

## Facial Emotion Perception in Schizophrenia: A Meta-analytic Review

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**Objectives:** A considerable body of literature has reported on emotion perception deficits and the relevance to clinical symptoms and social functioning in schizophrenia. Studies published between 1970–2007 were examined regarding emotion perception abilities between patient and control groups and potential methodological, demographic, and clinical moderators. **Data Sources and Review:** Eighty-six studies were identified through a computerized literature search of the MEDLINE, PsychINFO, and PubMed databases. A quality of reporting of meta-analysis standard was followed in the extraction of relevant studies and data. Data on emotion perception, methodology, demographic and clinical characteristics, and antipsychotic medication status were compiled and analyzed using Comprehensive Meta-analysis Version 2.0 (Borenstein M, Hedges L, Higgins J and Rothstein H. *Comprehensive Meta-analysis. 2.* Englewood, NJ: Biostat; 2005). **Results:** The meta-analysis revealed a large deficit in emotion perception in schizophrenia, irrespective of task type, and several factors that moderated the observed impairment. Illness-related factors included current hospitalization and—in part—clinical symptoms and antipsychotic treatment. Demographic factors included patient age and gender in controls but not race. **Conclusion:** Emotion perception impairment in schizophrenia represents a robust finding in schizophrenia that appears to be moderated by certain clinical and demographic factors. Future directions for research on emotion perception are discussed.

**Key words:** schizophrenia/meta-analysis/emotion perception

### Introduction

Although most efforts to examine behavioral deficits in schizophrenia have focused on neurocognition, the past 25 years have seen a growing literature on emotion perception deficits in schizophrenia (reviews by Edwards et al,<sup>1</sup> Mandal et al,<sup>2</sup> and Morrison et al<sup>3</sup>) and in the larger domain of social cognition,<sup>4,5</sup> which is defined as the ability to process and apply social information. Recognition of facial expressions of emotions is instrumental constituent of nonverbal communication, and several studies in schizophrenia have underscored that emotion perception abilities are related to social competence<sup>6–10</sup> and predict later work functioning and independent living.<sup>11</sup> In addition, emotion perception is more affected in schizophrenia compared with psychiatric control groups, such as mood disorders.<sup>12–14</sup>

Reviews of early studies<sup>3</sup> showed that results were limited by small sample sizes consisting of mostly inpatients with prolonged hospitalizations and the use of diverse nonstandardized stimuli. Study designs improved considerably in the 1990s<sup>1,2</sup> with employment of standardized tasks, exclusion criteria, and inclusion of in- and outpatient groups that with respect to demographic and clinical characteristics are more representative of schizophrenia. The qualitative review by Edwards et al<sup>1</sup> of studies published prior to 2000 details the need to attend to numerous demographic, task, and illness-related variables that can interfere with accurate emotion perception. Among others, duration of illness, negative symptoms, medication levels, outpatient vs inpatient status, stage of illness, and schizophrenia subtypes were identified as potential and unexamined variables that contribute to emotion perception impairment and warrant further attention.

In general, task designs within emotion perception studies can be separated into those that focus on identification of specific emotions and those that differentiate between intensities of emotion expressions. Identification tasks rely on choosing a qualitative label, usually from a limited number of choices, to the picture of a facial expression. Differentiation tasks require judgment regarding differences in emotion expressions—typically of 2 visual stimuli—without necessary identification of the emotion. Numerous studies have employed both identification and differentiation tasks, based on the possibility that the different tasks yield differential impairment.

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While early investigations included nonstandardized emotional stimuli, many subsequent studies employed face stimuli developed by Ekman and Friesen<sup>15</sup> or Gur *et al.*<sup>16</sup> The black and white stimuli created by Ekman and Friesen<sup>15</sup> consist of posed facial expressions of universally recognized emotions, including happiness, sadness, anger, fear, disgust, and surprise. Pictures are of mostly middle-aged Caucasian posers, with more recent inclusion of Asian but not African American or Hispanic posers. The stimuli of Gur *et al.*<sup>16</sup> include color faces expressing happy, sad, angry, fearful, and disgusted emotions in posed and evoked conditions, across adult age groups and different ethnicities. Very few studies have failed to elucidate emotion impairment in schizophrenia, and the argument has been made that methodology and task design, rather than emotion perception abilities, may account for group differences seen.<sup>17</sup>

Most<sup>9,18–22</sup>, but not all,<sup>17,23</sup> cross-sectional studies have shown an association between illness severity, positive and negative symptoms of schizophrenia, and emotion perception abilities that may be further mediated by chronicity of illness.<sup>8</sup> Potentially, the issue between clinical parameters and perception abilities can be more decisively investigated in a longitudinal design. Several studies<sup>12,24–26</sup> with short-term follow-up in acutely ill patients have revealed that standard treatment, including antipsychotics, and resultant response do not appreciably improve performance on emotion perception suggesting a trait-like deficit. On the other hand, specific application of emotion remediation has been found to be beneficial.<sup>27</sup>

While the vast majority of studies on facial emotion perception establish the existence of impairment in schizophrenia, potential factors related to task design and sample characteristics that may influence published findings remain to be better understood. We conducted a comprehensive meta-analysis of the existing studies on emotion perception in schizophrenia with the aim to quantify the magnitude of deficit seen in facial emotion perception and to identify variables that may moderate the impairment in schizophrenia. Specifically, the selection of variables was based on (1) the majority of facial emotion perception studies being based on tasks of emotion identification or differentiation, (2) findings in the existing literature that implicate certain clinical variables, *ie*, symptoms, hospitalization status, and illness duration with emotion perception abilities, (3) findings in the existing literature that implicate certain demographic variables, *ie*, age, gender, ethnicity, with emotion perception abilities, and (4) adequate representation of the potential variables within the extant literature to allow for meaningful comparisons.

Because most studies that employed tasks that measured emotion identification or differentiation reported on emotion perception in general, we did not anticipate finding a differential effect related to task. The lack of test design affecting performance may indicate that although the

task types may overlap with different aspects of cognition, emotion identification and differentiation tasks tap the general domain of facial emotion perception to a similar extent.

We examined relatedness for clinical factors, in particular diagnosis of schizophrenia vs inclusion of schizoaffective disorder, hospitalization status, duration of illness, and clinical symptoms, and we anticipated that emotion perception deficits in schizophrenia show association with characteristic clinical symptoms but are not clearly related to diagnosis, stabilization of psychosis, or to deterioration with prolonged duration of illness. Similarly, based on the limited effect of antipsychotics on cognition, we did not expect the meta-analysis to reveal clear effects associated with antipsychotic treatment, *ie*, related to being on antipsychotic and type and dosage.

Studies that have described demographic factors associated with emotion perception were performed on large sample sizes. In healthy controls, subtle effects of age, gender, and race have been associated with perception ability.<sup>28–31</sup> Considering group characteristics that commonly included age ranges between 18 and 65 years, male predominance, and limited inclusion of participants with different ethnicities, we were not confident to find a clear association between emotion perception and demographics between and within groups. Nevertheless, investigation of demographic characteristics may prove informative in elucidating that the effect of the clinical condition on emotion perception outweighs demographic influences.

## Materials and Methods

### *Search Strategy*

Studies were identified through a computerized literature search of the MEDLINE, PsychINFO, and PubMed databases from 1970 through August 2007 using the keywords “emotion, affect -perception, -recognition, --identification, -differentiation, -discrimination, social cognition, - perception, and schizophrenia and schizoaffective disorder.” In addition, a thorough manual search was performed using cross-references from original articles and reviews. The search was limited to English language publications and studies of humans only. For further consideration, articles included information about performance measures and relevant statistical information that permitted application of meta-analytical procedures.

### *Data Extraction*

Eligible studies focused on formal tests of facial emotion identification and emotion differentiation in patients with schizophrenia and healthy participants. Facial emotion identification tasks were defined as tests that required ascribing a qualitative label, usually from a limited number of choices, to the picture of a facial expression. Facial emotion differentiation tasks required judgment regarding differences in emotion expressions without necessary identification of the emotion. A quality

of reporting of meta-analysis standard<sup>32</sup> was followed in the extraction of relevant studies and data. Potential studies were initially reviewed for possible inclusion by 3 authors (C.G.K., E.A.M., J.B.W.) based on the aforementioned criteria. Relevant data for meta-analytic analysis, including statistical values on differences in emotion perception, and information on task type (emotion identification or differentiation), clinical characteristics (diagnosis, inpatient status, age at onset, duration, number of hospitalizations, clinical symptoms), antipsychotics (medication status and type and dosage), and demographic characteristics (age, gender, education, race of participant) were subsequently extracted and tabulated independently by 2 authors (J.B.W. and P.J.M.). Disagreements were resolved by discussion and consensus.

### Statistical Analyses

Comprehensive Meta-analysis Version 2.0<sup>33</sup> was used for the analysis. The mean difference in scores between studies reporting contrasts of schizophrenia patients and healthy controls on measures of facial emotion identification or differentiation was standardized by calculating Cohen  $d$ , the difference between the 2 raw means divided by the pooled SD. In order to control for study differences in sample size when mean effect sizes were computed, studies were weighted according to their inverse variance estimates. Effect sizes are typically categorized as small ( $d = 0.2$ ), medium ( $d = 0.5$ ), or large ( $d \geq 0.8$ ) based on these methods.<sup>34</sup> In order to determine whether mean effect sizes were statistically significant, the CI and  $z$  transformation of the effect size were used. The Cochran  $Q$  statistic was utilized to assess homogeneity of the effect sizes across studies for each facial emotion domain.<sup>35</sup> The significance level of the mean effect sizes was computed using fixed-effects linear models except when the  $Q$  statistic revealed significant within-group heterogeneity, in which case a random-effects model was used. The pooled estimates by the random-effects model did not differ significantly from those obtained by the fixed-effects model. The presented results are according to the latter. Possible effect size moderators were examined in those domains with significant heterogeneity, based on the  $Q$  statistic and meta-regression techniques. Cohen  $d$  values are provided for categorical moderating variables and are based on group comparisons but not for continuous moderating variables, where Cohen  $d$  values are based on unit of measure comparisons (ie, Scheduled Assessment of Positive Symptoms [SAPS] scores, % gender, etc) and do not yield information that can be easily interpreted. Analysis of facial emotion perception differences was performed including all eligible studies. Publication bias was assessed graphically using a funnel plot and mathematically using an adjusted rank correlation test, according to the methods of Begg and Mazumdar<sup>36</sup> and Egger et al.<sup>37</sup> Further analysis included comparison of studies grouped by task design and those reporting on

relevant demographic and clinical characteristics and anti-psychotic status.

## Results

### Search Results

Out of 91 articles examined in detail, 53 articles totaling 86 studies were identified that reported the results of comparative studies of facial emotion identification and differentiation<sup>6,8,9,12,19–23,26,38–80</sup> employing photographic images of emotion expressions. Thirty-eight articles were excluded for reasons of lack of control groups ( $N = 13$ ),<sup>11,18,81–91</sup> lack of data or statistics that precluded meta-analysis ( $N = 11$ ),<sup>13,92–101</sup> and tests that included ratings for friendliness/pleasantness or evaluation of video scenes ( $N = 8$ )<sup>3,17,102–107</sup> because these tasks did not necessarily focus on perception of facial emotions and other reasons ( $N = 6$ ).<sup>9,27,108–111</sup>

### Overall Meta-analysis Results

Analysis of facial identification and differentiation impairment collapsed across the entire sample revealed a large overall effect size ( $N = 3822$ ,  $d = -0.91$ , 95% CI =  $-0.97 < \delta < -0.84$ ) that was significantly heterogeneous ( $Q_B[76] = 295.7$ ,  $P < .001$ ). Evidence of publication bias was observed, as indicated by an asymmetric funnel plot and a significant Begg test ( $P = .005$ , 1 tailed) and Egger test ( $P = .003$ , 1 tailed). In light of this finding, we calculated a fail-safe  $N$ , which revealed that 9538 “null” studies would have to be located and included in order to nullify the observed effect. Effect sizes for the individual studies included in the meta-analysis are illustrated in figure 1. To further probe the variability among effect sizes, we proceeded to analyze psychometric, clinical, and demographic variables that might explain this heterogeneity.

### Task Type

Examination of experimental tasks used to probe facial emotion perception revealed that all tasks could be broken down into tests tapping the domains of facial emotion identification or differentiation. Comparisons of effect sizes for studies examining facial affect identification ( $N = 59$  studies,  $d = -0.89$ , 95% CI =  $-1.05 < \delta < -0.75$ ) and differentiation ( $N = 27$  studies,  $d = -1.09$ , 95% CI =  $-1.29 < \delta < -0.89$ ) revealed large performance deficits that did not differ significantly from each other ( $Q_B[33] = 2.46$ ,  $P = .117$ ) (figure 2). For the remainder of the analyses, the 2 test domains were collapsed into a single variable and are collectively referred to as “facial emotion perception.”

### Clinical Characteristics

**Diagnosis.** Studies were either comprised of a sole diagnosis of schizophrenia or a mix of patients with schizophrenia and schizoaffective disorder. Effect sizes for the

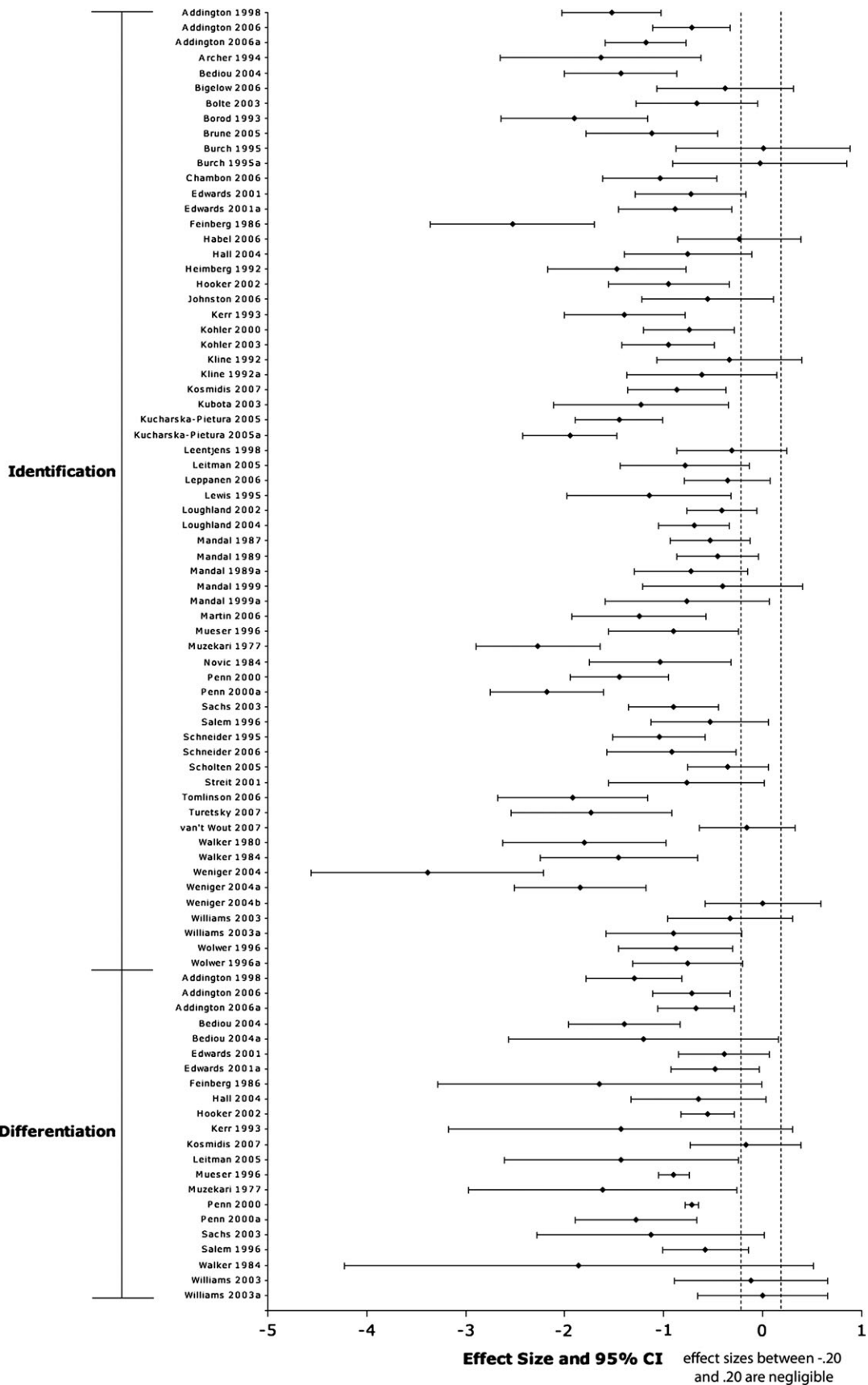
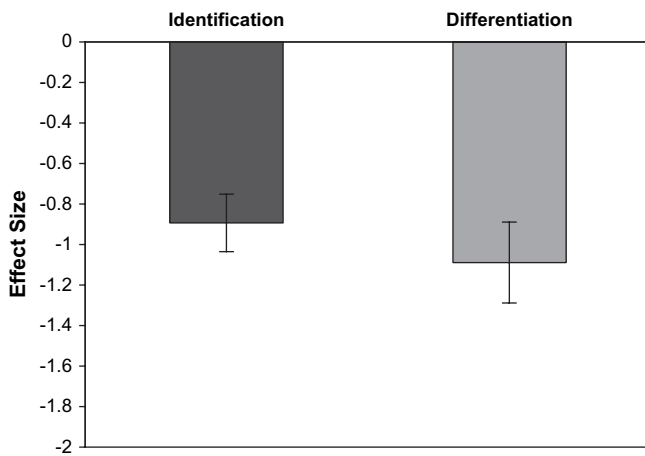


Fig. 1. Individual Effect Sizes (Cohen *d* and 95% CIs) for Emotion Perception Studies.



**Fig. 2.** Effect Sizes (Cohen  $d$  and 95% CI) for Facial Emotion Identification and Differentiation Deficits.

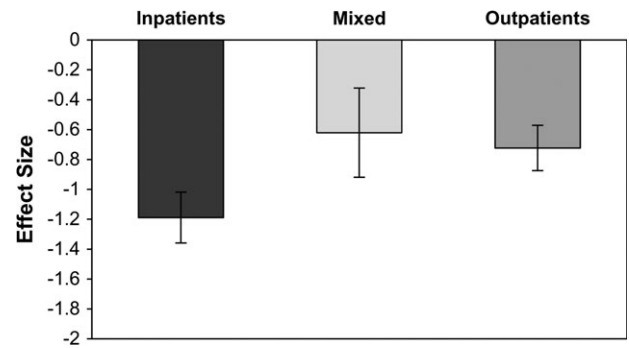
schizophrenia diagnosis ( $N = 71$  studies,  $d = -0.98$ , 95% CI =  $-1.12 < \delta < -0.85$ ) and the mixed diagnoses ( $N = 15$  studies ( $d = -0.85$ , 95% CI =  $-1.09 < \delta < -0.61$ ) were very large and did not differ significantly from each other ( $Q_B[33] = 0.90$ ,  $P = .34$ ). Although of interest, there were too few studies ( $N = 2$ )<sup>38,47</sup> examining first-episode patients to allow for meaningful comparisons.

**Inpatient/Outpatient Status.** Patient samples ranged from inclusion of inpatients ( $N = 38$  studies) and outpatients ( $N = 26$  studies) to mixed groups ( $N = 8$  studies). Analysis of facial emotion perception deficits for the 3 status classifications revealed significant heterogeneity of effect sizes ( $Q_B[1] = 19.65$ ,  $P < .001$ ) (figure 3). Post hoc analysis revealed that inpatients ( $d = -1.20$ , 95% CI =  $-1.30 < \delta < -1.10$ ) were more impaired than both outpatients ( $d = -0.70$ , 95% CI =  $-0.80 < \delta < -0.60$ ) ( $Q_B[33] = 16.01$ ,  $P < .001$ ) and the mixed group ( $d = -0.58$ , 95% CI =  $-0.76 < \delta < -0.39$ ) ( $Q_B[33] = 10.57$ ,  $P < .01$ ) but did not indicate a difference between outpatients and the mixed group ( $Q_B[33] = 0.37$ ,  $P = .55$ ).

**Age of Onset/Duration.** Schizophrenia patients varied throughout the sample with regard to their age at onset and the duration of illness. The age of onset ( $N = 16$  studies, mean  $\pm$  SD =  $23.3 \pm 1.68$ ) was shown to significantly moderate effect sizes, relating a later age of onset to greater impairment ( $Z = -2.79$ ,  $P = .006$ ). In contrast, duration of illness ( $N = 43$  studies, mean years  $\pm$  SD =  $10.3 \pm 4.34$ ) was not significantly associated with effect size on tasks of emotion perception ( $Z = 0.42$ ,  $P = .67$ ).

**Hospitalizations.** The total number of past and present hospitalizations of the patients ( $N = 26$  studies) did not appear to have a significant impact on obtained effect sizes ( $Z = -1.54$ ,  $P = .12$ ).

**Clinical Characteristics.** For clinical symptom assessment, results were mixed and based on the instruments

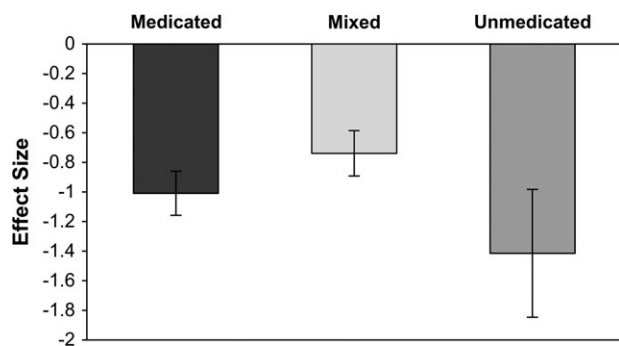


**Fig. 3.** Effect Sizes (Cohen  $d$  and 95% CI) for Facial Emotion Perception Deficits in Schizophrenia Patients by Study Setting (ie, Inpatients, Outpatients, and Mixed).

employed. Studies that employed the Scheduled Assessment of Negative Symptoms (SANS<sup>112</sup>) and SAPS<sup>113</sup> analysis revealed significant relationships between facial emotion perception effect sizes and SANS scores ( $N = 20$  studies,  $Z = -4.13$ ,  $P < .001$ ) as well as SAPS scores ( $N = 18$  studies,  $Z = -4.48$ ,  $P < .001$ ), relating higher levels of negative or positive symptoms to greater deficit in the ability to perceive facial affect. However, heterogeneity could not be explained by positive ( $N = 16$  studies,  $Z = 1.03$ ,  $P = .30$ ), negative ( $N = 16$  studies,  $Z = -1.44$ ,  $P = .15$ ), or overall symptom scores ( $N = 11$  studies,  $Z = -1.27$ ,  $P = .20$ ), as measured by the Positive and Negative Syndrome Scale.<sup>114</sup> Finally, measurements of general psychopathology obtained by the Brief Psychiatric Rating Scale (BPRS<sup>115</sup>) revealed a significant relationship with effect sizes ( $Z = -3.08$ ,  $P = .002$ ), but the latter finding is tentative due to limited BPRS data ( $N = 6$  studies).

#### Antipsychotics

**Medication Status.** In order to assess possible influences of antipsychotics on the observed effect sizes, studies were classified as including (1) medicated ( $N = 57$  studies), (2) unmedicated ( $N = 2$  studies), or (3) mixed (medicated and unmedicated) ( $N = 20$  studies) samples. Homogeneity analysis revealed significant variability among effect sizes ( $Q_B[1] = 11.76$ ,  $P < .01$ ); unmedicated patients ( $d = -0.141$ , 95% CI =  $-0.9 < \delta < -0.18$ ) were the most impaired, followed by medicated patients ( $d = -1.00$ , 95% CI =  $-1.10 < \delta < -0.86$ ), and then the mixed group ( $d = -0.73$ , 95% CI =  $-0.89 < \delta < -0.58$ ) (figure 4). Post hoc contrasts revealed that medicated patients did not differ from unmedicated patients ( $Q_B[33] = 3.02$ ,  $P = .082$ ). The mixed group was significantly less impaired than both the medicated ( $Q_B[33] = 6.17$ ,  $P < .05$ ) and the unmedicated patients ( $Q_B[33] = 8.35$ ,  $P < .01$ ). It should be noted, however, that data for unmedicated patients consisted of only 2 studies; thus, analysis involving this moderator variable classification should be considered tentative.



**Fig. 4.** Effect Sizes (Cohen  $d$  and 95% CI) for Facial Emotion Perception Deficits in Schizophrenia Patients by Medication Status (ie, Medicated, Unmedicated, and Mixed).

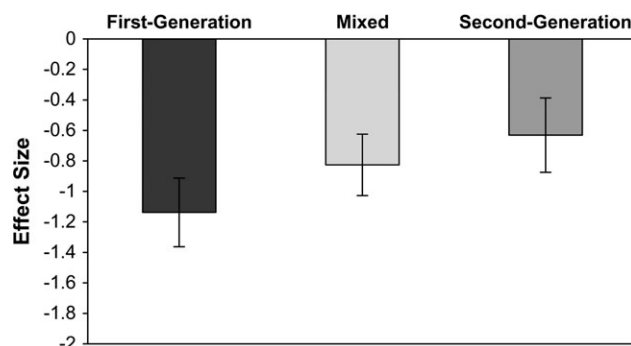
**Medication Type.** Medicated patients were further subdivided into those using first-generation antipsychotics (FGAs) ( $N = 25$  studies) or second-generation antipsychotics (SGAs) ( $N = 7$  studies) and mixed groups ( $N = 22$  studies). Effect sizes for these 3 groups were found to be heterogeneous ( $Q_B[1] = 9.35$ ,  $P < .01$ ). Post hoc contrasts revealed that FGA groups ( $d = -1.10$ , 95% CI =  $-1.30 < \delta < -0.91$ ) showed greater impairment in facial emotion perception relative to SGA groups ( $d = -0.63$ , 95% CI =  $-0.87 < \delta < -0.38$ ) ( $Q_B[33] = 9.00$ ,  $P < .01$ ) and mixed groups ( $d = -0.82$ , 95% CI =  $-1.00 < \delta < -0.62$ ) ( $Q_B[33] = 4.12$ ,  $P < .05$ ). Contrasts between patients on SGA and mixed groups, however, were not significant ( $Q_B[33] = 2.64$ ,  $P = .10$ ) (figure 5).

**Chlorpromazine Equivalents.** To further probe the effect of antipsychotics on facial emotion perception, we analyzed the relationship between effect sizes and chlorpromazine equivalents ( $N = 47$  studies) and found a marginal, but nonsignificant, relationship between higher chlorpromazine dosage and greater degree of impairment on tests of facial emotion perception ( $Z = -1.67$ ,  $P = .10$ ).

#### Demographic Characteristics

**Age.** Both the average age of controls ( $N = 81$  studies) and the average age of patients were examined ( $N = 84$  studies). Analysis revealed a strong relationship between greater age in both patients ( $Z = -5.25$ ,  $P < .001$ ) and healthy controls ( $Z = -2.98$ ,  $P < .01$ ) and facial emotion perception impairment.

**Gender.** The effect of gender was analyzed by comparing both the percentages of male controls ( $N = 80$  studies) and male patients ( $N = 81$  studies) to effect sizes. The percentage of male controls showed a relationship with effect sizes ( $Z = 3.53$ ,  $P < .001$ ), indicating that samples with more male controls were related to less impairment in facial emotion perception in schizophrenia. However, the percentage of male patients did not



**Fig. 5.** Effect Sizes (Cohen  $d$  and 95% CI) for Facial Emotion Perception Deficits in Schizophrenia Patients by Type of Antipsychotic Medication (ie, First Generation, Second Generation, and Mixed).

appear to moderate effect sizes in schizophrenia ( $Z = 1.58$ ,  $P = .11$ ).

**Education.** We then sought to determine if education had an impact on facial emotion perception. Analysis showed that education levels of controls ( $N = 66$  studies) were not significantly related to effect sizes ( $Z = -0.44$ ,  $P = .66$ ). Similarly, analyses of education levels of the patient group ( $N = 66$  studies) revealed no significant association between this moderator and effect size ( $Z = 1.62$ ,  $P = .10$ ).

**Race.** The last demographic variable investigated was race, identified by the percentage of Caucasians within control ( $N = 48$  studies) and patient groups ( $N = 53$  studies). Effect sizes were moderated by the percentage of Caucasian controls at a trend level ( $Z = -1.90$ ,  $P = .058$ ). In contrast, no relationship between the percentage of Caucasian patients and effect size was seen ( $Z = -1.01$ ,  $P = .31$ ).

#### Discussion

Over the past 25 years, a considerable body of literature has established the presence of emotion perception impairment in schizophrenia that affects quality of life and psychosocial functioning. Generalizability of the findings has been limited by the diversity of tasks employed and diversity in clinical and demographic characteristics of patient groups. While emotion perception impairment in schizophrenia has been well documented, it is questionable whether a differential deficit<sup>116</sup> can be demonstrated against the more general impairment in facial processing.<sup>9,19,23,39,47,53,69,117</sup> Among other reasons, impaired emotion perception may be related to the tendency of persons with schizophrenia to visually scan features of the face that are not important in the expression of a particular emotion, as has been shown with computerized procedures.<sup>62,118</sup>

As anticipated, the results of the current meta-analysis, which spanned the literature from 1970–2007 and included 86 studies, revealed a large deficit in emotion perception in patients with schizophrenia relative to healthy participants (ie,  $d = -0.91$ , 95% CI =  $-0.97 < \delta < -0.84$ ). The effect size of emotion perception impairment was significantly heterogeneous indicating the presence of methodological, illness-related, and demographic factors that moderate the severity of impairment seen in schizophrenia groups, specifically including hospitalization status, age at onset, negative and positive symptoms, medication status, and current age. Results of this meta-analysis can be grouped into findings that—given the existing literature and posted hypotheses—were expected, indeterminate findings that did not clearly confirm our hypotheses, and unexpected findings that ran counter to our hypotheses. Expected findings were those related to overall impairment, methodology, diagnostic status, and demographics of age, gender, race, and education. On the basis of most studies reporting on emotion perception impairment in schizophrenia, the overall effect size confirmed these results and was measured as large. In general, emotion perception tasks can be separated into those that rely on identification or differentiation. Identification tasks are based on choosing a qualitative label with greater reliance on language and semantic skills, while differentiation tasks require judgment regarding differences in emotion expressions and may be more dependent on visual analysis and spatial skills. Our results support that emotion identification and differentiation are independent of “top-down” mechanisms and have limited relationship to neurocognitive aspects of the tasks.

Examining clinical characteristics revealed no effect for diagnosis of schizophrenia compared with schizoaffective disorder in line with current assumptions that the 2 disorders are not viewed as distinct with respect to symptoms, outcome, and cognition. Several demographic characteristics influenced the findings, including age in patients and controls and race and gender in controls. Increased age of patients and controls was associated with greater impairment in support of age-related decline in emotion perception abilities.<sup>30</sup> Male gender in controls lessened the impairment found in patient groups, but male gender in patients did not moderate group differences. Evidence exists that men may have more difficulties in emotion perception<sup>31</sup> compared with women. Within the meta-analysis, the gender-related finding remained isolated to controls, and the effect of illness in patients may supersede any gender-related differences. The effect of race on emotion perception abilities has received considerable attention, and while it has been proposed that universal emotions are equally recognized across ethnic groups, recent studies support an own-race bias<sup>28</sup> that may be moderated by mood states.<sup>29</sup> In this meta-analysis, race of participants was summarized as Caucasian and

non-Caucasian, and a potential moderating effect on emotion perception was limited to a trend level of race in controls. In the majority of studies, race of emotion perception stimuli was not described or included Caucasian subjects only, limiting statistical power to confirm a possible own-race effect. Reports that specifically investigated this issue in healthy persons found an advantage for emotion perception in own-race faces<sup>28</sup> that is moderated by familiarity,<sup>119</sup> and this finding has been extended to schizophrenia.<sup>83,120,121</sup> Lastly, level of education failed to significantly moderate emotion perception findings. Because education can be viewed as a proxy measure of general cognition, the lack of association supports that neurocognition and social cognition represent largely independent functions.

Indeterminate findings included those involving measures of illness severity and antipsychotic treatment, while the finding for age at onset was unexpected. Previous longitudinal studies that lasted between weeks to 1 year showed lack of emotion perception improvement in acutely ill patients<sup>12,25,26</sup> and indicated the potential unrelatedness of emotion perception abilities and clinical status in schizophrenia, similar to what has been shown for neurocognition.<sup>122</sup> Within the meta-analysis, clinical moderators that indicate illness severity, including being hospitalized at the time of testing and some clinical symptom measurements, but not duration of illness, showed adverse effects on emotion perception abilities. Clinical symptoms were only characterized in about half of the studies, and some, but not all, measurements of negative, positive, and general symptoms were related to emotion perception abilities. Recent investigations on schizophrenia subtypes reported on paranoid patients to be highly accurate in recognition of genuine rather than posed emotion expressions<sup>123</sup> or less impaired than other subtypes.<sup>110</sup> Unfortunately, clinical descriptors within the published studies on static images did not allow further investigation of this relationship.

The results of examining effects of antipsychotics on emotion perception were limited by the small sample size of unmedicated patients who were most impaired. However, the notion of untreated illness exerting effects on emotion perception was not supported by comparison of studies that included mixed samples and medicated samples, where medicated samples performed worse. Within the medicated sample, patients on FGA were more impaired than patients on SGA. The literature on possible effects of antipsychotics on cognition in persons with acute and chronic schizophrenia remains in evolution but may indicate a greater beneficial effect<sup>124</sup> associated with SGAs compared with FGAs.

The single unexpected effect involved the association between later age at onset and greater emotion perception impairment, which is contrary to our understanding about the association between onset of illness with clinical symptoms and cognition. It must be noted that limitations

involving meta-analytic procedures include the descriptive nature of the analysis and the inability to more fully examine directional mechanisms underlying results. It is therefore quite possible that studies reporting on groups with later onset of illness differed in another measure that itself related to worse emotion perception abilities. This mechanism may also play a role in the indeterminate findings regarding clinical symptoms and antipsychotics.

In conclusion, to our knowledge, this is the first comprehensive meta-analysis examining facial emotion perception in schizophrenia and the moderating effects of illness-related and demographic factors. Further investigations may clarify the association of emotion perception with clinical aspects of schizophrenia, including the relationship between specific illness-related characteristics, such as first episode and subtype, on performance; emotion perception changes as the result of treatment and stabilization beyond acute psychosis, and emotion perception as a possible endophenotype related to genetic risk<sup>125,126</sup> and emergence of psychosis.<sup>127</sup>

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