viechtbauer, 2010). The analyses for negative and positive emotions were conducted separately. The summary effects across the studies for each emotion were calculated using either a fixed-effects or a random-effects (employing DerSimonian and Laird estimator; DerSimonian and Laird, 1986) model, using a method that statistically weighs each effect size according to its variance values. For the summary effects for each emotion, the heterogeneity among the effect sizes was assessed with Q-statistics (Cochran, 1954) and the I^2 index (Higgins and Thompson, 2002), in order to determine heterogeneity across the studies (Higgins et al., 2003). When heterogeneity was observed by Q-statistics or when I^2 index was greater than 50%, a random-effects model was used. If heterogeneity was not observed, a fixed-effects model was used for the meta-analysis.

In order to address publication bias, funnel plots (Egger and Smith, 1995) were created for both negative and positive emotion. Also, a statistical test (i.e., Regression Test for Funnel Plot Asymmetry; Egger et al., 1997) was employed as an additional measure to assess for publication bias. This was completed in order to detect if there was an asymmetry in the funnel plots as a confirmatory method. If the null hypothesis for this

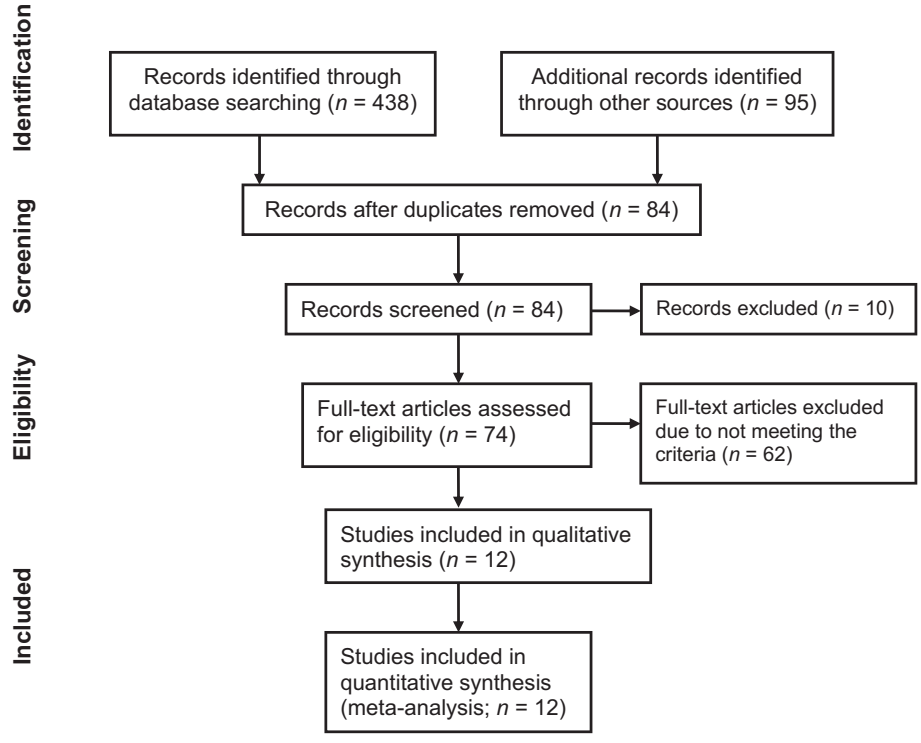

Fig. 1. Flow of information through the different phases of study selection process (PRISMA).

Table 2
Study characteristics of the studies that met the criteria for possible inclusion in this meta-analysis.

Study	Year	Journal	$N_{Patients}$	Diagnosis	(%) Female	M_{Age} (SD)	$N_{Controls}$	(%) Female	M_{Age} (SD)
Ben-Zeev et al.	2012	Schizophrenia Bulletin	24	SZ	29.2	44.87 (9.27)	26	65.4	34.23 (10.45)
Collip et al.	2011	CNS Neuroscience & Therapeutics	86	NAPD	33.0	32.26 (10.60)	109	68.0	40.17 (13.44)
Frissen et al.	2014	Social Psychiatry and Psychiatric Epidemiology	57	NAPD	29.8	28.00 (8.20)	75	70.7	32.30 (11.30)
Gard et al.	2007	Schizophrenia Research	15	SZ&SZA	50.0	42.67 (8.33)	12	58.0	36.33 (9.85)
Glaser et al.	2008	Psychological Medicine	42	PD	47.6	31.90 (7.70)	49	51.0	35.20 (8.90)
Johnson et al.	2009	International Journal of Methods in Psychiatric Research	47	SZ	37.0	44.10 (10.50)	82	67.0	19.40 (1.40)
Kuepper et al.	2013	Acta Psychiatrica Scandinavica	40	NAPD	40.0	37.70 (9.15)	57	28.1	27.40 (9.16)
Myin-Germeys et al.	2000	Schizophrenia Bulletin	58	SS	37.9	36.00 (9.00)	65	40.0	30.00 (14.00)
Myin-Germeys et al.	2001	Archives of General Psychiatry	42	PD	47.6	31.90 (7.70)	49	51.0	35.20 (8.90)
Pishva et al.	2014	PloS One	110	PD	69.1	34.20 (11.40)	112	69.6	33.20 (11.50)
Reininghaus et al.	2016	Schizophrenia Bulletin	51	SS	45.1	28.3 (8.6)	53	52.8	35.0 (12.6)
Sanchez et al.	2014	Psychiatry Research	47	SZ&SZA	26.0	39.55 (13.95)	41	37.0	36.83 (14.89)

SZ: schizophrenia; SZA: schizoaffective disorder; NAPD: non-affective psychotic disorder; PD: psychotic disorders; SS: schizophrenia spectrum.

test is rejected ($p < 0.05$), it indicates that a publication bias exists in the model, and it can be corrected by a funnel-plot based method that is used for adjusting for publication bias (Duval and Tweedie, 2000).

3. Results

3.1. Descriptive data

In all, from the 12 studies included, there were a total of 619 people with and 730 people without schizophrenia. Table 2 shows study characteristics. Table 1 contains information regarding the in-the-moment emotion ratings. Note that three studies collected data of negative emotion only – no study in our meta-analysis collected positive emotion only.

3.2. Negative emotion in patients vs. controls

For negative emotion, heterogeneity was not observed across the studies ($Q = 14.22$, $I^2 = 22.67$, $p = 0.22$), therefore a fixed-effects model was used for meta-analysis. In line with questionnaire-based studies, the model revealed a statistically significant mean effect size of 0.84 (95% CI, 0.73 to 0.95, $p < 0.0001$), suggesting that people with schizophrenia report more negative emotion in their daily lives than do people without schizophrenia (see Fig. 2; for the summary of effect sizes and variance of all studies for both negative and positive emotions, see Table 3).

3.3. Positive emotion in patients vs. controls

For positive emotion, heterogeneity was observed across the studies ($Q = 24.32$, $I^2 = 71.22$, $p = 0.001$), thus a random-effects model was used. Also in line with questionnaire-based measures, the model revealed a statistically significant mean effect size of −0.75 (95% CI, −1.03 to −0.46, $p < 0.0001$), indicating that people with schizophrenia reported experiencing less positive emotion in their daily lives than healthy control participants (see Fig. 3).

3.4. Publication bias

Funnel plots indicated an absence of publication bias (Figs. 4 and 5, respectively). The regression test for funnel plot asymmetry (Egger et al., 1997) confirmed that publication bias did not influence the validity

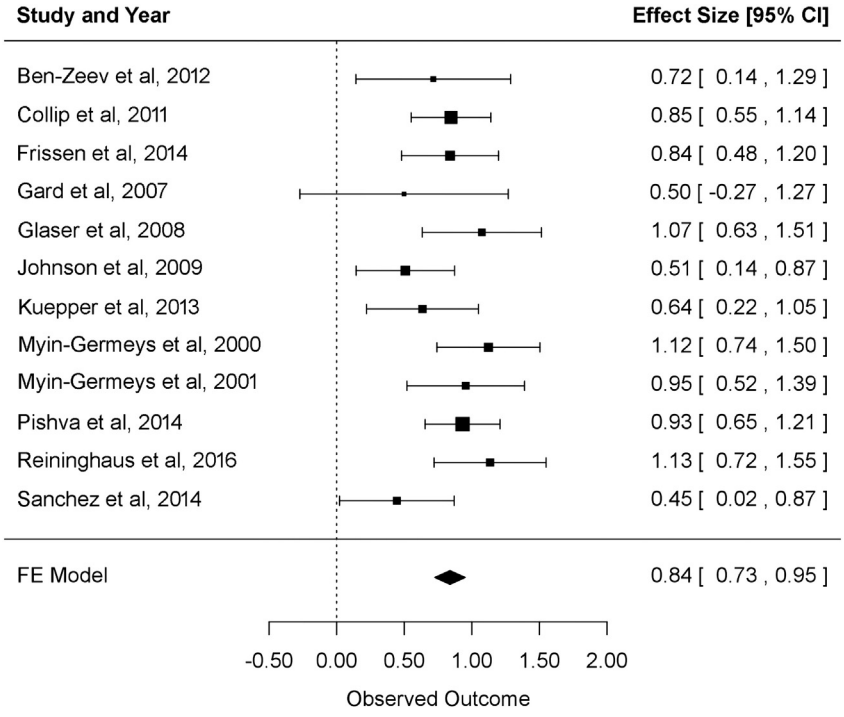

Fig. 2. Forest plot for negative affect using a fixed-effects (FE) model.

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Table 3
Summary of effect sizes for negative affect and positive affect.

Study	Positive affect		Negative affect	
	Effect size	Variance	Effect size	Variance
Ben-Zeev et al. (2012)	−1.01	0.09	0.72	0.09
Collip et al. (2011)	N/A	N/A	0.85	0.02
Frissen et al. (2014)	N/A	N/A	0.84	0.03
Gard et al. (2007)	0.11	0.15	0.50	0.15
Glaser et al. (2008)	−1.23	0.05	1.07	0.05
Johnson et al. (2009)	N/A	N/A	0.51	0.03
Kuepper et al. (2013)	−0.72	0.05	0.64	0.04
Myin-Germeys and Delespaul (2000)	−0.90	0.04	1.12	0.04
Myin-Germeys et al. (2001)	−1.23	0.05	0.95	0.05
Pishva et al. (2014)	−0.65	0.02	0.93	0.02
Reininghaus et al. (2016)	N/A	N/A	1.13	0.04
Sanchez et al. (2014)	−0.11	0.05	0.45	0.05

of the summary effect size of this meta-analysis across the studies examining negative emotion ($p = 0.39$) or positive emotion ($p = 0.44$).

4. Discussion

4.1. Overview

In 12 studies utilizing EMA/ESM, with a total of 619 people with and 730 people without schizophrenia, people with schizophrenia consistently reported more negative emotion and less positive emotion in their daily lives than people without the disorder. These findings are consistent with several studies that have used questionnaire-based methods to assess emotion experience (e.g., the PANAS), but contrast with numerous laboratory-based studies that consistently show that people with schizophrenia have a similar *capacity* to experience emotion. In other words, when people with schizophrenia are shown standardized emotion-eliciting stimuli, they report similar experiences of positive and negative emotions. However, in their own day-to-day lives, people with schizophrenia report very different emotional experiences.

This difference in findings between the laboratory and daily-life emotion-experience studies may be attributable to several different factors. For one, the stimuli presented in the laboratory may not be an ecologically precise representation of the emotion experience of people with schizophrenia. While the standardized stimuli can provide us with clearer internal validity, it may not be as emotionally representative of emotion experience of people with schizophrenia. In fact, one clear distinction between the 'emotion capacity' studies and EMA/ESM studies is that the former requires a reaction to a specific stimulus, while the latter reflects only the participant's actual lived emotional experience, which may or may not be in response to a specific event. Instead, the higher negative emotion seen in EMA studies, for example, may be due to difficulties that patients have with regulating emotions (Horan et al., 2013; Kimhy et al., 2012; Strauss et al., 2013). In addition, we have shown that high negative emotion in daily life may be impacting putatively enjoyable experiences for people with schizophrenia (Sanchez et al., 2014). That is, the overall higher levels of negative emotion experience may be related to the symptom of anhedonia or depression more broadly in the disorder.

Another crucial difference between the laboratory and EMA/ESM studies is the potential difference in the environments of the participants in EMA/ESM studies. Although in one study we did not find differences in how stimulating the environments were between patients and healthy control participants (Gard et al., 2014), much more work is yet to be done in this area. Relatedly, while all studies included here had control groups that closely matched patient participant groups, there are often key differences in groups that go beyond diagnosis, including education level of the participants, parental education level, socioeconomic status, and others (Bjelland et al., 2008; Blanchflower and Oswald, 2011; Lorant et al., 2003). It is certainly possible that additional factors that are either independent of the diagnosis, or are the sequelae of the diagnosis, could impact or be the cause of the emotion differences seen here. Of course, these differences could also be contributing to emotion regulation problems overall in schizophrenia (e.g., O'Driscoll et al., 2014; Strauss et al., 2013), and related to the higher negative emotion experience seen in people with schizophrenia. It is important to note, however, that the group differences often seen in patients and controls (such as education level) are also present in the emotion

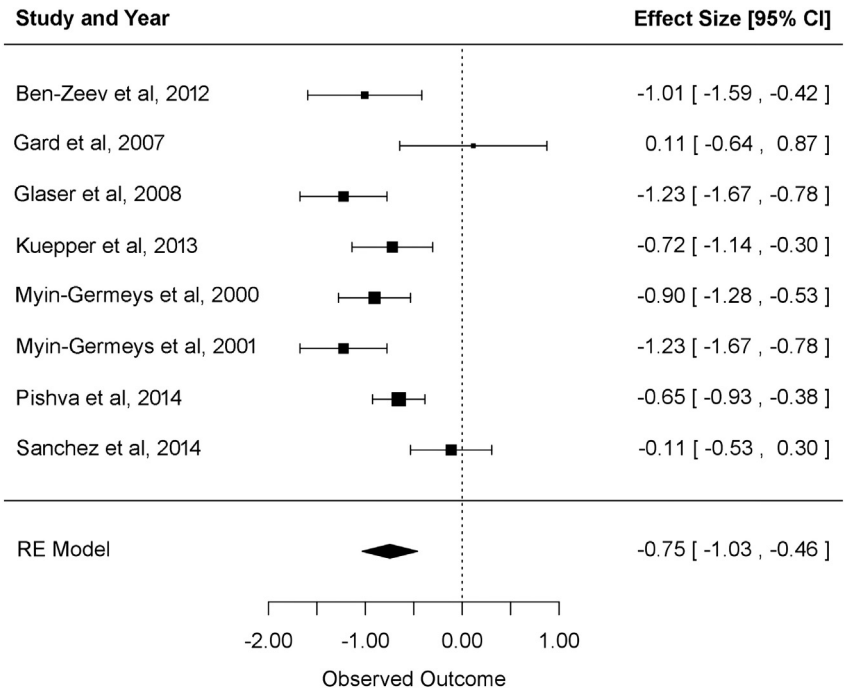

Fig. 3. Forest plot for positive affect using a random-effects (RE) model.

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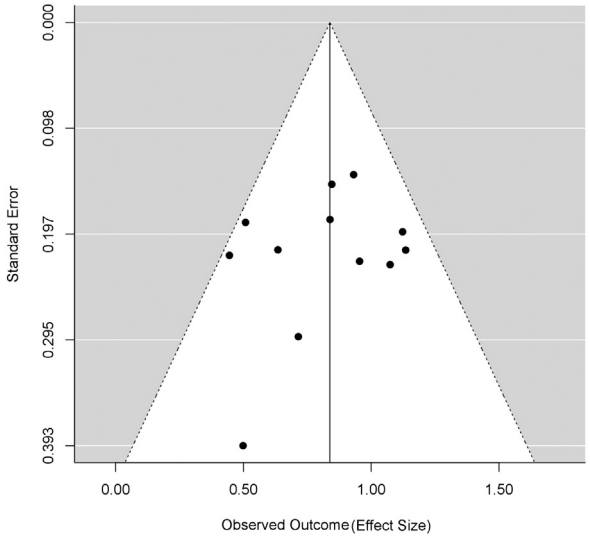

Fig. 4. Funnel plot for negative affect.

capacity studies. The key difference in the findings between the EMA and emotion capacity studies seen here are most likely due to the environments where the emotion experiences is sampled.

4.2. Limitations and future directions

Although the higher negative emotion finding was consistent in 11 of the 12 studies, two studies did not find lower positive emotion in patients. However, these two studies may be due to study specific factors, including sample size and live caller methodology (Gard et al., 2014). Nonetheless, positive emotion remained significantly lower in the broader spectrum of studies. While the number of studies analyzed here was large enough to assess the overall emotion experience of people with schizophrenia, the number of studies within that sample that investigated moderators or mediators was not large enough to begin to parse the relationship of emotion to symptoms or functioning, or to more broadly explain the group differences seen. Future studies may wish to connect emotion experience to these key factors in order to identify clear treatment targets. For now, it is clear that the emotion experience of people with schizophrenia reflects increased experiences of negative emotion and decreased experiences of positive emotion. Thus clinicians should work to help increase emotion regulation skills in people with schizophrenia, and to target an increase in positive emotion experience, such as increasing the experience of anticipatory pleasure (Edwards et al., 2015; Favrod et al., 2010). Finally, it should be noted that the EMA/ESM findings here mirror those in easy-to-implement questionnaires of positive and negative emotion experience (e.g., the PANAS and MPQ). Given the fact that EMA/ESM studies can be labor intensive to implement, clinicians and researchers may choose to rely on these measures for emotion experience, when that experience is not the primary area of focus.

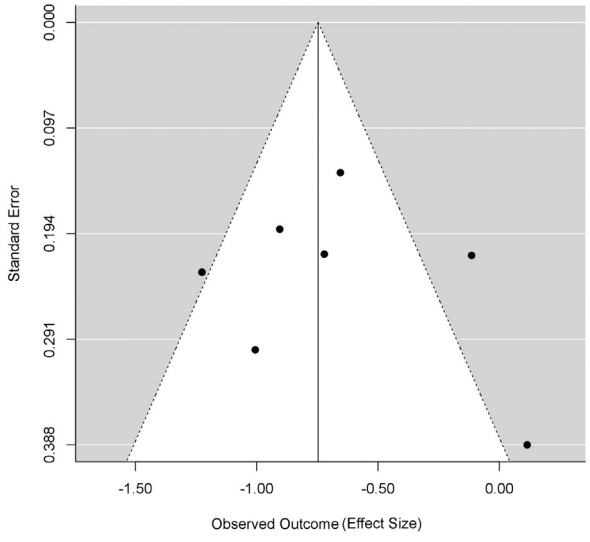

Fig. 5. Funnel plot for positive affect.

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None.

Contributors

Dr. David Gard contributed to the design of the study, data interpretation, and preparation of the manuscript. Hyein Cho contributed to the literature searches, data collection, data analysis, interpretation of the results, and preparation of the manuscript. Rachel Gonzalez and Lindsey M. Lavaysse contributed to the literature searches, data collection, and preparation of the manuscript. Sunny Pence and Dr. Daniel Fulford contributed to the preparation of the manuscript. All authors contributed to and have approved the final manuscript.

Conflict of interest

None.

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