

Functional Impairments and Theory of Mind Deficits in Schizophrenia: A Meta-analysis of the Associations

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Schizophrenia is associated with major functioning difficulties. Theory of mind (ToM), the ability to infer the mental states of others, is an important determinant of functioning. However, the contribution of ToM to each specific domain of functioning remains to be better understood. The objectives of this meta-analysis were to document and compare the magnitude of the associations between ToM and (1) different domains of functioning (social functioning, productive activities, and instrumental activities of daily living), each assessed separately for functional performance and functional outcome and (2) different aspects of functioning (functional performance and functional outcome) in schizophrenia. Fifty-nine studies ($N = 4369$) published between 1980 and May 2019 targeting patients with schizophrenia or schizoaffective disorder aged between 18 and 65 years old were included. Studies were retrieved from seven databases. Correlations were extracted from the articles, transformed into effect sizes Zr and combined as weighted and unweighted means. The strength of the associations between the domains and aspects of functioning were compared using focused tests. A moderate association was observed between ToM and all domains of functioning, with a stronger association between ToM and productive activities compared with social functioning (only for functional outcome [$\chi^2(2) = 6.43, P = 0.040$]). Regarding the different aspects of functioning, a stronger association was observed between ToM and functional performance, compared with functional outcome, for overall functioning ($\chi^2(1) = 13.77, P < 0.001$) and social functioning ($\chi^2(1) = 18.21, P < 0.001$). The results highlight a stronger association of ToM with productive activities and with functional performance, which should be considered in future studies to improve functional recovery in schizophrenia.

Key words: social functioning/occupational functioning/psychosis/social cognition/performance-based task

Introduction

According to the Global Burden of Disease study,¹ schizophrenia, in its acute phase, is considered as the most debilitating disorder among psychiatric and neurological disorders and is ranked in ninth position even when the illness is stabilized. The onset of the illness often occurs during adolescence or early adulthood, a period of major transitions. Thus, the onset of schizophrenia can have a direct impact on functioning, but can also cause delays in the achievement of important milestones.

Functioning difficulties in schizophrenia have been observed in various areas that can be conceptualized in four domains according to Kleinman et al.² One area is social functioning, which is defined as the initiation and the appropriateness of interactions with family and friends.² Social functioning is impaired in schizophrenia, such that these people often have a reduced social network and receive reduced levels of social support.³ The second area of functioning is productive activities, defined as the accomplishment of daily goal-oriented activities such as work and school.² Given the timing of illness onset, a high rate of high school drop-out is observed,⁴ and even those who pursue their education tend to struggle to complete high school or to access postsecondary education.⁴ Employment rates are also very low⁵ with a major drop following the first psychotic episode.⁶ A third area is instrumental activities of daily living (IADL), defined as the performance in various daily activities such as self-care, psychiatric treatment adherence, or planning skills.² Difficulties are observed in various IADL such

as medication management, handling of finances, or preparing food.⁷ Finally, difficulties in independent living skills are observed in schizophrenia,⁸ which represents the level of supervision needed and how much control the individual has over his own schedule.²

Functioning difficulties in schizophrenia have been linked to various clinical characteristics, most notably, negative symptoms⁹⁻¹¹ and cognition.^{12,13} Among the different cognitive domains, social cognition seems most directly related to social functioning in schizophrenia.¹⁴⁻¹⁶ Several studies have highlighted that the effect of neurocognition on functioning is mediated by social cognitive abilities.¹⁷⁻¹⁹ Social cognition is defined as the mental processes underlying social interactions, including the abilities involved in perceiving and interpreting social information to guide social interactions.²⁰ Evidence suggests that theory of mind (ToM) may be the cognitive ability most strongly associated with functioning, when compared with other social cognitive or neurocognitive abilities.^{15,21-23}

ToM refers to the ability to represent and infer the mental states of other people such as their intentions, beliefs, or emotions.^{20,22,24} ToM deficits are common in schizophrenia²⁵ and are recognized as important obstacles to adequate functioning. In addition to mediating the association between neurocognition and functioning,²⁶⁻²⁸ ToM has also been proved to mediate the association between social knowledge and functioning.²¹ Several studies have revealed a relationship between ToM abilities and functioning in domains involving social interactions such as social functioning²⁹⁻³¹ and productive activities,^{27,28,32,33} but also in other domains like IADL.^{34,35} Further, poorer performance in social cognition (including ToM) is associated with poorer work outcomes 1 year later, the effect being greater for work outcomes than for social functioning or independent living skills.³⁶

While ToM abilities are clearly linked with functioning, the impact ToM has on each specific domain of functioning remains to be better understood. In 2011, the results of a meta-analysis published by Fett et al¹⁵ suggested that ToM was more strongly related to functioning than all other social cognitive and neurocognitive domains (with the exception of verbal fluency). The conclusions were, at the time, limited by the number of available studies reporting an association between ToM and functioning. An update of this meta-analysis was recently published and includes a larger number of studies reporting a correlation between ToM and different areas of functioning.¹⁹ The results revealed that the strongest relationship in the domain of social cognition was the association between ToM and social skills. However, in this meta-analysis, ToM was not more strongly related to functioning than all the other cognitive domains. While these results provide a better understanding of these relationships, two questions remain to be addressed.

First, it is still unclear if the relationships between ToM and the different domains of functioning are all of the same magnitude, or if the impact is more evident in some areas than others. Despite several new studies for the category of community functioning identified by Halverson et al,¹⁹ this category includes several global measures that take into account more than one domain of functioning, preventing the understanding of the relationships between ToM and specific domains of functioning (eg, productive activities).

Second, while Halverson et al¹⁹ address the distinction between functional outcome (community functioning, social behavior during hospitalization) and functional performance (social problem solving, social skills), there is no specific assessment of whether these different aspects of functioning show different strengths of association with cognition. Functioning can be evaluated by targeting either functional performance (FP; ie, what an individual is able to do) or functional outcome (FO; ie, what an individual actually does in his daily life).^{37,38} FP is defined as the capacity of an individual to perform key tasks of daily living²⁴ and is typically assessed using performance-based tasks that emulate real-life situations. FO is assessed using community functioning measures that target everyday functioning and typically take the form of questionnaires or semi-structured interviews. Thus, another question that remains to be addressed is how ToM may affect these different aspects of functioning.

The aim of this meta-analysis was to assess the relationships between ToM and functioning in people with schizophrenia using correlational studies. The first objective was to document and compare the magnitude of the associations between ToM and the different domains of functioning, separately for FO and FP. We expected a stronger association between ToM and productive activities^{32,36} compared with the other domains of functioning. The second objective was to document and compare the magnitude of the associations between ToM and both aspects of functioning (FO, FP). We expected that FP would be more strongly related to ToM than FO.² An additional, exploratory objective was to examine whether the associations between ToM and functioning were significantly moderated by the variables linked to the measures used in the different studies or to the characteristics of the patient samples.

Methods

Data Sources and Literature Search

Articles were identified through searches in the following databases: *PubMed*, *PsycInfo*, *Embase*, *Proquest*, *SciVerse*, *ScienceDirect*, and *Cochrane Library*. Keywords and an example of search strategy (keywords, limits) are presented in [Supplementary 1](#). The PRISMA guidelines were followed, using the PRISMA statement³⁹ and the PRISMA explanation and elaboration document.⁴⁰

However, no prior registration of the protocol was done. The PRISMA checklist for meta-analysis is presented in [Supplementary 2](#).

As illustrated in [figure 1](#), 12 353 articles were identified through this search and 13 articles were identified through other sources such as the references of the articles that were screened. After removing the duplicates, 10 346 articles were considered for inclusion (see [figure 1](#)).

Inclusion and Exclusion Criteria

The inclusion criteria were: (1) diagnosis of schizophrenia or schizoaffective disorder (at least 75% of the sample) according to the Diagnostic and Statistical Manual of Mental Disorders (DSM-III to 5⁴¹⁻⁴⁵) or the International Classification of Diseases (ICD-9⁴⁶ or 10⁴⁷) since ToM and functional difficulties have been largely demonstrated in these diagnoses, (2) participants aged 18 to 65 years, (3) publication written in English, French, or Spanish, (4) published from 1980 to May 23, 2019 (including Epub), and (5) provides at least one correlation between a measure of functioning and a ToM task.

To classify tasks as assessing ToM, we used an operational definition used in previous meta-analyses.⁴⁸⁻⁵⁰ Tasks were classified as evaluating ToM if the participants had to attribute mental states (eg, intentions, beliefs, knowledge, desires, and emotions) to a specific character that expresses something (facial, verbal, or bodily expression) in a given situation (contextualized ToM). As suggested by Lavoie et al,⁴⁸ for some tasks, the expressions themselves were complex enough to consider that it targeted ToM, even if it did not present explicit contextual information (decontextualized ToM;⁴⁸(p 130)). This distinction allows the inclusion of tasks that assess complex mental states (eg, Reading the Mind in the Eyes test) but that do not provide an explicit context as typically presented in classic ToM tasks such as comic strips or verbal stories. The classification of ToM tasks is presented in [Supplementary 3](#).

Procedure

After the initial search and the removal of the duplicates, two independent judges (ET, MT) screened the articles based on the title and the abstract. The articles retained after the first screening were then evaluated based on the full article by the same two judges. The reference lists of all included articles were screened to potentially identify relevant references that did not come up during the initial search and screening for eligibility was performed. In case of disagreement about the inclusion of an article (first screening: 6.9%, second screening: 1.2%), the two judges met to make a final decision.

Next, the extraction of the relevant information was done by the first author and by a second judge (MT) for approximately 20% of the articles (13/59). Given the very low percentage of error for the extraction (0.82% of discrepancies), the first author extracted the relevant information from the remaining articles and the other judge (MT) double-checked the extraction. In addition to relevant correlations, extraction was done for the date of publication, total sample size, sex, age, education, illness duration, age at onset of psychosis, diagnosis, chlorpromazine equivalent, and number of hospitalizations and Positive And Negative Syndrome Scale (PANSS).

Finally, the quality of the included studies was assessed using the Quality appraisal checklist quantitative studies reporting correlations and associations of the National Institute for Health and Care Excellence (NICE).⁵¹ The two independent judges scored the external and internal validity (range 1–3 points for each scale). A third judge was consulted in case of disagreement (0.07% of disagreement). An overall quality score was obtained by adding the two validity scores together (range 2–6 points).

Classification of the Functioning Measures

Functioning measures were classified using the domains of the Schizophrenia Objective Functioning Instrument (SOFI).² These domains were proposed by a consortium of experts² following a rigorous iterative process that involved focus groups with patients and their caregivers. This allowed for the development of a functioning measure relevant to clinical trials, that assessed the effect of interventions on cognitive deficits in schizophrenia. The measures used in the included articles could either be classified as targeting one of the domains proposed in the SOFI or as targeting a combination of domains. The domains of functioning, their definitions, and the aspects of functioning are presented in [table 1](#). All measures of functioning included in the current meta-analysis are listed and classified in their respective domain and aspect in [table 2](#). None of the articles included in the meta-analysis used a measure targeting only the domain of living situation of the SOFI.

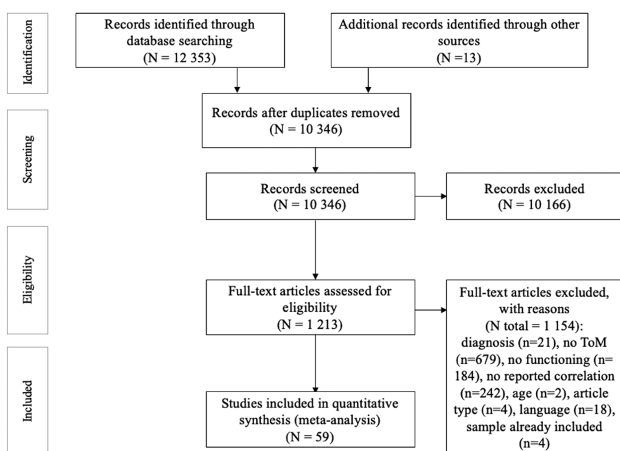


Fig. 1. Flowchart of the meta-analysis.

Table 1. Definition of the Functioning Domains and the Aspects of Functioning

Domains of functioning	
Domain*	Definition and included areas of functioning
Instrumental activities of daily living (IADL) Productive activities	Includes the assessment of self-care, psychiatric treatment adherence, money management skills, planning skills, transportation and leisure activities Refers to various goal-oriented activities such as work or school (full-time or part-time), vocational training or employment skills programs, socialization programs, day hospital programs, childcare and/or homemaking
Social functioning	Refers to the interactions with family and friends, including the initiation and appropriateness of social behaviors
Global functioning	Includes measures of functioning that combine items targeting various domains of functioning (eg, combining productive activities and social functioning). Some of these global measures also include the assessment of clinical symptoms along with more traditional aspects of community functioning *Articles including these global measures were only used for the analyses regarding the overall association between ToM and functioning
Aspects of functioning	
Aspects of functioning	Definition
Functional outcome	Assessed using measures of community functioning. Includes questionnaires and interviews that assess real-world functioning. These measures can be rated by the patient, an informant, a clinician or a researcher
Functional performance	Measured with performance-based tasks. Typically rely on role-play to assess the functional capacity of an individual. These measures are rated by a clinician or a researcher

*None of the articles included in the meta-analysis used a measure targeting only the first domain of the SOFI, namely living situation.

Statistical Analyses

Based on the meta-analytic procedure proposed by Rosenthal,^{52–54} each correlation between a ToM task and a measure of functioning was transformed into an effect size Z_r through a Fisher Z transformation.⁵⁵ To preserve the independence of the data, when a single article included more than one relevant correlation falling under the same category (same domain of functioning, same aspect of functioning), the Z_r s were combined by computing a mean score to enter a single score per category in each of the analyses presented below.

Then, weighted and unweighted means⁵⁵ were calculated for the combinations between the three domains of functioning (IADL, productive activities, and social functioning) and the aspects of functioning (FO, FP), for a total of six combinations: IADL assessed with FO or FP, productive activities assessed with FO or FP and social functioning assessed with FO or FP. Additionally, weighted and unweighted means were calculated for the association between ToM and overall functioning for both aspects of functioning. Unweighted means refers to effect sizes in which each study has the same weight regardless of the size of the sample, while weighted means refers to effect sizes that are weighted by the degrees of freedom ($N-3$) of the studies included in the mean effect size.⁵⁵ The heterogeneity within each combination was then assessed as detailed by Rosenthal⁵⁵ and the statistical significance of heterogeneity was obtained from a chi-square distribution (see^{55,56}). The significant outliers were identified and removed from further analyses. Weighted and unweighted means, as well as the heterogeneity for each combination, were then recalculated.

To determine if ToM was more strongly related to one domain of functioning (IADL, productive activities, and social functioning), separately for FO and FP, we used the focused test approach presented by Rosenthal⁵⁵ to assess the significance between contrast of effect sizes. This takes the form of a contrast scaled for unit variance, yielding a Z score with an expected value of zero under the null hypothesis. This method⁵⁵ allows the comparison between two categories while the method of Hedge⁵⁷ allows the comparison of more than two categories. Following an approach similar to the transition from a Student t -test for two independent groups to an analysis of variance involving two or more independent groups, this approach proposes an extension of the z statistics to χ^2 . The same analyses were repeated including the outliers. Similar analyses were used to determine if ToM was more strongly related to one aspect of functioning (FO, FP), respectively, for overall functioning, IADL, productive activities, and social functioning.

Finally, we explored whether the associations between ToM and functioning were moderated by the different variables linked to the measures, to the samples or to the quality of the studies. A focused test approach^{55,57} was used to assess the effect of categorical variables whereas correlations (Pearson or Spearman) were used for continuous variables. For the characteristics related to the measures, we assessed the moderating effect of the ToM task, the context of ToM task, the functioning measure and the informant who rated the measure of FO (self-report, clinician, relative, combination). For the effect of the characteristics related to the samples, we assessed the effects of sex ratio (ie, percentage of men in the sample),

Table 2. Functioning Measures Included in the Meta-analysis

Functioning domain	Functioning subdomain	Aspect of functioning	Measures	Informant
IADL		FO	Quality of Life Scale—Common objects	CL
		FO	Quality of Life Scale—Activities	CL
		FO	Social Functioning Scale—Independence/competence, Competence of activities of community living	CL, SR, CO
		FO	Social Functioning Scale—Independence/Performance, Frequency of activities of community living	CL, SR, CO
		FO	Revised Social Functioning Scale—Taiwan short version—Independence/competence	SR
		FO	Revised Social Functioning Scale—Taiwan short version—Independence/performance	SR
		FO	The Specific Level of Functioning Scale—Community life skills (activities)	R
		FO	Role functioning scale—Independent living	CL
		FO	Socio-occupational functioning scale—Social appropriateness	CL
		FO	Indian Disability Evaluation Assessment Scale—Self-care Indian Disability Evaluation Assessment Scale—Self-care	CL
		FP	UCSD Performance-based Skills Assessment—Brief (UPSA-B)	CL
		FP	Virtual Reality Supermarket Shopping Test	CL
		FP	Real Life Supermarket Shopping Test	CL
		FP	Chinese Work Personality Profile—Personal appearance	CL
	Self-care	FO	Disability Assessment Schedule (Italian version)—Poor self-care	CO
		FO	Personal and Social Performance—Self-care	CL
	Psychiatric treatment adherence	FO	Service Engagement Scale	CL
	Leisure activities	FO	Social Functioning Scale—Pro-social/Social activities	CL, SR, CO
		FO	Social Functioning Scale—Recreation	CL SR, CO
		FO	Revised Social Functioning Scale—Taiwan short version—Social activity	SR
		FO	Revised Social Functioning Scale—Taiwan short version—Recreation	SR
	Productive activities	FO	Personal and Social Performance (PSP)—Social activity	CL
		FO	Quality of Life Scale—Instrumental	CL
		FO	Social Functioning Scale—Employment/occupation	CL, SR, CO
		FO	Revised Social Functioning Scale—Taiwan short version—Employment	SR
		FO	Role functioning scale—Work/school	CL
	Full or part time employment or volunteering	FO	Social Discomfort on the job—Stressful at work	SR
		FO	Hours worked	CL
		FO	Complexity of the work	CL
		FO	Work Behavior Inventory	CL
		FO	The Specific Level of Functioning Scale—Work skills	R
		FO	Disability Assessment Schedule (Italian version)—Poor work ability	CO
		FO	Indian Disability Evaluation Assessment Scale—Self-care Indian Disability Evaluation Assessment Scale—Work	CL
		FP	Chinese Work Personality Profile—Task orientation	CL

Table 2. Continued

Functioning domain	Functioning subdomain	Aspect of functioning	Measures	Informant
Social functioning		FP	Chinese Work Personality Profile—Attitude toward supervision	CL
		FO	The Specific Level of Functioning Scale—Interpersonal	CL
		FO	Personal and Social Performance (PSP)—Social relationships	CL
		FO	Quality of Life Scale—Interpersonal	CL
		FO	Social Functioning Scale—Social engagement/withdrawal	CL, SR, CO
		FO	Revised Social Functioning Scale—Taiwan short version—Social engagement/ withdrawal	SR, CO
		FO	The Specific Level of Functioning Scale—Interpersonal	SR
		FO	Frankfurt Scales of Self-concept—Assertiveness	SR
		FO	Frankfurt Scales of Self-concept—Contact and interpersonal abilities	SR
		FO	Disability Assessment Schedule (Italian version)—Poor social contact	CO
		FO	Socio-occupational functioning scale—Interpersonal skills	CL
		FO	Indian Disability Evaluation Assessment Scale—Self-care Indian Disability Evaluation Assessment Scale—Communication and understanding	CL
		FP	Maryland Assessment of Social Competence	CL
		FP	Social Skills Performance Assessment (SSPA)	CL
		FP	Role play scenarios adjusted from Bellack, Mueser, Douglas, and Bennett (1981) and Patterson et al. (2001)	CL
Close relationships		FP	Chinese Work Personality Profile—Social skills	CL
		FP	Social Performance Rating Scale	CL
		FP	Conversation Probe role-play test (CP; Penn et al., 1994)	CL
		FO	Social Functioning Scale—Interpersonal communication/behavior	CL, SR, CO
		FO	Revised Social Functioning Scale—Taiwan short version—Interpersonal	SR
Acquaintances		FO	Role functioning scale—Family Network	CL
		FO	Role functioning scale—Social network	CL
		FO	Frankfurt Scales of Self-concept—Self-estimation-by-others	SR
		FO	Quality of Life Scale—Rapport score	CL
		FO	Social Discomfort on the job—Understanding coworkers	SR
		FO	Social Discomfort on the job—Talking to coworkers	SR
		FO	Role functioning scale—Extended Social network	CL
		FO	Nurse's Observation Scale for Inpatient Evaluation (NOSIE-30)—NOSIE-Social competence (NOSIE-SC)	CL
		FO	Quality of life scale—Total	CL, CO
		FO	Social Functioning Scale—Total	CO, SR, R
Global excluding symptoms		FO	Social Adaptation Self-Evaluation Scale	SR
		FO	Independent Living Skills Survey	SR
		FO	The Specific Level of Functioning Scale—Total	CL, R
		FO	Role functioning scale—Total	CL
		FO	Global social and role functioning scale—Current role functioning	CL
		FO	Social and Occupational Functioning Assessment Scale	CL
		FO	Occupation/Education—Combinaison Modified Social Adjustment Scale (Subotnik et al., 1997) and Modified Birchwood Social Functioning Scale (Birchwood et al., 1990)	SR
		FO	Groningen Social Disabilities Schedule	CL

Table 2. Continued

Functioning domain	Functioning subdomain	Aspect of functioning	Measures	Informant
		FO	The Health of the Nation Outcome Scale—secure (HoNOS—secure)—Social	CL
		FO	Personal and Social Performance	CL
		FO	Disability Assessment Schedule (Italian version)—Global community functioning	CO
		FO	Social Adjustment Scale—Self-report	SR
		FO	Socio-occupational functioning scale—Adaptive skills	CL
		FO	Socio-occupational functioning scale—Total	CL
		FO	Indian Disability Evaluation Assessment Scale—Self-care Indian Disability Evaluation Assessment Scale—Total	CL
		FO	Indian Disability Evaluation Assessment Scale—Self-care Indian Disability Evaluation Assessment Scale—Total	CL
		FP	Chinese Work Personality Profile—Self-control	CL
		FP	Independent Living Scale—Problem solving	CL
Global including symptoms		FO	Social Behavior Scale	CL
		FO	Multnomah community ability scale	CL
		FO	Global Assessment of Functioning	CL
		FO	VADO Personal and Social Functioning Scale	CL

Note: FO, Functional outcome; FP, Functional performance; CL, Clinician; SR, Self-report; R, Relatives; CO, Combination; IADL, Instrumental Activities of Daily Living.

mean age, years of education, chlorpromazine equivalent, number of hospitalizations, duration of illness, age at onset of illness and PANSS total, positive and negative scores. The Zrs can be interpreted as follows: $Zr \sim 0.10$ = small; $Zr \sim 0.30$ = moderate; $Zr \sim 0.50$ = strong.⁵³

The workbook Correlational data of the Meta-Essentials⁵⁸ was used to compute publication bias statistics and figures. For the main analyses, we used the workbook created by AMA, that implements the procedures proposed by Rosenthal⁵⁵ as well as the Hedge formula⁵⁷ for comparisons that go beyond two categories.

Results

After the first screening based on the titles and the abstracts, 1213 of the 10 346 articles were considered for inclusion. Following the eligibility screening based on the entire articles, 1154 articles were excluded. The reasons and the number of excluded articles are detailed in figure 1. This led to the inclusion of 59 articles that met all our inclusion criteria, with the full list presented in table 3.

Demographic and Clinical Information

A total of 4369 patients were included in the meta-analysis, with a mean number of 5.2 hospitalizations. Some studies reported chlorpromazine equivalent (mean = 486.2; SD = 398.6) ($k = 25$; $N = 1604$). Among articles that reported clinical symptoms ($N = 46$), the majority used the PANSS: total $M = 66.2$ (SD = 14.9) ($k = 17$; $N = 849$), positive $M = 15.4$ (SD = 5.7) ($k = 31$; $N = 2675$), negative $M = 16.2$ (SD = 5.9) ($k = 30$; $N = 1935$). Additional demographic information is presented in table 3.

Objective 1: Associations Between ToM and each Domain of Functioning

Functional outcome. After the removal of the significant outlier for the domain of social functioning,¹⁰⁴ moderate effect-size Zrs were observed for the associations between ToM and the three domains of functioning (IADL = 0.21, 95% CI [0.16–0.27]; productive activities = 0.26, 95% CI [0.21–0.31]; social functioning = 0.17, 95% CI [0.13–0.21]) (see table 4 for detailed results and Supplementary 4 for forest plots). A significant difference emerged between the three domains of functioning ($\chi^2(2) = 6.43$, $P = 0.040$), with paired-comparisons revealing a significantly stronger association between ToM and productive activities compared with social functioning ($\chi^2(1) = 6.40$, $P = 0.011$). When the outlier¹⁰⁴ for social functioning was included, the difference between the three domains no longer reached significance ($\chi^2(2) = 4.80$, $P = 0.091$).

Supplementary analyses were conducted on the associations between ToM and certain subdomains of functioning and are presented in Supplementary 5.

Table 3. Characteristics of the Articles Included in the Meta-analysis

Sample	Study	N	% Men	Age	Education (y)	Illness duration (y)	Age at onset	% Sz	% Sz affective	Functional domains and aspects	ToM tasks
1	Achim et al ²²	31	84	24.9	-	1.9	-	74	1	Global (FO)	COST
2	Bambini et al ⁵⁹	43	62	39.7	11.8	15.5	24.5	100	-	Global (FO)	PST
3	Bechi et al ⁶⁰	79	62	40.9	-	-	23.6	100	-	Global (FO); IADL (FP)	RMET
4	Bechi et al ⁶¹	30	47	37.7	11.3	12.5	25.5	100	-	IADL (FP)	PST
5	Bell et al ²⁷	151	58	42.8	13.2	-	22.6	69	31	PA (FO); SF (FO)	Hinting
6	Bora et al ²⁹	50	66	30.6	11.5	9.1	21.4	100	-	Global (FO); IADL (FO); PA (FO); SF (FO)	Hinting; RMET
7	Brown et al ³⁴	45	51	36.2	11.1	12.2	-	100	-	IADL (FO); PA (FO); SF (FO)	Hinting; RMET
8	Brüne et al ⁶²	50	44	39.2	-	9.9	29.3	76	18	Global (FO)	FB; PST
9	Brüne et al ⁶³	69	65	36.3	-	10.6	25.9	84	16	Global (FO)	PST
10	Cavieres et al ⁶⁴	42	67	24.3	-	-	-	100	-	Global (FO)	Basic and complex emotions
11	Chen et al ³⁵	53	77	42.3	-	21.3	-	100	-	IADL (FO); PA (FO); SF (FO)	FP; RMET; Strange stories
12	Cook et al ⁶⁵	43	67	42.2	12.9	-	-	47	28	Global (FO)	Hinting
13	Couture et al ²³	178	64	45.9	12.2	-	-	100	-	Global (FO); PA (FP)	Hinting
14	Davidson et al ⁶⁶	48	58	51.0	12.3	-	21.2	77	13	Global (FO)	Comic strips; Hinting; RMET; TASIT-III; ToM PST
15	Fiszdon et al ³⁰	119	65	44.9	12.9	9.6	22.7	69	31	Global (FO); IADL (FO); PA (FO); SF (FO)	Hinting
16	Fox et al ⁶⁷	28	64	33.2	-	14.6	-	100	-	SF (FP)	TASIT-III
17	Galdarisi et al ⁶⁸	740	70	40.0	11.7	16.4	24.1	100	-	IADL (FO); PA (FO); SF (FO); IADL (FP)	TASIT-III
18	Giusti et al ⁶⁹	20	70	36.2	13.4	11.6	-	100	-	Global (FO)	RMET; Strange stories
19	Green et al ⁷⁰	191	68	46.6	12.7	24.2	-	91	1	Global (FO); IADL (FP)	TASIT-III
20	Greenwood et al ⁷¹	43	51	39.5	-	-	-	100	-	IADL (FP)	Comic strips
21	Hajduk et al ⁷²	43	60	38.2	-	11.3	-	72	28	Global (FO); IADL (FO); PA (FO); SF (FO)	Hinting
22a	Harvey et al ^{73*}	103	64	42.6	12.5	-	-	**	-	SF (FO)	Hinting; RMET; TASIT-III
22b	Harvey et al ^{73*}	209	63	41.6	13.1	-	-	**	-	SF (FO)	Hinting; RMET; TASIT-III
23	Horan et al ³⁶	55	76	22.3	12.7	0.9	-	100	-	IADL (FO); PA (FO); SF (FO)	TASIT-III
24	Horton et al ⁷⁴	34	62	45.0	-	18.0	-	76	24	Global (FO)	Hinting
25	Johannesen et al ⁷⁵	32	59	48.8	12.7	-	-	100	-	IADL (FO)	Hinting; SAT-MC; TASIT-III
26	Jung et al ⁷⁶	56	55	33.4	15.2	11.2	-	73	16	Global (FO)	FB; MTSS
27	Kalin et al ⁷⁷	179	65	42.1	12.7	-	-	54	46	SF (FO); SF (FP)	Hinting; RMET; TASIT-III
28	Kamie et al ⁷⁸	52	54	38.1	13.7	13.2	-	100	-	Global (FO); IADL (FO); PA (FO); SF (FO)	SCSQ

Table 3. Continued

Sample	Study	N	% Men	Age	Education (y)	Illness duration (y)	Age at onset	% Sz	% Sz affective	Functional domains and aspects	ToM tasks
29	Kern et al ⁷⁹	50	63	34.5	13.9	-	-	100	-	Global (FO); IADL (FO); PA (FO); SF (FO)	TASIT-III
30	Konstantakopoulos et al ⁸⁰	52	60	42.0	11.5	17.4	-	100	-	Global (FO)	FP
31	Kosmidis et al ⁸¹	28	79	36.9	12.4	10.9	26.0	100	-	SF (FP)	Cartoon stories; Verbal stories
32	Langdon et al ⁸²	23	96	20.9	11.4	0.9	19.9	91	0.1	Global (FO)	PST
33	Le et al ⁸³	146	68	41.5	12.3	-	-	80	20	Global (FO)	Hinting
34	Lee et al ⁸⁴	55	49	41.4	11.2	12.9	28.5	100	-	SF (FO)	Cartoon stories
35	Lincoln et al ⁸⁵	75	63	33.9	14.9	10.0	-	88	12	SF (FO)	FB; MTSS
36	Lo & Siu ⁸⁶	30	53	41.6	9.0	-	24.3	100	-	Global (FP); IADL (FP); PA (FP); SF (FP)	SCSQ
37	Lo & Siu ³³	62	45	37.9	10.7	12.0	25.9	100	-	Global (FP); IADL (FP); PA (FP); SF (FP)	SCSQ
38	Ludwig et al ⁸⁷	38	87	23.5	14.0	-	-	66	16	Global (FO); IADL (FP); SF (FP)	Hinting; RMET; TASIT-III
39	Martinez-Dominguez et al ²⁸	21	71	39.2	16.1	13.3	-	100	-	Global (FO); IADL (FO); PA (FO); SF (FO)	Hinting; RMET
40	Mathews & Barch ⁸⁸	40	65	36.8	13.1	-	19.0	75	25	Global (FO); IADL (FO); PA (FO); SF (FO)	TASIT-III
41	Mazza et al ⁸⁹	49	67	26.4	12.6	1.0	-	100	-	Global (FO)	Advanced ToM
42	McGlade et al ⁹⁰	73	67	41.4	13.6	18.2	-	77	23	Global (FP)	RMET
43	Mehl et al ⁹¹	55	54	32.1	15.1	9.6	-	78	15	SF (FO); SF (FP)	MTSS
44	Mehta et al ⁹²	60	70	33.3	13.0	8.1	-	88	12	Global (FO)	SOCRATIS
45	Murphy ⁹³	30	100	37.4	-	13.1	-	100	-	Global (FO)	MAT; RMET
46	Oh et al ⁹⁴	42	55	35.8	12.4	7.6	-	100	-	Global (FO); IADL (FO); PA (FO); SF (FO)	SAT-MC
47	Pijnenborg et al ⁹⁵	46	74	27.4	4.8	7.0	24.2	100	-	Global (FO)	FP
48	Pinkham & Penn ⁹⁶	49	57	33.2	14.3	10.4	-	71	25	SF (FP)	Hinting; ToM vignette
49	Pinkham et al ⁹⁷	218	65	41.7	13.0	-	-	51	49	Global (FO); IADL (FP); SF (FP)	Hinting; RMET; SAT-MC; TASIT-III
50	Piovan et al ⁹⁸	30	63	45.4	9.6	16.0	29.4	100	-	Global (FO)	PST
51	Riccardi et al ⁹⁹	30	70	37.8	9.9	13.9	-	100	-	Global (FO)	Visual jokes
52	Robertson et al ¹⁰⁰	216	74	40.7	-	17.1	-	100	-	Global (FO)	Hinting; RMET
53	Roncione et al ¹⁶	44	77	33.4	11.6	10.7	-	77	1	Global (FO); IADL (FO); PA (FO); SF (FO)	ToM stories
54	Smith et al ¹⁰¹	60	63	35.4	-	14.4	-	100	-	Global (FO); SF (FP)	EPTT
55	Tas et al ¹⁰²	28	46	34.1	11.2	11.4	-	100	-	IADL (FO); PA (FO); SF (FO)	Hinting; RMET
56	Tso et al ¹⁰³	33	67	38.5	13.8	3.9	11.8	100	-	Global (FO)	RMET
57	Valaparla et al ¹⁰⁴	51	43	32.4	12.2	5.5	26.7	100	-	Global (FO); IADL (FO); PA (FO); SF (FO)	SOCRATIS
58	Weijers et al ¹⁰⁵	87	64	31.7	-	5.7	-	63	14	Global (FO)	Hinting

Table 3. Continued

Sample	Study	N	% Men	Age	Education (y)	Illness duration (y)	Age at onset	% Sz affective	% Sz affective	Functional domains and aspects		ToM tasks	
										Global (FO); IADL (FO); PA (FO); SF (FO)	Global (FO); IADL (FO); PA (FO); SF (FO)	FP	FP
59	Zhu et al ¹⁰⁶	40	45	30.2	10.7	6.8	-	100	-	Global (FO); IADL (FO); PA (FO); SF (FO)	Global (FO); IADL (FO); PA (FO); SF (FO)	FP	FP
Characteristics of the overall participants across all studies (means and standard deviations are presented)													
		4369	65.0	38.9 (10.1)	12.4 (2.6)	13.5 (8.9)	24.2 (7.6)	87.5	10.9				

Note: SZ, Schizophrenia; SZaffective, Schizo-affective; IADL, Instrumental activities of daily living; PA, Productive activities; SF, Social functioning; Global, Global functioning; FO, Functional outcome; FP, Functional performance; COST, Combined Stories Test; PST, Picture Sequencing Task; RMET, Reading the Mind in the Eyes Test; Hinting, Hinting task; FB, False belief task; FP, Faux-Pas task; ToM PST, Theory of Mind Picture Stories Task; TASIT-III, The Awareness of Social Inference Test; SAT-MC, The Social Attribution Task-Multiple Choice; MTSS, Movie Task of Social Situation; SCSQ, Social Cognition and Screening Questionnaire; SOCRATIS, Social Cognition Rating Tools in Indian Setting; MAT, Modified Advanced theory of mind test; EPTT, Emotional Perspective Taking Task.

*Harvey et al (2019) include participants from the study of Pinkham et al (2018). To avoid overlap of the samples, only data from Pinkham et al (2018) were used to calculate sociodemographic information. Harvey et al (2019) however provided correlations between ToM and social functioning that were used for the analyses since they provided distinct information.

**Diagnoses are provided for the whole group, but not detailed for the subgroups, but include only patients with SZ or SZaffective.

Functional performance. After the removal of the significant outliers ($N = 2$) for the domain of IADL,^{68,70} moderate associations were observed between ToM and each domain of functioning (IADL = 0.28, 95% CI [0.19–0.37]; productive activities = 0.30, 95% CI [0.09–0.51]; social functioning = 0.34, 95% CI [0.27–0.40]), with no significant difference between the domains ($\chi^2(2) = 1.12, P = 0.571$). When the two significant outliers were included, a significant difference was observed ($\chi^2(2) = 11.13, P = 0.004$), which was driven by a stronger association between social functioning and ToM ($Zr = 0.34, 95\% \text{ CI } [0.27-0.40]$), compared with IADL ($Zr = 0.20, 95\% \text{ CI } [0.14-0.25]$) ($\chi^2(1) = 10.95, P = 0.001$).

Objective 2: Associations Between ToM and the Different Aspects of Functioning

When considering the association between ToM and overall functioning, effect-size Zrs revealed moderate associations for both aspects of functioning (FO = 0.24, 95% CI [0.21–0.27]; FP = 0.36, 95% CI [0.31–0.42]), with a significantly stronger association between ToM and FP ($\chi^2(1) = 13.77, P < 0.001$) when excluding the significant outlier for FP⁶⁸ (see table 4). When the outlier was included, the difference between the two aspects of functioning disappeared ($\chi^2(1) = 0.11, P = 0.741$).

For IADL, there was no significant difference between FO ($Zr = 0.21, 95\% \text{ CI } [0.16-0.27]$) and FP ($Zr = 0.28, 95\% \text{ CI } [0.19-0.37]$) with ($\chi^2(1) = 0.21, P = 0.647$) or without ($\chi^2(1) = 1.53, P = 0.216$) the significant outlier.⁶⁸

For the association between ToM and productive activities, there was also no significant difference between FO ($Zr = 0.26, 95\% \text{ CI } [0.21-0.31]$) and FP ($Zr = 0.30, 95\% \text{ CI } [0.09-0.51]$) ($\chi^2(1) = 0.15, P = 0.701$; see table 4).

Finally, for social functioning, there was a significantly stronger association for FP ($Zr = 0.34, 95\% \text{ CI } [0.27-0.40]$) compared with FO ($Zr = 0.17, 95\% \text{ CI } [0.13-0.21]$) ($\chi^2(1) = 17.30, P < 0.001$) when the outlier was excluded.¹⁰⁴ When the significant outlier was included, a similar pattern was observed ($\chi^2(1) = 15.06, P < 0.001$; FO: $Zr = 0.18, 95\% \text{ CI } [0.14-0.23]$; FP: $Zr = 0.34, 95\% \text{ CI } [0.27-0.40]$).

Exploration of Potential Moderators

Characteristics related to the measures. The results were not significantly influenced by the informant who rated the FO measures (see Supplementary 6). Regarding the specific functioning measures, a significant effect was observed for overall functioning ($\chi^2(44) = 16.73, P = 0.033$) for FO (see Supplementary 6). The results revealed that the Social Behavior Scale and the Multnomah Community Ability Scale were more strongly related to ToM than other measures. Further, a significant effect of ToM tasks was observed, with a stronger association with the Hinting task, the Picture Sequencing task (PST), and

Table 4. Effect Sizes of the Associations Between ToM and the Domains of Functioning as well as the Aspects of Functioning

Domain	Weighted Zr (SE)	Unweighted Zr (SE)	95% confidence interval	Total sample size (N)	Number of samples (k)	Heterogeneity	
						χ^2 (dfs)	P
Functional outcome							
Overall	0.24 (0.19)	0.29 (0.19)	0.21–0.27	4205	53	67.28 (52)	0.075
IADL	0.21 (0.15)	0.26 (0.15)	0.16–0.27	1505	17	18.99 (16)	0.269
Productive activities	0.26 (0.08)	0.28 (0.08)	0.21–0.31	1624	17	20.81 (16)	0.186
Social functioning (including 1 outlier)	0.18 (0.15)	0.26 (0.15)	0.14–0.23	2300	23	41.23 (22)	0.008*
Social functioning (without 1 outlier)	0.17 (0.15)	0.24 (0.15)	0.13–0.21	2249	22	27.77 (21)	0.147
Functional performance							
Overall (including 1 outlier)	0.25 (0.15)	0.33 (0.15)	0.21–0.30	2081	17	57.60 (16)	<0.001*
Overall (without 1 outlier)	0.36 (0.15)	0.35 (0.15)	0.31–0.42	1341	16	14.85 (15)	0.462
IADL (including 2 outliers)	0.20 (0.20)	0.28 (0.20)	0.14–0.25	1431	9	41.26 (8)	<0.001*
IADL (without 2 outliers)	0.28 (0.02)	0.27 (0.02)	0.19–0.37	500	7	4.40 (6)	0.623
Productive activities	0.30 (0.03)	0.26 (0.03)	0.09–0.51	92	2	0.98 (1)	0.321
Social functioning	0.34 (0.15)	0.35 (0.15)	0.27–0.40	925	11	5.33 (10)	0.868

Note: IADL, Instrumental activities of daily living. Results in bold indicate the effect-sizes excluding the significant outliers that were used for comparison.

* <0.05.

the Social Attribution Task-Multiple Choice (SAT-MC) compared with other ToM tasks for FO and FP (see [Supplementary 7](#)). A stronger association was also observed for contextualized tasks, compared with decontextualized tasks for FO (see [Supplementary 7](#)).

Characteristics related to the patients. The detailed results of the correlations between the mean Zrs and the characteristics of the patient's samples are presented in [Supplementary 8](#). No significant effect was observed for FP. For FO, a significant effect of the sex ratio was observed in the domain of social functioning, with a stronger association observed in samples including more women ($r = -0.48$, $P = 0.021$, 95% CI [-0.88 to -0.08]). There was also a significant effect of PANSS negative symptoms on the association between ToM and overall functioning ($r = 0.53$, 95% CI [0.15–0.89], $P = 0.004$) as well as social functioning ($r = 0.78$, 95% CI [0.33–0.99], $P = 0.003$), with stronger associations observed when the patient samples showed more severe negative symptoms.

Publication Bias and Quality of the Studies

The Rosenthal failsafe-N ($N = 6977$) and the symmetrical distribution of the funnel plot⁵⁷ for the association between ToM and the overall functioning (see [Supplementary 9](#)) revealed no indication of a publication bias. The forest plot for the association between ToM and overall functioning is presented in [Supplementary 9](#). The mean overall quality of the studies was 5.3/6 and showed no significant effect on the association between ToM and functioning for FO ($\chi^2(2) = 3.31$, $P = 0.192$) or FP ($\chi^2(1) = 0.26$, $P = 0.607$). The quality of each study is presented in [Supplementary 9](#).

Discussion

The meta-analysis included 59 studies for a total of 4369 participants and revealed moderate overall associations between ToM and functioning. The first objective was to document and compare the magnitude of the associations between ToM and the different domains of functioning. As hypothesized, a stronger association between ToM and productive activities was observed, but only when compared with social functioning. The second objective was to document and compare the magnitude of the associations between ToM and both aspects of functioning. Our hypothesis was confirmed such that FP was more strongly associated with ToM than FO (for overall and social functioning). Finally, the results of our exploratory analyses revealed moderating effects on the associations between ToM and functioning for certain functioning measures (ie, Social Behavior Scale, Multnomah Community Ability Scale), certain ToM tasks (ie, Hinting task, PST, SAT-MC), samples with a greater proportion of women and samples with more severe negative symptoms.

ToM and the Different Domains of Functioning

To the best of our knowledge, this is the first meta-analysis to use a classification based on the functional domains proposed by the consortium of experts who developed the SOFI scale² that includes IADL, productive activities, social functioning, and living situation. However, no study has assessed the domain of living situation in this meta-analysis. Our results provide a new understanding of the relationship between ToM and specific domains of functioning, and most notably, a stronger

relationship between productive activities and ToM. This result should be interpreted carefully due to the presence of an outlier, but is, however, in line with previous studies, supporting the relationship between productive activities and ToM.^{27,32,36} While Lo and Siu⁸⁶ suggested that ToM deficits could lead to difficulties in understanding the instructions received in the workplace, Horan et al³⁶ highlighted the high social demand involved in productive activities. These are activities in which ToM could often be solicited to adapt to new and fluctuating social interactions and to understand mutual information to achieve a common goal (Achim et al, in preparation).

It is also possible that people with schizophrenia who are able to go to school or to maintain a job have better ToM abilities as well as more opportunities to develop these skills. In the study of Lo and Siu,⁸⁶ patients who had worked within the past 2 years had better ToM abilities than those who were unemployed. Further, the results of Bechi et al³² suggest that improvement in ToM is a significant predictor of performance on the Work Performance Scale, which assesses several variables linked to job functioning, such as adaptation to the context of work, motivation, relationships in the workplace, and competence. Lastly, it is possible to hypothesize that predicting the mental states of acquaintances such as coworkers might recruit more importantly ToM abilities. Since information about a person is an important source of information for ToM,¹⁷ we are able to use previous knowledge about our relatives to predict their emotions or intentions. Thus, understanding the mental states of coworkers might represent an additional challenge since it is not possible to rely on the same amount of information. This hypothesis would need to be further explored but might contribute to this result of a stronger association of productive activities to ToM, compared with social functioning.

ToM, Functional Performance, and Functional Outcome

Functioning is a complex and multidimensional construct that can be conceptualized into two main aspects, FP and FO, respectively, assessed using performance-based tasks and measures of community functioning.³⁸ In schizophrenia, this distinction is particularly relevant since functioning difficulties could arise from an inability to perform a task, or from an inappropriate effort linked to clinical or cognitive symptoms.² This distinction is also important to consider when identifying variables that could influence functioning, since discrepancies between these two aspects have been demonstrated.¹⁰⁷ To the best of our knowledge, this is the first meta-analysis that specifically aimed to explore the relationship between these two aspects of functioning and ToM. The results revealed a stronger association of FP to ToM compared with FO in certain domains, which could be explained by different factors.

Performance-based tasks used to assess FP were included as co-primary measures (ie, functionally meaningful) in the MATRICS initiative, because these tasks appear to be more sensitive to interventions, are less dependent on environmental variables, and rely on direct observation of the patient in a context that emulates real-life situations.^{24,38} On the other hand, FO assessed with measures of community functioning is based on retrospective information that could influence the association with ToM for several reasons (eg, cognitive deficit,³⁸ social desirability, lack of insight¹⁰⁸). Performance-based tasks decrease the possibility of such response bias, since it relies on direct observation.^{37,109} Moreover, it is likely that external resources such as external aids (physical [eg, cellphone], social [eg, relative of the patient]) can influence FO.^{37,110} During performance-based tasks, the patients do not have access to external aid, and thus only rely on their own cognitive resources. Further, it is possible to hypothesize a shared measurement variance between ToM and performance-based tasks. Finally, the stronger association between ToM and FP seems to be particularly driven by the domain of social functioning in the current meta-analysis. It is possible to hypothesize that the very nature of performance-based tasks to assess social functioning might tap more directly into ToM, while those assessing IADL (eg, counting change) or productive activities (eg, maintaining work pace) might recruit neurocognitive skills more extensively.

Our results are consistent with the choice of FP as co-primary measure in treatments such as cognitive remediation therapy, since changes in ToM are more likely to be identified quickly. However, FP alone does not seem sufficient to guarantee actual capacity in everyday functioning,³⁷ which is why assessing long-term changes in FO is also important.

Moderators of the Relationship Between ToM and Functioning

In the current meta-analysis, negative symptoms were significant moderators in the association between ToM and functioning, which is in line with several studies that have highlighted the impact of negative symptoms on functioning.¹¹¹⁻¹¹³ Negative symptoms are persistent after the acute psychotic phase of schizophrenia and they are less responsive to pharmacological treatment than positive symptoms.¹¹⁴ In addition to their direct impact on functioning, negative symptoms can thus also moderate the association between ToM and functioning.

Another finding was the better predicted relationship between ToM and social functioning in women. Abu-Akel and Bo¹¹⁵ have demonstrated better ToM performance in women with schizophrenia compared with men, while Navarra-Ventura et al¹¹⁶ found no significant difference. This finding is particularly interesting given that there is an over-representation of men

in the research on schizophrenia.^{115,116} Furthermore, several studies have found that women with schizophrenia often exhibit better social functioning than men.¹¹⁷ Future studies exploring the impact of the sex of the participant on ToM in schizophrenia thus appear necessary.

Lastly, our meta-analysis has revealed that contextualized ToM tasks significantly moderated the association between ToM and FO. Even if contextualized ToM tasks are not completely representative of dynamic real-life social interactions, it is still possible to hypothesize that they are complex and require to be taken into account several information to infer a mental state. Further, the specific ToM task also has a significant effect on the relationship between ToM and functioning. These results are mainly driven by a stronger association when the Hinting task, the PST and the SAT-MC are used, compared with the RMET and the Awareness of Social Inference Test (TASIT). While the former might be explained by the effect of the context of the task, the latter appears more surprising. One might expect a stronger association with functioning when a task with a high ecological validity such as the TASIT is used, which was not observed in our meta-analysis. While these results might be partly explained by the psychometric properties of ToM tasks,⁹⁶ they need to be taken into account when choosing a ToM task, particularly if the link with functioning is considered.

Limitations

The first limitation is the statistically significant heterogeneity observed in some results, which was explained by the presence of a few outliers. While we reported the results with and without the outliers, this heterogeneity requires careful interpretation as several characteristics of these outliers could account for their diverging results. Second, Rosenthal estimates of effect sizes do not provide a high level of power when working with a small number of studies ($k \leq 20$) and with study with small sample size ($N \leq 40$),¹¹⁸ which was the case for some of the reported relationships. Third, as for any correlational design, it is not possible to draw causal inferences.¹¹⁹ Fourth, while we performed a thorough search and included any relevant type of publications, it is not possible to conclude that all data has been retrieved. To control for this potential “file-drawer” problem,¹²⁰ we computed a fail-safe number.¹²¹ Lastly, it was not possible to document the living situation domain of the SOFI.

Conclusion

The current meta-analysis revealed a moderate association between ToM and all domains of functioning in schizophrenia, with a stronger association for productive activities, compared with social functioning for FO.

Further, the results suggest that FP is more strongly related to ToM than FO. The current results provide a new perspective on the association between ToM and functioning. ToM deficits in schizophrenia can lead to difficulties in all areas of functioning, which should be taken into account to promote functional recovery. Social relationships are ubiquitous and improving ToM deficits should be a target to promote functional recovery not only for the domain of social functioning, but also in other areas such as work. While improving neurocognition might be beneficial to improve one’s abilities to complete tasks at work, improving the ability to understand and predict colleague behavior also appear as essential to function adequately at work. Cognitive remediation therapy, and more generally social cognitive skills training, are promising interventions that have shown their potential to significantly improve ToM and functioning.¹²² Improving ToM deficits thus surpass the domain of social functioning, and could contribute to the recovery in every sphere of functioning in schizophrenia.

Supplementary Material

Supplementary material is available at <https://academic.oup.com/schizophreniabulletin/>.

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Conflict of interest

The authors have declared that there are no conflicts of interest in relation to the subject of this study.

References

1. Whiteford HA, Ferrari AJ, Degenhardt L, Feigin V, Vos T. The global burden of mental, neurological and substance use disorders: an analysis from the Global Burden of Disease Study 2010. *PloS one* 2015;10(2):e0116820.
2. Kleinman L, Lieberman J, Dube S, et al. Development and psychometric performance of the schizophrenia objective functioning instrument: an interviewer administered measure of function. *Schizophr Res.* 2009;107(2–3):275–285.
3. Gayer-Anderson C, Morgan C. Social networks, support and early psychosis: a systematic review. *Epidemiol Psychiatr Sci.* 2013;22(2):131–146.
4. Goulding SM, Chien VH, Compton MT. Prevalence and correlates of school drop-out prior to initial treatment of

- nonaffective psychosis: further evidence suggesting a need for supported education. *Schizophr Res.* 2010;116(2–3):228–233.
5. Rosenheck R, Leslie D, Keefe R, et al.; CATIE Study Investigators Group. Barriers to employment for people with schizophrenia. *Am J Psychiatry.* 2006;163(3):411–417.
 6. Marwaha S, Johnson S. Schizophrenia and employment—a review. *Soc Psychiatry Psychiatr Epidemiol.* 2004;39(5):337–349.
 7. Samuel R, Thomas E, Jacob KS. Instrumental activities of daily living dysfunction among people with schizophrenia. *Indian J Psychol Med.* 2018;40(2):134–138.
 8. Heinrichs RW, Goldberg JO, Miles AA, McDermid Vaz S. Predictors of medication competence in schizophrenia patients. *Psychiatry Res.* 2008;157(1–3):47–52.
 9. Abram SV, Karpouzian TM, Reilly JL, Derntl B, Habel U, Smith MJ. Accurate perception of negative emotions predicts functional capacity in schizophrenia. *Psychiatry Res.* 2014;216(1):6–11.
 10. Bowie CR, Leung WW, Reichenberg A, et al. Predicting schizophrenia patients' real-world behavior with specific neuropsychological and functional capacity measures. *Biol Psychiatry.* 2008;63(5):505–511.
 11. Ventura J, Hellemann GS, Thames AD, Koellner V, Nuechterlein KH. Symptoms as mediators of the relationship between neurocognition and functional outcome in schizophrenia: a meta-analysis. *Schizophr Res.* 2009;113(2–3):189–199.
 12. Green MF, Kern RS, Braff DL, Mintz J. Neurocognitive deficits and functional outcome in schizophrenia: are we measuring the “right stuff”? *Schizophr Bull.* 2000;26(1):119–136.
 13. Bosia M, Buonocore M, Bechi M, et al. Cognitive remediation and functional improvement in schizophrenia: is it a matter of size? *Eur Psychiatry.* 2017;40:26–32.
 14. Brekke J, Kay DD, Lee KS, Green MF. Biosocial pathways to functional outcome in schizophrenia. *Schizophr Res.* 2005;80(2–3):213–225.
 15. Fett AK, Viechtbauer W, Dominguez MD, Penn DL, van Os J, Krabbendam L. The relationship between neurocognition and social cognition with functional outcomes in schizophrenia: a meta-analysis. *Neurosci Biobehav Rev.* 2011;35(3):573–588.
 16. Roncone R, Falloon IR, Mazza M, et al. Is theory of mind in schizophrenia more strongly associated with clinical and social functioning than with neurocognitive deficits? *Psychopathology.* 2002;35(5):280–288.
 17. Achim AM, Guitton M, Jackson PL, Boutin A, Monetta L. On what ground do we mentalize? Characteristics of current tasks and sources of information that contribute to mentalizing judgments. *Psychol Assess.* 2013;25(1):117–126.
 18. Addington J, Girard TA, Christensen BK, Addington D. Social cognition mediates illness-related and cognitive influences on social function in patients with schizophrenia-spectrum disorders. *J Psychiatry Neurosci.* 2010;35(1):49–54.
 19. Halverson TF, Orleans-Pobee M, Merritt C, Sheeran P, Fett AK, Penn DL. Pathways to functional outcomes in schizophrenia spectrum disorders: Meta-analysis of social cognitive and neurocognitive predictors. *Neurosci Biobehav Rev.* 2019;105:212–219.
 20. Pinkham AE. Social cognition in schizophrenia. *J Clin Psychiatry.* 2014;75(Suppl 2):14–19.
 21. Achim AM, Ouellet R, Lavoie MA, Vallières C, Jackson PL, Roy MA. Impact of social anxiety on social cognition and functioning in patients with recent-onset schizophrenia spectrum disorders. *Schizophr Res.* 2013;145(1–3):75–81.
 22. Achim AM, Ouellet R, Roy MA, Jackson PL. Mentalizing in first-episode psychosis. *Psychiatry Res.* 2012;196(2–3):207–213.
 23. Couture SM, Granholm EL, Fish SC. A path model investigation of neurocognition, theory of mind, social competence, negative symptoms and real-world functioning in schizophrenia. *Schizophr Res.* 2011;125(2–3):152–160.
 24. Green MF, Penn DL, Bentall R, et al. Social cognition in schizophrenia: an NIMH workshop on definitions, assessment, and research opportunities. *Schizophr Bull.* 2008;34(6):1211–1220.
 25. Savla GN, Vella L, Armstrong CC, Penn DL, Twamley EW. Deficits in domains of social cognition in schizophrenia: a meta-analysis of the empirical evidence. *Schizophr Bull.* 2013;39(5):979–992.
 26. Addington J, Saeedi H, Addington D. Influence of social perception and social knowledge on cognitive and social functioning in early psychosis. *Br J Psychiatry.* 2006;189:373–378.
 27. Bell M, Tsang HW, Greig TC, Bryson GJ. Neurocognition, social cognition, perceived social discomfort, and vocational outcomes in schizophrenia. *Schizophr Bull.* 2009;35(4):738–747.
 28. Martínez-Domínguez S, Penadés R, Segura B, González-Rodríguez A, Catalán R. Influence of social cognition on daily functioning in schizophrenia: study of incremental validity and mediational effects. *Psychiatry Res.* 2015;225(3):374–380.
 29. Bora E, Eryavuz A, Kayahan B, Sungu G, Veznedaroglu B. Social functioning, theory of mind and neurocognition in outpatients with schizophrenia; mental state decoding may be a better predictor of social functioning than mental state reasoning. *Psychiatry Res.* 2006;145(2–3):95–103.
 30. Fiszdon JM, Fanning JR, Johannesen JK, Bell MD. Social cognitive deficits in schizophrenia and their relationship to clinical and functional status. *Psychiatry Res.* 2013;205(1–2):25–29.
 31. Tas C, Danaci AE, Cubukcuoglu Z, Brüne M. Impact of family involvement on social cognition training in clinically stable outpatients with schizophrenia—a randomized pilot study. *Psychiatry Res.* 2012;195(1–2):32–38.
 32. Bechi M, Spangaro M, Pignoni A, et al. Exploring predictors of work competence in schizophrenia: the role of theory of mind. *Neuropsychol Rehabil.* 2019;29(5):691–703.
 33. Lo PMT, Siu AMH. Assessing social cognition of persons with schizophrenia in a Chinese population: a pilot study. *Front Psychiatry.* 2017;8:302.
 34. Brown EC, Tas C, Can H, Esen-Danaci A, Brüne M. A closer look at the relationship between the subdomains of social functioning, social cognition and symptomatology in clinically stable patients with schizophrenia. *Compr Psychiatry.* 2014;55(1):25–32.
 35. Chen KW, Lee SC, Chiang HY, Syu YC, Yu XX, Hsieh CL. Psychometric properties of three measures assessing advanced theory of mind: evidence from people with schizophrenia. *Psychiatry Res.* 2017;257:490–496.
 36. Horan WP, Green MF, DeGroot M, et al. Social cognition in schizophrenia, Part 2: 12-month stability and prediction of functional outcome in first-episode patients. *Schizophr Bull.* 2012;38(4):865–872.
 37. Harvey PD, Velligan DI, Bellack AS. Performance-based measures of functional skills: usefulness in clinical treatment studies. *Schizophr Bull.* 2007;33(5):1138–1148.
 38. Mantovani LM, Teixeira AL, Salgado JV. Functional capacity: a new framework for the assessment of everyday functioning in schizophrenia. *Braz J Psychiatry.* 2015;37(3):249–255.

39. Moher D, Liberati A, Tetzlaff J, Altman DG; PRISMA Group. Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. *PLoS Med*. 2009;6(7):e1000097.
40. Liberati A, Altman DG, Tetzlaff J, et al. The PRISMA statement for reporting systematic reviews and meta-analyses of studies that evaluate health care interventions: explanation and elaboration. *Ann Intern Med*. 2009;151(4):W65–W94.
41. American Psychiatric Association. *Diagnostic and Statistical Manual of Mental Disorders: DSM-III*. Paris: American Psychiatric Association; 1983.
42. American Psychiatric Association. *Diagnostic and Statistical Manual of Mental Disorders: DSM-III-R*. Paris: American Psychiatric Association; 1989.
43. American Psychiatric Association. *Diagnostic and Statistical Manual of Mental Disorders: DSM-IV*. Paris: American Psychiatric Association; 1996.
44. American Psychiatric Association. *Diagnostic and Statistical Manual of Mental Disorders: DSM-IV-TR*. Paris: American Psychiatric Association; 2003.
45. American Psychiatric Association. *Diagnostic and Statistical Manual of Mental Disorders: DSM-V*. Arlington, VA: American Psychiatric Association; 2013.
46. World Health Organization. *The International Classification of Diseases*, 9th Revision. Geneva: World Health Organization; 1996.
47. World Health Organization. *The International Statistical Classification of Diseases and Related Health Problems*, 10th Revision. Vol 2. Geneva: World Health Organization; 2011.
48. Lavoie MA, Plana I, Bédard Lacroix J, Godmaire-Duhaime F, Jackson PL, Achim AM. Social cognition in first-degree relatives of people with schizophrenia: a meta-analysis. *Psychiatry Res*. 2013;209(2):129–135.
49. Plana I, Lavoie MA, Battaglia M, Achim AM. A meta-analysis and scoping review of social cognition performance in social phobia, posttraumatic stress disorder and other anxiety disorders. *J Anxiety Disord*. 2014;28(2):169–177.
50. Thibaut É, Achim AM, Parent C, Turcotte M, Cellard C. A meta-analysis of the associations between theory of mind and neurocognition in schizophrenia. *Schizophr Res*. 2020;216:118–128.
51. National Institute for Health and Care Excellence. *Methods for the Development of NICE Public Health Guidance*, 3rd ed. National Institute for Health and Care Excellence; 2012. <https://www.nice.org.uk/process/pmg4/resources/methods-for-the-development-of-nice-public-health-guidance-third-edition-pdf-2007967445701>.
52. Rosenthal R, Rosnow RL. *Essentials of Behavioral Research: Methods and Data Analysis*. Vol 2. New York: Beth Meija; 1991.
53. Rosenthal R, DiMatteo MR. Meta-analysis: recent developments in quantitative methods for literature reviews. *Annu Rev Psychol*. 2001;52:59–82.
54. Rosnow RL. Effect sizes for experimenting psychologists. *Can J Exp Psychol*. 2003;57(3):221–237.
55. Rosenthal R. *Meta-analytic Procedures for Social Research*. Newbury Park, CA: SAGE; 1991.
56. Snedecor GW, Cochran WG. *Statistical Methods*, 8th ed. Ames, IA: The Iowa State University Press; 1989.
57. Hedges LV. Fitting categorical models to effect sizes from a series of experiments. *J Educ Behav Stat* 1982;7(2):119–137.
58. Suurmond R, van Rhee H, Hak T. Introduction, comparison, and validation of Meta-Essentials: a free and simple tool for meta-analysis. *Res Synth Methods*. 2017;8(4):537–553.
59. Bambini V, Arcara G, Bechi M, Buonocore M, Cavallaro R, Bosia M. The communicative impairment as a core feature of schizophrenia: frequency of pragmatic deficit, cognitive substrates, and relation with quality of life. *Compr Psychiatry*. 2016;71:106–120.
60. Bechi M, Bosia M, Spangaro M, et al. Exploring functioning in schizophrenia: Predictors of functional capacity and real-world behaviour. *Psychiatry Res*. 2017;251:118–124.
61. Bechi M, Spangaro M, Bosia M, et al. Theory of Mind intervention for outpatients with schizophrenia. *Neuropsychol Rehabil*. 2013;23(3):383–400.
62. Brüne M, Abdel-Hamid M, Sonntag C, Lehmkämpfer C, Langdon R. Linking social cognition with social interaction: non-verbal expressivity, social competence and “mentalising” in patients with schizophrenia spectrum disorders. *Behav Brain Funct*. 2009;5:6.
63. Brüne M, Blank K, Witthaus H, Saft C. “Theory of mind” is impaired in Huntington’s disease. *Mov Disord*. 2011;26(4):671–678.
64. Cavieres A, Valdebenito M. Deficit in recognizing emotions from facial expressions in schizophrenia; Clinical and neuropsychological implications. *Rev Chil Neuropsiquiatr*. 2007;45(2):120–128.
65. Cook EA, Liu NH, Tarasenko M, Davidson CA, Spaulding WD. Longitudinal relationships between neurocognition, theory of mind, and community functioning in outpatients with serious mental illness. *J Nerv Ment Dis*. 2013;201(9):786–794.
66. Davidson CA, Lesser R, Parente LT, Fiszdon JM. Psychometrics of social cognitive measures for psychosis treatment research. *Schizophr Res*. 2018;193:51–57.
67. Fox JM, Abram SV, Reilly JL, et al. Default mode functional connectivity is associated with social functioning in schizophrenia. *J Abnorm Psychol*. 2017;126(4):392–405.
68. Galderisi S, Rucci P, Kirkpatrick B, et al. Interplay among psychopathologic variables, personal resources, context-related factors, and real-life functioning in individuals with schizophrenia: a network analysis. *JAMA Psychiatry*. 2018;75(4):396–404.
69. Giusti L, Mazza M, Pollice R, Casacchia M, Roncone R. Relationship between self-reflectivity, theory of mind, neurocognition, and global functioning: an investigation of schizophrenic disorder. *Clin Psychol*. 2013;17(2):67–76.
70. Green MF, Helleman G, Horan WP, Lee J, Wynn JK. From perception to functional outcome in schizophrenia: modeling the role of ability and motivation. *Arch Gen Psychiatry*. 2012;69(12):1216–1224.
71. Greenwood KE, Morris R, Smith V, Jones AM, Pearman D, Wykes T. Virtual shopping: a viable alternative to direct assessment of real life function? *Schizophr Res*. 2016;172(1–3):206–210.
72. Hajdúk M, Krajčovičová D, Zimányiová M, Kořínková V, Heretik A, Pečeňák J. Theory of mind—not emotion recognition—mediates the relationship between executive functions and social functioning in patients with schizophrenia. *Psychiatr Danub* 2018;30(3):292–298.
73. Harvey PD, Deckler E, Jarskog F, Penn DL, Pinkham AE. Predictors of social functioning in patients with higher and lower levels of reduced emotional experience: social cognition, social competence, and symptom severity. *Schizophr Res*. 2019;206:271–276.

74. Horton HK. Linguistic ability and mental health outcomes among deaf people with schizophrenia. *J Nerv Ment Dis.* 2010;198(9):634–642.
75. Johannesen JK, Fiszdon JM, Weinstein A, Ciosek D, Bell MD. The Social Attribution Task—Multiple Choice (SAT-MC): psychometric comparison with social cognitive measures for schizophrenia research. *Psychiatry Res.* 2018;262:154–161.
76. Jung E, Wiesjahn M, Lincoln TM. Negative, not positive symptoms predict the early therapeutic alliance in cognitive behavioral therapy for psychosis. *Psychother Res.* 2014;24(2):171–183.
77. Kalin M, Kaplan S, Gould F, Pinkham AE, Penn DL, Harvey PD. Social cognition, social competence, negative symptoms and social outcomes: inter-relationships in people with schizophrenia. *J Psychiatr Res.* 2015;68:254–260.
78. Kanie A, Hagiya K, Ashida S, et al. New instrument for measuring multiple domains of social cognition: construct validity of the Social Cognition Screening Questionnaire (Japanese version). *Psychiatry Clin Neurosci.* 2014;68(9):701–711.
79. Kern RS, Green MF, Fiske AP, et al. Theory of mind deficits for processing counterfactual information in persons with chronic schizophrenia. *Psychol Med.* 2009;39(4):645–654.
80. Konstantakopoulos G, Ploumpidis D, Oulis P, et al. The relationship between insight and theory of mind in schizophrenia. *Schizophr Res.* 2014;152(1):217–222.
81. Kosmidis MH, Giannakou M, Garyfallos G, Kiosseoglou G, Bozikas VP. The impact of impaired “Theory of Mind” on social interactions in schizophrenia. *J Int Neuropsychol Soc.* 2011;17(3):511–521.
82. Langdon R, Connors MH, Still M, Ward PB, Catts S. Theory of mind and neurocognition in early psychosis: a quasi-experimental study. *BMC Psychiatry.* 2014;14:316.
83. Le TP, Holden JL, Link PC, Granholm EL. Neurocognitive and theory of mind deficits and poor social competence in schizophrenia: the moderating role of social disinterest attitudes. *Psychiatry Res.* 2018;270:459–466.
84. Lee WK, Kim YK. Theory of mind in schizophrenia: correlation with clinical symptomatology, emotional recognition and ward behavior. *Asia Pac Psychiatry.* 2013;5(3):157–163.
85. Lincoln TM, Mehl S, Kesting ML, Rief W. Negative symptoms and social cognition: identifying targets for psychological interventions. *Schizophr Bull.* 2011;37(Suppl 2):S23–S32.
86. Lo P, Siu AM. Social cognition and work performance of persons with schizophrenia in a Chinese population. *Work.* 2015;50(4):629–636.
87. Ludwig KA, Pinkham AE, Harvey PD, Kelsven S, Penn DL. Social cognition psychometric evaluation (SCOPE) in people with early psychosis: a preliminary study. *Schizophr Res.* 2017;190:136–143.
88. Mathews JR, Barch DM. Emotion responsivity, social cognition, and functional outcome in schizophrenia. *J Abnorm Psychol.* 2010;119(1):50–59.
89. Mazza M, Pollice R, Pacitti F, et al. New evidence in theory of mind deficits in subjects with chronic schizophrenia and first episode: correlation with symptoms, neurocognition and social function. *Riv Psichiatr.* 2012;47(4):327–336.
90. McGlade N, Behan C, Hayden J, et al. Mental state decoding v. mental state reasoning as a mediator between cognitive and social function in psychosis. *Br J Psychiatry.* 2008;193(1):77–78.
91. Mehl S, Rief W, Mink K, Lüllmann E, Lincoln TM. Social performance is more closely associated with theory of mind and autobiographical memory than with psychopathological symptoms in clinically stable patients with schizophrenia-spectrum disorders. *Psychiatry Res.* 2010;178(2):276–283.
92. Mehta UM, Bhagyavathi HD, Thirthalli J, Kumar KJ, Gangadhar BN. Neurocognitive predictors of social cognition in remitted schizophrenia. *Psychiatry Res.* 2014;219(2):268–274.
93. Murphy D. Theory of mind functioning in mentally disordered offenders detained in high security psychiatric care: its relationship to clinical outcome, need and risk. *Crim Behav Ment Health.* 2007;17(5):300–311.
94. Oh SE, Lee SH, Park YM, Bae SM. The multiple faces of social cognition in schizophrenia: its relationship with neurocognition and functional outcomes. *Clin Psychopharmacol Neurosci.* 2010;8(2):90–96.
95. Pijnenborg GH, Withaar FK, Evans JJ, van den Bosch RJ, Timmerman ME, Brouwer WH. The predictive value of measures of social cognition for community functioning in schizophrenia: implications for neuropsychological assessment. *J Int Neuropsychol Soc.* 2009;15(2):239–247.
96. Pinkham AE, Penn DL. Neurocognitive and social cognitive predictors of interpersonal skill in schizophrenia. *Psychiatry Res.* 2006;143(2–3):167–178.
97. Pinkham AE, Harvey PD, Penn DL. Social cognition psychometric evaluation: results of the final validation study. *Schizophr Bull.* 2018;44(4):737–748.
98. Piovan C, Gava L, Campeol M. Theory of Mind and social functioning in schizophrenia: correlation with figurative language abnormalities, clinical symptoms and general intelligence. *Riv Psichiatr.* 2016;51(1):20–29.
99. Riccardi I, Carcione A, D’Arcangelo M, et al. Empathic and cognitive processing in people with schizophrenia: a study on an Italian sample. *Journal of Psychopathology.* 2016;22:127–134.
100. Robertson DA, Hargreaves A, Kelleher EB, et al. Social dysfunction in schizophrenia: an investigation of the GAF scale’s sensitivity to deficits in social cognition. *Schizophr Res.* 2013;146(1–3):363–365.
101. Smith MJ, Horan WP, Cobia DJ, et al. Performance-based empathy mediates the influence of working memory on social competence in schizophrenia. *Schizophr Bull.* 2014;40(4):824–834.
102. Tas C, Brown E, Cubukcuoglu Z, Aydemir O, Danaci AE, Brüne M. Towards an integrative approach to understanding quality of life in schizophrenia: the role of neurocognition, social cognition, and psychopathology. *Compr Psychiatry.* 2013;54(3):262–268.
103. Tso IF, Grove TB, Taylor SF. Emotional experience predicts social adjustment independent of neurocognition and social cognition in schizophrenia. *Schizophr Res.* 2010;122(1–3):156–163.
104. Valaparla VL, Nehra R, Mehta UM, Thirthalli J, Grover S. Social cognition of patients with schizophrenia across the phases of illness—A longitudinal study. *Schizophr Res.* 2017;190:150–159.
105. Weijers J, Fonagy P, Eurelings-Bontekoe E, Termorshuizen F, Viechtbauer W, Selten JP. Mentalizing impairment as a mediator between reported childhood abuse and outcome in nonaffective psychotic disorder. *Psychiatry Res.* 2018;259:463–469.

106. Zhu CY, Lee TM, Li XS, Jing SC, Wang YG, Wang K. Impairments of social cues recognition and social functioning in Chinese people with schizophrenia. *Psychiatry Clin Neurosci*. 2007;61(2):149–158.
107. Gupta M, Bassett E, Iftene F, Bowie CR. Functional outcomes in schizophrenia: understanding the competence-performance discrepancy. *J Psychiatr Res*. 2012;46(2):205–211.
108. Gould F, Sabbag S, Durand D, Patterson TL, Harvey PD. Self-assessment of functional ability in schizophrenia: milestone achievement and its relationship to accuracy of self-evaluation. *Psychiatry Res*. 2013;207(1–2):19–24.
109. McKibbin CL, Brekke JS, Sires D, Jeste DV, Patterson TL. Direct assessment of functional abilities: relevance to persons with schizophrenia. *Schizophr Res*. 2004;72(1):53–67.
110. Couture SM, Penn DL, Roberts DL. The functional significance of social cognition in schizophrenia: a review. *Schizophr Bull*. 2006;32(Suppl 1):S44–S63.
111. Ventura J, Ered A, Gretchen-Doorly D, et al. Theory of mind in the early course of schizophrenia: stability, symptom and neurocognitive correlates, and relationship with functioning. *Psychol Med*. 2015;45(10):2031–2043.
112. Degan A, Berry K, Sweet D, Abel K, Crossley N, Edge D. Social networks and symptomatic and functional outcomes in schizophrenia: a systematic review and meta-analysis. *Soc Psychiatry Psychiatr Epidemiol*. 2018;53(9):873–888.
113. Strauss GP, Horan WP, Kirkpatrick B, et al. Deconstructing negative symptoms of schizophrenia: avolition-apathy and diminished expression clusters predict clinical presentation and functional outcome. *J Psychiatr Res*. 2013;47(6):783–790.
114. Möller HJ. The Relevance of Negative Symptoms in Schizophrenia and How to Treat Them with Psychopharmaceuticals? *Psychiatr Danub* 2016;28(4):435–440.
115. Abu-Akel A, Bo S. Superior mentalizing abilities of female patients with schizophrenia. *Psychiatry Res*. 2013;210(3):794–799.
116. Navarra-Ventura G, Fernandez-Gonzalo S, Turon M, et al. Gender differences in social cognition: a cross-sectional pilot study of recently diagnosed patients with schizophrenia and healthy subjects. *Can J Psychiatry*. 2018;63(8):538–546.
117. Ochoa S, Usall J, Cobo J, Labad X, Kulkarni J. Gender differences in schizophrenia and first-episode psychosis: a comprehensive literature review. *Schizophr Res Treatment*. 2012;2012:916198.
118. Field AP. Meta-analysis of correlation coefficients: a Monte Carlo comparison of fixed- and random-effects methods. *Psychol Methods*. 2001;6(2):161–180.
119. Levin KA. Study design III: cross-sectional studies. *Evid Based Dent*. 2006;7(1):24–25.
120. Borenstein M, Hedges LV, Higgins JPT, Rothstein HR. Criticisms of meta-analysis. In: Borenstein M, ed. *Introduction to Meta-analyses*. Sussex: Hoboken: John Wiley & Sons; 2009:452.
121. Rosenthal R. The file drawer problem and tolerance for null results. *Psychol Bull* 1979;86(3):638–664.
122. Kurtz MM, Gagen E, Rocha NB, Machado S, Penn DL. Comprehensive treatments for social cognitive deficits in schizophrenia: a critical review and effect-size analysis of controlled studies. *Clin Psychol Rev*. 2016;43:80–89.