

Sex Differences in Wisconsin Schizotypy Scales—A Meta-analysis

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Previous single studies have found inconsistent results on sex differences in positive schizotypy, women scoring mainly higher than men, whereas in negative schizotypy studies have often found that men score higher than women. However, information on the overall effect is unknown. In this study, meta-analytic methods were used to estimate sex differences in Wisconsin Schizotypy Scales developed to measure schizotypal traits and psychosis proneness. We also studied the effect of the sample characteristics on possible differences. Studies on healthy populations were extensively collected; the required minimum sample size was 50. According to the results, men scored higher on the scales of negative schizotypy, ie, in the Physical Anhedonia Scale ($n = 23$ studies, effect size, Cohen $d = 0.59$, z test $P < .001$) and Social Anhedonia Scale ($n = 14$, $d = 0.44$, $P < .001$). Differences were virtually nonexistent in the measurements of the positive schizotypy, ie, the Magical Ideation Scale ($n = 29$, $d = -0.01$, $P = .74$) and Perceptual Aberration Scale ($n = 22$, $d = -0.08$, $P = .05$). The sex difference was larger in studies with non-student and older samples on the Perceptual Aberration Scale ($d = -0.19$ vs $d = -0.03$, $P < .05$). This study was the first one to pool studies on sex differences in these scales. The gender differences in social anhedonia both in nonclinical samples and in schizophrenia may relate to a broader aspect of social and interpersonal deficits. The results should be taken into account in studies using these instruments.

Key words: anhedonia/magical thinking/prodrome/schizophrenia/schizotypal personality

Introduction

Many studies have found differences in psychological characteristics between men and women.¹ On the other hand, Hyde² argued on the basis of her meta-analysis us-

ing a large range of various psychometric measurements that men and women are in fact similar on most, but not all, psychological variables. Several studies and even some meta-analyses have been published on sex differences in cognition, communication, and social factors, for example.² There have not been any meta-analyses on sex differences in schizotypy.

In schizophrenia, previous studies on sex differences have found, eg, that men have earlier age of onset, poorer course, and lower family morbid risk of schizophrenia.^{3,4} There have also been studies related to sex differences in symptomatology. Most studies, eg, Hambrecht et al,⁵ have reported that men with schizophrenia have more negative symptoms although some studies have reported that there are no differences,⁶ and one study even found that women have more severe negative symptoms than men.⁷ Studies have found that women have more affective symptoms, whereas studies on positive symptoms indicate no major sex differences.^{3,4} Gur et al⁸ have studied sex differences in symptoms by age; they found that sex differences are evident across the life span. These studies on sex differences in schizophrenia have been reviewed, eg, by Salem and Kring³ and Leung and Chue.⁴

Construct of Psychosis Continuum and Schizotypy

There are different views regarding the term “schizotypy.” Some, mainly American, researchers use the term to refer to persons with underlying latent liability for schizophrenia but who have not expressed the illness. These persons have a latent personality with genetic vulnerability for schizophrenia, but they may never decompensate into clinical psychosis.⁹ There is evidence that psychotic symptoms are expressed on a continuum from mild, clinically irrelevant forms to manifestly psychotic symptoms.¹⁰ Schizotypy is also suggested, mainly by European researchers, to be expressed on a continuum ranging from psychological well-being to schizophrenia-spectrum personality disorders and to schizophrenia.^{11,12}

Also a multidimensional model of schizotypy has been proposed, with proposed dimensions such as positive schizotypy, negative schizotypy, cognitive disorganization, paranoia, and nonconformity.¹² Of these, positive and negative schizotypy are the most consistently replicated dimensions. The positive symptoms of schizophrenia include symptoms such as hallucinations and

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delusions. In schizotypy, the psychotic-like or “positive” symptoms include, eg, perceptual and magical thinking distortions. Examples of negative symptoms of schizophrenia include, eg, flat affect and social withdrawal, whereas schizotypal patients with negative symptoms are often characterized by, eg, constricted affect and social isolation.¹³ Men are suggested to score higher in negative schizotypy and women in positive schizotypy; similar sex differences have been found in schizophrenic symptomatology, especially in negative symptoms. Concepts of schizotypy and its relation to schizophrenia has been reviewed, eg, by Raine.¹⁴

Schizotypal personality disorder (SPD) can be seen as one form of schizotypy. According to *Diagnostic and Statistical Manual of Mental Disorders*, SPD is a “lifelong, pervasive, and enduring disorder with an onset by early adulthood and a stable course”; however, it is also suggested to refer to attenuated form of schizophrenia that may also represent a premorbid stage of this disorder.¹⁴ SPD can be approached in 2 ways. Clinically and categorically, it can be assessed by utilizing psychiatric diagnostic criteria, eg, *Diagnostic and Statistical Manual of Mental Disorders (Fourth Edition)*.¹⁵ Dimensionally it can be measured by utilizing so-called “psychosis proneness” scales, eg, the Schizotypal Personality Questionnaire (SPQ)¹⁶ or the Wisconsin Schizotypy Scales.^{17–19}

Measurements of Schizotypy

Several instruments have been developed to identify subjects at risk for psychotic illness, especially schizophrenia and related psychoses.²⁰ These schizotypy or psychosis proneness scales can be used to identify, eg, vulnerable but symptom-free relatives of schizophrenia patients. Among the oldest and most frequently used schizotypy scales are the Wisconsin Schizotypy Scales developed by Chapman and colleagues. The scales include true-false items for diverse symptoms of the psychosis-prone. The scales are mainly based on the theory of schizotypal traits developed by Meehl.⁹ His model emphasizes a genetically influenced aberration in neural transmission that could eventuate in different clinical schizophrenia, nonpsychotic schizotypic states, or apparent normalcy depending on the coexistence of other factors.^{21,22} An important assumption in Meehl’s model is that schizotypy can manifest itself behaviorally and psychologically in various degrees of clinical compensation.^{9,21,22}

The Wisconsin Schizotypy Scales include the Magical Ideation Scale (MIS), Perceptual Aberration Scale (PER), Physical Anhedonia Scale (PAS), and Social Anhedonia Scale (SAS). MIS and PER are considered to measure so-called positive and PAS and SAS so-called negative schizotypy. This categorization has been used, eg, recently by Miller and Burns²³ in a study on gender differences in schizotypy. MIS measures magical ideation, which is defined as belief in forms of causation that by conventional

standards are invalid.¹⁹ PER measures distorted perceptions of one’s own body and other objects.¹⁸ High scorers on PAS have decreased ability to experience physical and sensory pleasures,¹⁷ while high scorers on SAS have schizoid lack of interest in social interaction.¹⁷ Sample items in these scales are such as “At times I perform certain little rituals to ward off negative influences” (MIS), “Parts of my body occasionally seem dead or unreal” (PER), “I have seldom enjoyed any kind of sexual experience” (PAS), and “People sometimes think that I am shy when I really just want to be left alone” (SAS).

There are no extensive reviews or meta-analyses on sex differences in schizotypal traits, eg, on the Wisconsin Schizotypy Scales. Previous single studies have found inconsistent results on sex differences in magical ideation. Higher scores in men have been reported, eg, by Chmielewski et al,²⁴ and higher scores in women, eg, by Eckblad and Chapman.¹⁹ Similarly, in perceptual aberration some studies have found higher scores among men²⁵ and some among women.²⁶ In the positive schizotypy subscales of the SPQ, women have scored higher than men.²⁷ In negative schizotypy, previous single studies have found that men score higher than women,²⁴ but information on the overall effect and on how, eg, age relates to sex differences is unknown.

The Present Study

In this study, using a meta-analytic approach, we pooled previously published studies on Wisconsin Schizotypy Scales presenting mean values by sex in nonclinical samples. The aim was to get estimates for sex differences in these scales and to study the effects of age and student status of the sample on possible sex differences. We hypothesized that men would have more negative and women somewhat more positive schizotypal symptoms. We also expected that in samples with younger mean age or comprising only students, men could have relatively more schizotypal symptoms because men have on average younger age at onset of psychotic illness than women.^{3,4}

Methods

Design

Studies on Wisconsin Schizotypy Scales in healthy adult population were systematically searched from the Medline (Pubmed and Ovid), PsycINFO, SCOPUS, and ISI (Science and Social Science Citation Index) databases in November 2007. The main search used the keywords “physical anhedonia” OR “social anhedonia” OR “perceptual aberration” OR “magical ideation” OR “Chapman scales.” This search resulted in 519 journal articles. Articles were also searched from Google Scholar and from the reference lists of the included articles. We

also contacted over 80 authors who have used these scales and asked for possible unpublished data. We included studies using the by far most commonly used versions of the scales, the 30-item MIS, the 35-item PER, the 61-item revised PAS, and the 40-item revised SAS.

Other inclusion criteria were the following. A minimum total sample size of 50 was required, including no fewer than 15 subjects in each sex. Only samples from nonpsychiatric populations (including student samples) were included. In the case of articles with possible overlapping samples, the study with a larger or more informative sample was included. We required information on mean scores and standard deviations (SDs) for the scales by sex.

Location of the study (ie, country and state, if United States, where the data were collected) and available information on the age of the participants (mean or median, SD, and range) were also collected. The data of all the included articles were independently checked by the 2 authors.

Original Studies Presenting Sex Differences

Forty-four studies with samples from 12 countries were included in the final study. Many of the articles used several Wisconsin Schizotypy Scales. Table 1 presents the instruments used, reference, location of the study, sample size (by sex), description of the study population, and information on age of the subjects for the included studies. The included samples often represented unselected populations, although many of the studies included only students (see table 1).

Some studies did not give all the required information, which is why some compromises were required. Barnett and Corballis³¹ and Ross et al⁶⁰ did not report SDs by sex, so the SDs from the total sample were used for both sexes. Jaspers-Fayer and Peters⁴⁴ used a 4-point scale in MIS; however, they dichotomized the scale to 0/1 in the analyses to be comparable with previous studies, and these results are also used in the present study. Chmielewski et al²⁴ and Kwapil et al⁴⁶ reported results by ethnic groups; in this study, these groups were pooled. Balogh and Merritt³⁰ reported normative data for MIS from 2 Indiana universities; these were pooled to one sample. If median or mode age was given instead of mean that was used in meta-regression. Nine of the samples did not report average statistics for age; these were excluded when studying the effect of age but were included when comparing the samples including only students to the other samples.

Many of the studies included have reported psychometric data on these scales. The main findings of validity studies have been that the internal consistency of the scales is good. Vollema and van den Bosch²⁰ reviewed the Cronbach α values of the scales by the mid-1990s; α values were between .84 and .94 for PER, .82 and .87 for MIS, .71 and .93 for PAS, and 0.76 and 0.88

for SAS. The predictive validity for psychosis has been best for a combination of the MIS and PER, but also promising for the SAS scale.⁶⁴

Statistical Methods

Effect sizes (ESs) for sex differences are presented with 95% confidence intervals (CIs) using forest plots.⁶⁵ ES is calculated by dividing the difference between mean scores of men and women by the pooled SD. Cohen d values were used as measure for ES. Cohen⁶⁶ describes a d value of 0.2 as being a small, 0.5 a medium, and 0.8 a large effect. In this study, negative values of d mean that women scored higher on a dimension, and positive values of d indicate that men scored higher. We studied the heterogeneity of the studies by the Q and I^2 statistics (with 95% CI). Values of I^2 range from 0% to 100%, reflecting the proportion of the total variation across studies beyond chance. A value of 25% describes low, 50% moderate, and 75% high heterogeneity.⁶⁷

Due to the possible heterogeneity based on the CIs of I^2 , the studies were pooled using the more conservative random effects method in all the scales. Meta-regression with a z test⁶⁵ was used to study the reasons for heterogeneity by exploring the effect of mean age of the sample as a continuous variable. We also studied whether samples including only students differed from other samples, which included mainly older participants. Meta-regression models were done both separately and simultaneously for these 2 variables. Estimated pooled mean values (with SDs) of the scales are presented by sex. We also made an influence analysis in which the meta-analysis estimates are computed omitting one study at a time.⁶⁵ An α level of .05 was used for all statistical tests. The data were analyzed with Stata 9.0.⁶⁸

Results

The included samples had a total of 41 003 participants (40% men). The studies were possible heterogeneous in sex differences in PER ($I^2 = 31\%$, 95% CI = 0%–59%, $Q = 30.65$, $P = .08$) but not in the other scales ($I^2 = 0\%$, 95% CI = 0%–41%, $Q = 18.66$, $P = .91$, in MIS; $I^2 = 0\%$, 95% CI = 0%–45%, $Q = 14.79$, $P = .87$, in PAS; $I^2 = 0\%$, 95% CI = 0%–55%, $Q = 5.38$, $P = .97$, in SAS).

Figure 1 presents random method ESs for differences between men and women in MIS. The results are presented using ESs in forest plots with 95% CIs for the studies. The scores are sorted by the ES, and the pooled ES with 95% CI is also reported. The corresponding forest plots for PER, PAS, and SAS are presented in figures 2–4, respectively.

Sex differences were virtually nonexistent in MIS ($n = 29$, pooled ES, Cohen $d = -0.01$, z test = -0.33 , $P = .74$) and PER ($n = 22$, $d = -0.08$, $z = -1.96$, $P = .05$). Men

Table 1. Studies of Wisconsin Schizotypy Scales Included in the Meta-analysis

Reference	Year	Scales	Location	Sample Size (Men/Women)	Population	Age of the Sample (y) Mean \pm SD [range]
Atbasoglu et al ²⁸	2003	MIS	Turkey	332 (181/151)	Medical students	19.9 \pm 1.3 [17–28]
Bailer et al ²⁹	2004	SAS	Germany	83 (35/48)	Students and employees	33.5 \pm 8.2
Balogh and Merritt ³⁰	1990	MIS	Indiana	3249 (1247/2002)	Undergraduate students	—
Barnett and Corballis ³¹	2002	MIS	New Zealand	250 (70/180)	Undergraduate psychology students	23.8 [18–59]
Berry et al ³²	2006 ^a	SAS	United Kingdom	230 (58/158) ^b	Students	Md = 21 [17–67]
Camisa et al ³³	2005 ^a	MIS, PER, SAS	Indiana	54 (35/19)	Colunteers	34.5 \pm 12.1
Chapman et al ²⁶	1980	PAS, PER	Wisconsin	2576 (1209/1367)	College students	—
Chapman and Chapman	Unpublished	MIS, SAS	Wisconsin	1615 (775/840)	College students	—
Chen and Su ³⁴	2006 ^a	PER	Taiwan	905 (446/459)	Junior high school students	14.0 \pm 0.9
Chen et al ³⁵	1997 ^a	PER	Taiwan	115 (52/63)	Junior high school students	14.0 \pm 0.8
Chen et al ³⁵	1997 ^a	PER	Taiwan	345 (165/180)	Community	41.3 \pm 12.9
Chmielewski et al ²⁴	1995	MIS, PAS, PER, SAS	Illinois	7691 (3648/4043)	College students	Md = 18
Diduca and Joseph ³⁶	1997	MIS	United Kingdom	201 (87/114)	45% University students, others employees	31.3 \pm 12.3 [17–71]
Dumas et al ³⁷	1999	MIS	France	134 (60/74)	Students	20.1 \pm 1.5
Dumas et al ³⁸	2000	MIS, PAS, PER, SAS	France	233 (108/225)	Undergraduate students	21.2 \pm 1.5
Etain et al ³⁹	2007 ^a	PAS	France	170 (98/72)	Blood donors	42.7 \pm 9.7 [19–64]
Farias et al ⁴⁰	2005	MIS	United Kingdom	99 (43/56)	54% Students, others volunteers	38.2 \pm 21.1 [17–79]
Franken et al ⁴¹	2007 ^a	PAS	The Netherlands	219 (37/182)	Undergraduate psychology students	20.0 \pm 2.2 [17–28]
Glatt et al ⁴²	2006 ^a	MIS, PAS, PER	Maryland	55 (24/31)	Volunteers	17.6 \pm 3.7
Graves and Weinstein ⁴³	2004 ^a	MIS, PAS, PER	Canada	108 (36/72)	Volunteers, mostly students	25.5 \pm 9.4 [18–72]
Jaspers-Fayer and Peters ⁴⁴	2005	MIS	Canada	413 (156/257)	General population	19.2
Kelley	Unpublished	MIS	Maryland	740 (302/438)	Undergraduate students	—
Kosmadakis et al ⁴⁵	1995	PAS, SAS	France	126 (53/73)	General population	34.2 \pm 10.1 [18–70]
Kwapil et al ⁴⁶	In press	MIS, PAS, PER, SAS	North Carolina	6137 (1473/4664)	undergraduate students	19.4 \pm 3.7 y
Lenzenweger and Moldin ⁴⁷	1990	PER	New York	707 (325/382)	First year university students	“Nearly all over 18”
Leventhal et al ⁴⁸	2006 ^a	PAS	Texas	151 (46/105)	College students	22.8 \pm 5.3 [18–60]
Lipp et al ⁴⁹	1994	MIS, PAS, PER, SAS	Australia	537 (166/371)	Undergraduate students	— [17–51]
Loas ⁵⁰	1995	PAS	France	384 (154/230)	General population	31.8 \pm 12.2 [17–76]
Mathews and Barch ⁵¹	2006 ^a	MIS, PAS, PER, SAS	Missouri	389 (160/229) ^d	Undergraduate students	19.5 \pm 1.2 [18–26]
Meyer and Hautzinger ⁵²	1999	MIS, PAS, PER	Germany	279 (111/159)	Community	23.3 \pm 2.6
Miettunen et al	Unpublished	PAS, PER, SAS	Finland	4908 (2193/2715) ^d	General population	30.9 \pm 0.3
Miller and Burns ²³	1995	MIS, PAS, PER, SAS	Georgia	1106 (404/702)	Undergraduate students	19.0 \pm 2.0 [17–43]
Mohr and Leonards ⁵³	2005	MIS, PAS	United Kingdom	122 (20/102)	University students	20.1 \pm 3.5 [18–39]
Muntaner et al ⁵⁴	1988	MIS, PAS, PER, SAS	Spain	735 (355/380)	First year university students	19.2 \pm 2.5
Muris and Merckelbach ⁵⁵	2003 ^a	MIS, PER	The Netherlands	77 (34/43)	undergraduate students	21.0 \pm 1.9 [18–27]
Nicholls et al ⁵⁶	2005	MIS	Australia	933 (212/721)	Undergraduate psychology students	Mode = 20 [17–56]
Overby ⁵⁷	1993	MIS, PAS, PER	Texas	2092 (920/1172)	Undergraduate students	—
Peeters	Unpublished	PAS	Canada	199 (99/100)	University, volunteers	— [18–24]
Peltier and Walsh ⁵⁸	1990	MIS, PAS, PER	Montana	228 (89/139)	College students	—
Peeters et al ⁵⁹	1999	MIS	United Kingdom	267 (81/133) ^b	Open university students	36.5 (10.2) [19–75] ^e
Ross et al ⁶⁰	2002	MIS, PAS, PER, SAS	Canada	473 (142/321)	Undergraduate college students	20.1 \pm 3.4

Table 1. Continued

Reference	Year	Scales	Location	Sample Size (Men/Women)	Population	Age of the Sample (y) Mean \pm SD [range]
Scherbarth-Roschmann and Hautzinger ⁶¹	1991	PAS, PER	Germany	871 (428/418) ^b	Healthy volunteers, students, and employees	22.5 \pm 3.76
Tobacyk and Wilkinson ⁶²	1990	MIS	Ar-Lo-Mis-Tx	282 (145/137)	College students	19.7 \pm 2.2
White et al ⁶³	1995	MIS	United Kingdom	183 (78/105)	Normal volunteers	34.2 \pm 11.6 [18-70]

Note: MIS = Magical Ideation Scale, PER = Perceptual Aberration Scale, PAS = Physical Anhedonia Scale, SAS = Social Anhedonia Scale; Md = median.

^aAlso unpublished data from the authors.

^bAll participants did not report sex.

^cUnpublished study, data presented in Kwapil et al.²⁵

^dMaximum sample size, sample sizes vary by scale.

^eAge for total sample, including also subjects who fulfilled only other scales, in addition, not all participants reported their age. Ar-Lo-Mis-Tx = Arkansas, Louisiana, Missouri, and Texas.

scored higher on PAS ($n = 23$, $d = 0.59$, $z = 15.91$, $P < .001$) and SAS ($n = 14$, $d = 0.44$, $z = 13.10$, $P < .001$). In the influence study, ESs were not affected statistically significantly when one study was excluded at a time.

The mean age of the samples was not statistically significantly associated with ESs of sex differences when included as only predictor in the model. However, when sample selection (students vs others) was controlled for, in samples with a higher mean age ESs were higher in PER ($z = 2.18$, $P = .03$), ie, women scored relatively higher with increasing mean age of the sample. Furthermore, in samples which included also other subjects besides students, sex difference was larger in PER ($d = -0.21$ vs $d = -0.01$, $z = 3.19$, $P = .001$), also when adjusted for the sample mean age. Table 2 summarizes mean values by sex in all studies and dividing the samples to students only and to other samples.

Discussion

This is the first report that pools studies on sex differences in Wisconsin Schizotypy Personality Scales. The main results of this study were that men scored higher on physical and in social anhedonia, with ESs at medium level, 0.59 and 0.44, respectively. We found no sex difference in magical ideation and perceptual aberration; this was the opposite to that of presented in some of the previous reviews relating to positive schizotypy.¹⁴

Sex Differences in Magical Ideation and Perceptual Aberration

There were no sex differences in the scales related to positive schizotypy, ie, magical ideation and perceptual aberration. This finding is similar to that found in positive symptoms of schizophrenia.^{3,4} Some studies have compared mean scores between the sexes in other related schizotypy scales and have reported similar findings. However, previous reviews have also concluded that women tend to score higher in scales of positive schizotypy.¹⁴

SPQ is based on the *Diagnostic and Statistical Manual of Mental Disorders (Third Edition Revised)* diagnostic symptoms of SPD.¹⁶ In the subscale “odd beliefs or magical thinking” of the SPQ, researchers have reported higher scores for women. For example, in the study by Raine,²⁷ the ES was 0.28 and in the study by Miller and Burns²³ 0.14. In these studies, sex differences in the “unusual perceptual experiences” subscale were small and inconsistent. These varying results in sex differences in positive schizotypy could also be due to differences in the instruments used. In general, different psychological instruments may differ in the way they contain items that are more appropriate for different sexes; this has been suggested to be the case, eg, in a scale for neuroticism.⁶⁹

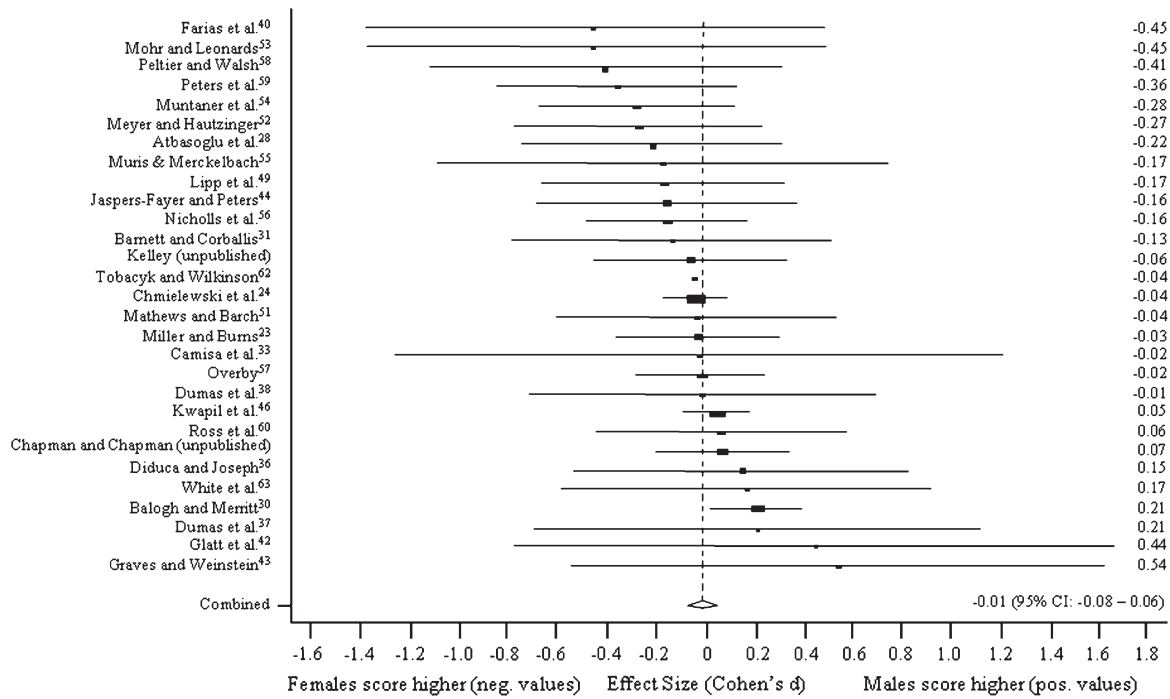


Fig. 1. Sex Differences in Magical Ideation Scale.

It should be noted that the PER has a more clinical approach to schizotypy than the other schizotypy scales.⁷⁰ The current study should be replicated using other schizotypy instruments, eg, in SPQ.¹⁶

We also found that in perceptual aberration women scored higher than men in nonstudent (mainly older) compared with student samples; however, the ES was still small (0.19). This may be due to chance because only a

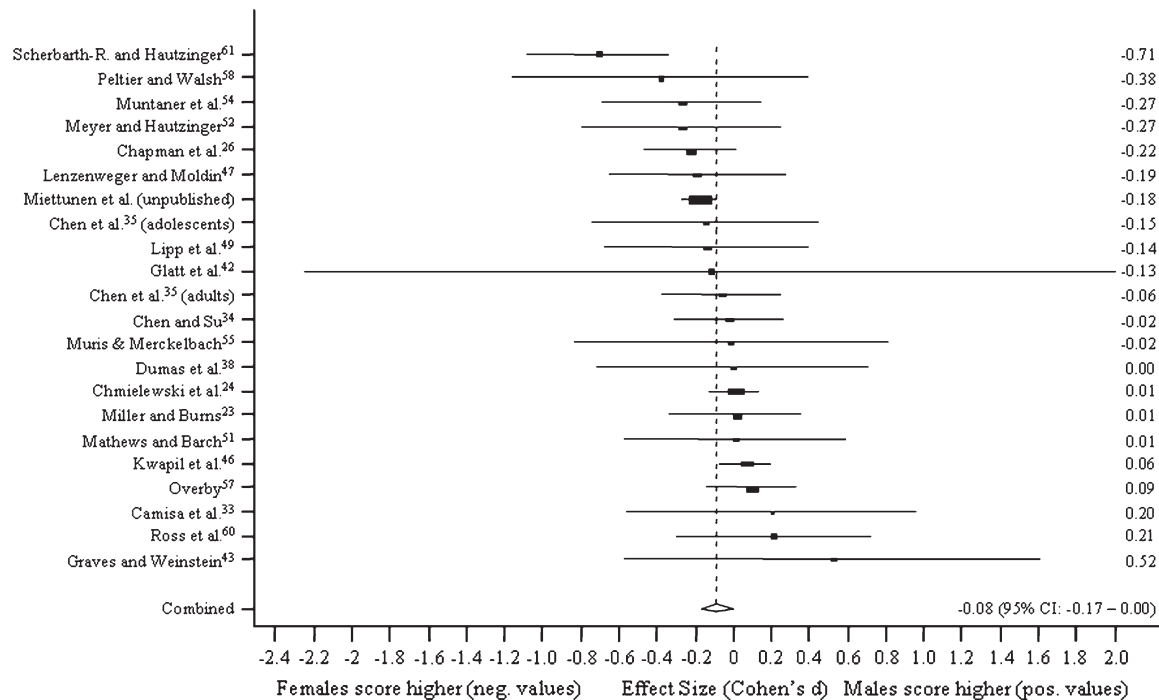


Fig. 2. Sex Differences in Perceptual Aberration Scale.

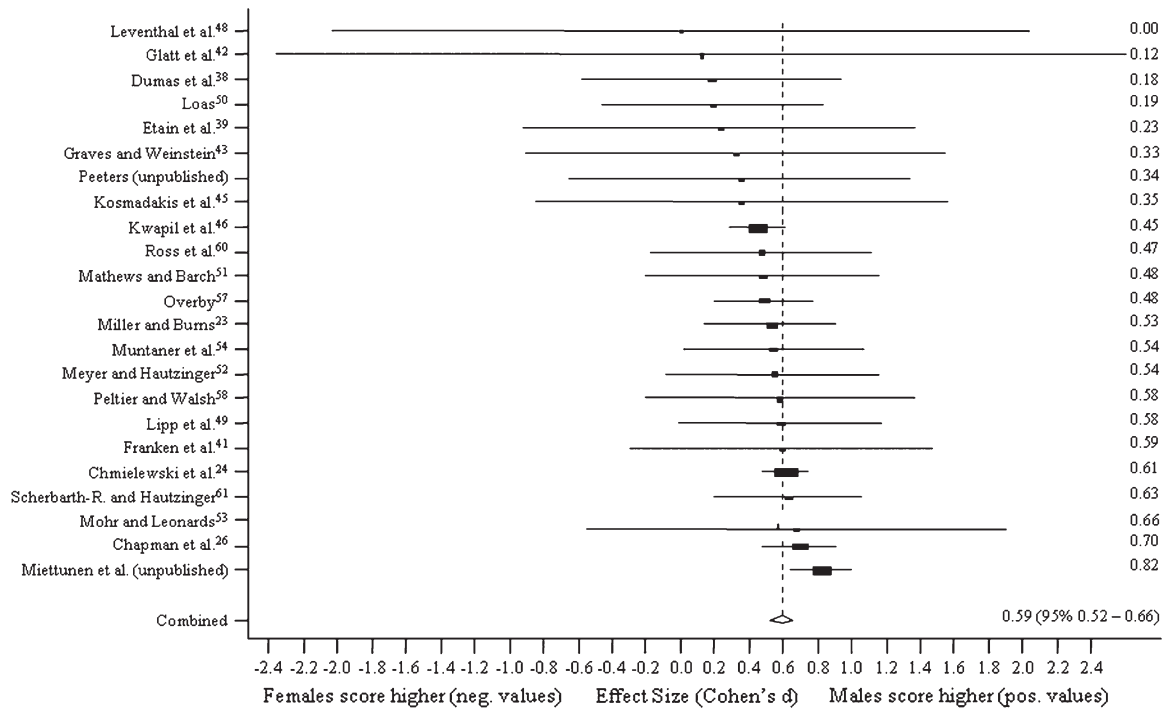


Fig. 3. Sex Differences in Physical Anhedonia Scale.

few studies included older subjects. Mason and Claridge⁷¹ studied the “unusual experiences” subscale of the Oxford-Liverpool Inventory of Feelings and Experiences (O-LIFE). The subscale correlated negatively with age

($r = -0.18$). The researchers found that women under 22 scored somewhat higher than did men under 22, men scored slightly higher among those aged 21–30 years, women scored higher in age group 31–50 years, while

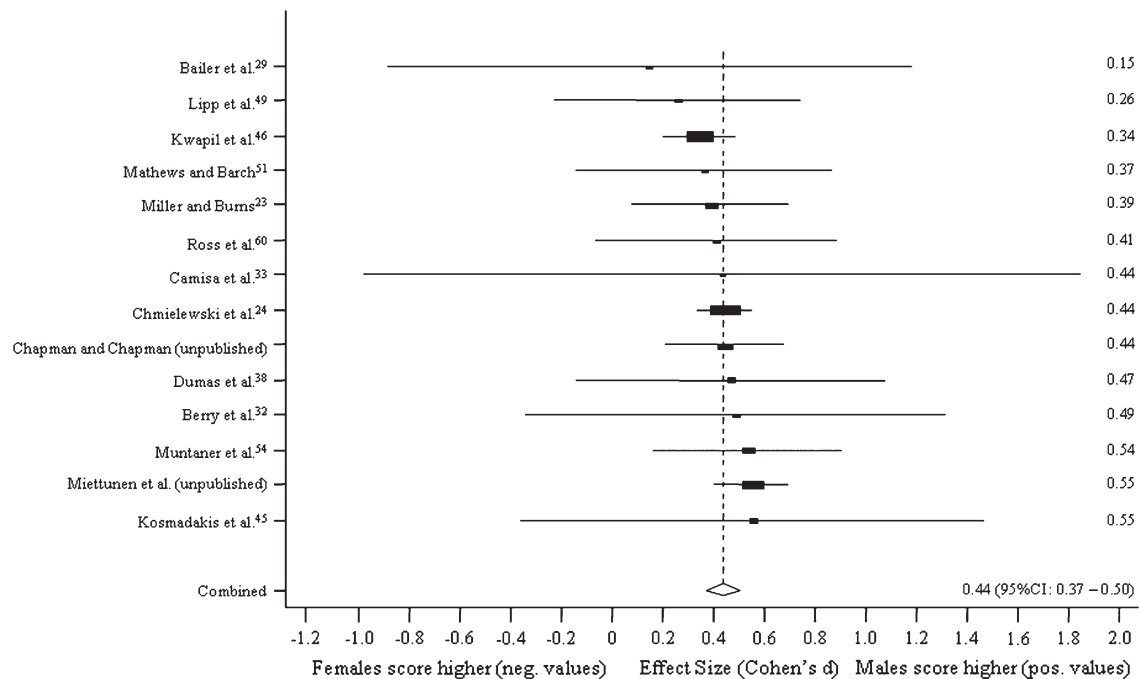


Fig. 4. Sex Differences in Social Anhedonia Scale.

Table 2. Summary of the Sex Differences and Pooled Mean Scores in Wisconsin Schizotypy Scales, in Total and Comparing Studies With Only Students and Other Studies

	Magical Ideation Scale				Perceptual Aberration Scale				Physical Anhedonia Scale				Social Anhedonia Scale			
	N	Men Mean	Women Mean	ES (<i>d</i>)	N	Men Mean	Women Mean	ES (<i>d</i>)	N	Men Mean	Women Mean	ES (<i>d</i>)	N	Men Mean	Women Mean	ES (<i>d</i>)
All studies	29	8.29	8.54	-0.01	22	5.25	5.67	-0.08	23	14.72	11.73	0.59	14	9.96	7.77	0.44
Only students																
Yes	21	8.62	9.08	-0.05	15	5.72	6.11	-0.03	14	14.62	11.37	0.47	10	9.89	7.71	0.42
No	8	7.42	7.11	-0.02	7	4.25	4.72	-0.19 ^a	9	14.86	12.27	0.40	4	10.13	7.91	0.42

Note: ES (*d*) = effect size (Cohen *d*). Statistically significant ($P < .05$, *z* test) ESs are in bold.

^aWhen compared with “only students,” ES was statistically significantly smaller in studies that included only students in Perceptual Aberration Scale ($z = 3.19$, $P = .001$).

men scored slightly higher again among the older participants. These results may be due to small sample size or may indicate that the possible effect of age is not straightforward.

Sex Differences in Physical and Social Anhedonia

Berrios and Olivares⁷² have reviewed the history of the anhedonia concept. Anhedonia is a symptom commonly associated with both schizophrenia and depression. However, Chapman Anhedonia Scales do not measure depressive anhedonia. Anhedonia in schizophrenia has been reviewed recently by Wolf.⁷³ While the content validity of the Chapman Anhedonia Scales may be somewhat outdated, they remain the standard anhedonia questionnaires in the field.⁷⁴

In our meta-analysis, men scored quite consistently higher on the 2 anhedonia scales. On the O-LIFE subscale of introverted anhedonia, men scored higher in the study by Mason and Claridge,⁷¹ although the ES was only 0.11. In the study by Miller and Burns,²³ men scored statistically significantly higher on the 2 subscales of SPQ, which relate to negative symptoms of schizophrenia. ESs were 0.33 on the “constricted affect” and 0.34 on the “no close friends” subscale.

John et al⁷⁵ found in their retrospective study that women with schizophrenia commonly had anhedonic symptoms before the onset of illness, whereas men commonly had disciplinary problems. This could mean that although anhedonia is more common among men, the women having these symptoms could be at relatively higher risk of developing schizophrenia. Due to this, different gender-specific norms in anhedonia should be considered, eg, in high-risk designs.

Studies on sex differences in negative symptoms, such as anhedonia, among individuals with diagnosis of schizophrenia are inconsistent, although most studies have reported more symptoms among men. In schizophrenia, anhedonia is often present already in the premorbid phase.⁷⁶ In our meta-analysis in healthy sub-

jects, anhedonia increased with the mean age of the samples; there is also evidence for this in the original studies of other schizotypy scales. For example, in the UK study using O-LIFE, the introverted anhedonia subscale correlated positively with age ($r = 0.19$).⁷¹ Among participants with familial risk for psychosis, Freedman et al⁷⁷ found higher scores for physical anhedonia among men than women. The sex differences in schizophrenia, eg, in these traits, may reflect proneness to different subtypes of schizophrenia.³

Gender differences in social anhedonia (both in general population and among schizophrenia patients) may also relate to a broader aspect of interpersonal or social deficits rather than to the dichotomy of positive/negative schizotypy.²³ The finding of Dworkin⁷⁸ supports this: they found that male schizophrenia patients had poorer premorbid social competence than female patients, although they found no gender differences in negative symptoms. Primary (and persistent) negative symptoms often begin already at the premorbid level; thus, premorbid anhedonia (eg, measured by PAS and SAS) could be a risk factor especially for the development of schizophrenia with primary negative symptoms.^{23,76} Horan et al⁷⁹ studied schizotypy scales and clinical symptoms in 3 assessment points, and they found that physical anhedonia is less sensitive to changes in symptomatology in schizophrenia than magical ideation and perceptual aberration. It has also been found that negative schizotypy (measured with PAS and SAS) is more heritable than positive schizotypy (measured with MIS and PER) (see Horan et al⁷⁹). This genetic component may interact with psychosocial and environmental factors. The existence of gender differences in negative but not positive schizotypy in our sample supports this finding. In all, as we have found support for our results on studies using other schizotypy scales (O-LIFE and SPQ) indicating that the findings are likely to be independent of the scales used and are probably based on differences in psychopathology between males and females.

Wisconsin Schizotypy Scales and Risk of Schizophrenia

The link between schizotypy (eg, measured by the Wisconsin Schizotypy Scales) and schizophrenia is not straightforward. There are some studies that have found support for usefulness of the Wisconsin Schizotypy Scales in predicting psychotic symptoms and even schizophrenia: However, the sample sizes have been quite small, especially the number of new schizophrenia cases after the follow-up. For 10 years, Kwapil⁸⁰ followed up subjects who had scored high in SAS ($n = 34$) and controls ($n = 139$); at follow-up, 24% of those in high-risk group were diagnosed with schizophrenia-spectrum diagnosis, compared with only 1% of the controls. Gooding et al⁸¹ followed up high scorers in SAS ($n = 32$) and a control group ($n = 44$) for 5 years; at the end of the follow-up 16% of the high scorers and none in control group had a schizophrenia-spectrum disorder. In studies comparing subjects who already have schizophrenia and controls, schizophrenia patients have scored significantly higher in these scales; eg, in the study by Camisa et al³² ESs were large (about 1.5). Catts et al⁸² have reviewed studies on relatives of schizophrenia patients, and they concluded that relatives tend to score higher than controls in PAS but not in PER. These findings give support for the usefulness of the scales, but the scales could be developed further, eg, the wording of the items is somewhat old fashioned.

Strengths and Limitations of the Study

There are limitations in this study design. Possible differences in the original samples may affect the results and conclusions of this meta-analysis because most of the samples included only students, for example. There were only 4–9 nonstudent samples in the different scales. The schizotypy scales are often used to estimate the risk of developing schizophrenia, and student age samples are useful for that. However, also among older subjects, scales of this kind may serve in epidemiological research as instruments to detect an intermediate phenotype or endophenotype, reflecting the genetic liability of an individual to psychotic disorder. In such research, the quantitative scales are hypothesized to be more informative than the dichotomous clinical diagnosis.⁸³ College students differ from other subjects of that age in terms of intellectual ability; but they have been considered generally representative of their cohort in terms of their rates of psychopathology.⁸⁴ In future, more studies using samples from general population are needed.

There is still controversy regarding the underlying nature of schizotypy, ie, whether it is fully continuous¹² or not.⁹ This article studied scales based on the latter theory, without taking a stand to the nature of schizotypy. In addition, the dimensional structure of schizophrenia is still controversial.⁸⁵ In most of the previous studies as well as in the current study, the SAS was thought to measure

negative schizotypy; however, the recent study by Kwapil et al⁴⁶ found that it also relates to positive schizotypy.

We used the mean age of the sample to study the association of age to sex difference; this is not the most efficient way to study this. Nevertheless, some associations were found, although there were only few older (nonstudent) samples. It would have been interesting to study differences between different cultures as well, but we were not able to locate any African and only a few Asian samples.

There are notable strengths in this study. This was the first meta-analysis on sex differences in schizotypal symptoms. These symptoms relating to the prodromal phase of psychosis are of increasing interest. Meta-analyses in general are laborious, and in this study, the literature search was particularly extensive, including several database searches and contacts with numerous researchers. All the studies included were read by 2 researchers. In addition, the use of meta-regression is an advantage to most meta-analyses. This enabled us to present the possible effect of age and being a student sample on sex differences in the scales.

Conclusions

This study was the first one to pool studies on sex differences in Wisconsin Schizotypy Scales. The results were quite concordant with the results in schizophrenia and other schizotypal scales. It can be concluded that compared with women, men had more physical and social anhedonia, which relate to negative schizotypy. The gender differences in social anhedonia found here in nonclinical samples, and also in schizophrenia, may relate to a broader aspect of interpersonal and social deficits. There were some sex differences in magical ideation and perceptual aberration in single studies, but when the studies were pooled no sex differences were found. This could mean that there really are no major sex differences in positive schizotypy; however, this should also be studied using meta-analytic methods in other schizotypy instruments. Based on the systematic search of the articles, we can also conclude that more studies using samples from general population are needed. The data provided on the sex differences in schizotypy should be taken into account in future studies, eg by giving norms by sex, and in general on studies on schizotypy and schizophrenia prediction.

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