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Specific learning disorders in young adults: Investigating pragmatic abilities and their relationship with theory of mind, executive functions and quality of life.

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ABSTRACT

Background: Specific Learning Disorders (SLD) are lifelong conditions often associated with language difficulties, executive dysfunctions, and psychological problems. Previous research has shown that communicative-pragmatic ability may be impaired in SLD. However, the role of other cognitive abilities in explaining pragmatic difficulties has still not been fully investigated. The relationship between pragmatics and quality of life is not yet clear, as well.

Aims: Firstly, the study assessed pragmatic comprehension abilities in adults with SLD. Secondly, we examined the relationship between pragmatics, theory of mind, executive functions and quality of life.

Method and procedures: We enrolled 26 adults with SLD and 30 adults without SLD. Standardized tests assessing pragmatic comprehension, theory of mind and executive functions were used. The quality of life was investigated with a self-reported questionnaire.

Outcomes and results: Pragmatic comprehension abilities were compromised in young adults with SLD. In this clinical population we also found a link between pragmatic comprehension and visual theory of mind. Finally, independently from the presence of SLD, pragmatics abilities were in relationship with quality of life.

Conclusions and implications: Overall, these data highlight the importance of including pragmatic abilities both in the clinical evaluation, as well as in psychological intervention for adults with SLD.

1. Introduction

Pragmatics refers to the use of language and other expressive means to convey communicative meaning in a certain context. It

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includes both linguistic functions (e.g. register, appropriate initiation, the choice of referential expressions and turn-taking), as well as non-linguistic functions (e.g. eye contact, body language and facial expressions) (Bara, 2010; Holler & Levinson, 2019).

Metaphor, narrative discourse and other high-level language aspects are also considered in the domain of pragmatics. Pragmatic ability is considered the most complex aspect of linguistic functioning as it uses many different knowledge bases and cognitive systems. In fact, the ability to communicate and understand the message during a conversation relies upon “higher order” abilities and different cognitive systems interact in order to combine novel inferences, specific to the communicative act, with the interlocutor’s knowledge of the world.

Martin (Martin & McDonald, 2003) examined three theories that have been considered the most valid to describe pragmatic difficulties.

According to the Weak central coherence (WCC) hypothesis (Frith, 1989) pragmatic deficits are caused by the inability to use contexts to derive meanings. This theory was first applied to children with Autism Spectrum Disorder (ASD) in order to explain the failure in integrating the different sources of information. In fact, individuals with ASD are less able to draw coherent inferences across a set of statements (Jolliffe & Baron-Cohen, 1999) and to construct higher-level meaning in contexts (Frith & Happe, 1994). Following the WCC hypothesis, to understand and use pragmatic language, the elements of discourse need to be integrated via inferences. When this process does not work efficiently, pragmatic difficulties may arise. In particular, a deficit in WCC could impair the use of contextual information to understand non-literal meanings of communication (Poletti, 2011).

Even though the WCC hypothesis was developed to explain pragmatic deficits in ASD, it introduced important concepts, and it could be considered the first account that have attempted to bring different clinical conditions under the same theoretical domain in relation to social language difficulties.

The second theory, the “Social inference theory”, is based on the assumption that social inferences are required when we attempt to explain or predict the intentions, thoughts and behaviors of our interlocutors. One facet of social inference is the mentalizing ability (Theory of Mind, ToM), namely the ability to form representations of other people’s mental states and to use them in order to judge utterances and behaviors (Brownell & Martino, 1998). Mentalizing is somehow considered as necessary for the normal development of pragmatic language competence (Geurts et al., 2010; Matthews et al., 2018; O’Neill, 2012; Poletti, 2011). In fact, ToM, and the second-order mental state attribution, in particular, is required to comprehend the speaker’s beliefs and intentions and to distinguish for example a joke from a lie (Winner et al., 1998). Thus, ToM and pragmatics are related, and deficits in ToM could compromise the ability to understand the speaker intention and his/her message in a precise context. Social inference theory was verified in previous studies regarding the comprehension of non-literal language both in typically developing children (Lecce et al., 2019) and children with neurodevelopmental disorders (Andrés-Roqueta et al., 2013; De Rosnay et al., 2014; Whyte & Nelson, 2015). Even though it appears likely that ToM is implicated in pragmatics, the developmental picture from individual-differences research is still not clear (see Matthews et al., 2018).

Similar, the debate on healthy adults is wide and inconclusive. Recent evidences show that differences in ToM are associated with pragmatic abilities in typical adults across distinct pragmatic phenomena (Fairchild & Papafragou, 2021). Other studies argued that ToM and pragmatics are two independent cognitive domains and their relationship is evident only in specific communicative situations (Bosco et al., 2018; Bischetti et al., 2019).

In adults, the link between ToM and pragmatics has been explored also in patients with different clinical conditions i.e. Right Hemisphere Damage (RHD), schizophrenia and Traumatic Brain Injury (TBI) (e.g. Bosco et al., 2017; Champagne-Lavau & Stip, 2010; Langdon et al., 2002; Parola et al., 2020). Overall the studies on these clinical population described a relationship between ToM and pragmatic competence (e.g. Brüne & Bodenstein, 2005; Winner et al., 1998).

The third theory that has emerged to explain the pragmatic deficits is the “Executive dysfunction account”. Executive functions (EF) are argued to play a role in adaptive behavior and in responding to novel and challenging tasks. EF include three main functions, i.e. inhibition, working memory (WM) and cognitive flexibility, and allow both self-regulation and the enactment of goal-directed behavior, contributing to the coordination of different cognitive processes over time (e.g. Diamond, 2013; Miyake et al., 2000). EF have been linked to pragmatic abilities and to social behavior (Barkley, 2001) as they are involved in planning, monitoring and inhibiting of the behavior in discourse and in social exchanges. For example, in production and understanding narratives, the speakers have to hold in mind and update information, suppress one’s self-perception and flexibly respond to the interlocutor (Matthews et al., 2018). Moreover, intact EF system seems to be necessary to engage in motivated, adaptive and effective communication (Champagne-Lavau & Stip, 2010; Martin & McDonald, 2003). Among EF, inhibitory control seems to be the most involved process in pragmatic functioning. In fact, the mechanism permits to suppress the superfluous information, automatically activated by the external environment, to consider the communicative partner’s perspective. Therefore, executive dysfunction may result in a rigid and concrete elaboration of linguistic information and in the comprehension of figurative language impairments (Poletti, 2011).

Carriedo and colleagues (Carriedo et al., 2016) proposed a significant contribution on the role of EF on pragmatics across typically developing subjects. The authors found that the role of EF (updating information in WM and cognitive inhibition) in pragmatic comprehension (i.e. metaphors) becomes stronger in adolescents compared to younger children. Interestingly, in the case of young adults, EF continue to have a significant effect on pragmatics, even if their influence decreases. Recently, Fairchild (Fairchild & Papafragou, 2021) examined the association between EF (WM) and pragmatic judgments in neurotypical adults. The findings showed no direct contributions of WM to metaphor as well as to scalar implicature. However, the authors pointed the need to include additional EF subcomponents in future studies to better understand the EF involvement in pragmatic inference.

Results from studies on clinical population are still controversial, and a consistent picture of the relationships between EF and pragmatics in children and adults with psychiatric or neurological disorders is yet to emerge.

As reported in a recent review on pragmatic ability in children with neurodevelopmental disorders (Matthews et al., 2018) many

studies assume that executive problems are associated with pragmatic difficulties. For example, a correlation between performance on the pragmatic tasks and EF was found in children with ASD (e.g. Akbar et al., 2013; Pellicano, 2013) and in children with inattentive or hyperactive-impulsive symptoms (e.g. Rints et al., 2015). However, the studies have failed to yield converging evidence for clear and reliable relationships between EF and pragmatics (see Matthews et al., 2018).

In the literature on adult patients, the role of EF in explaining pragmatic abilities was described in clinical populations with TBI. Inhibitory processes and cognitive flexibility seem to contribute to the explanation of pragmatic abilities in individuals with TBI (e.g. Channon & Watts, 2003; McDonald et al., 2014). Recently, Bosco and colleagues (Bosco et al., 2017) supported these findings. In fact, the authors described the role of WM, cognitive flexibility and planning in pragmatic impairments. On the contrary a number of studies, disconfirmed these results in patients with TBI (e.g. Martin & McDonald, 2005) and they reported the lack of association between EF and pragmatics.

Similar inconsistent results emerge in other clinical populations such as schizophrenia. While several authors showed the involvement of EF in pragmatic abilities in adults with schizophrenia (e.g. Bambini et al., 2016; Thoma et al., 2009), some studies suggested that no relationship exists between EF and pragmatic competence (Champagne-Lavau & Stip, 2010; Langdon et al., 2002). Even if pragmatic deficits often co-occurs with lack of inhibition and flexibility, it seems that pragmatics in schizophrenia cannot be completely explained by executive dysfunction.

Interestingly, Poletti (2011) introduced a new neurocognitive model based on the influence of EF and ToM on pragmatic language abilities. The assumptions include both the role of every single component on pragmatic language and the role of EF (WM and inhibitory control) mediated by ToM. According to this model, EF deficits, inhibitory control problems, in particular, may impair the development of the pragmatic language ability through direct or indirect processes. The direct process assumes that inhibitory control effects on language determining difficulties in the mechanism of suppression. The indirect way considers the influence of EF deficits on ToM abilities and the consequent influence of ToM on pragmatic language. The model seems to be useful to explain the complexity of pragmatics and the differences in cognitive and social outcomes in individuals with different clinical disorders and pragmatic difficulties.

The aforementioned theories, as well as the pragmatic difficulties, have been studied in different neurodevelopmental and neurological disorders, e.g. ASD, Developmental Language Disorders (DL) and Schizophrenia (e.g. Bambini et al., 2016; Frith, 1992; Happe, 1993).

Unexpectedly, pragmatic abilities in patients with Specific Learning Disorders (SLD) have remained nearly unexplored. SLD are typically defined in terms of difficulties with reading, spelling, writing and mathematics (American Psychiatric Association, 2013). According to previous studies, SLD also seem to be linked with impairments in EF, in particular in WM functioning (Smith-Spark et al., 2016; Varvara et al., 2014). To the best of our knowledge, only few studies have focused on the pragmatic competence in children with SLD (Ferrara et al., 2020; Lam & Ho, 2014). The data, collected through structured questionnaires completed by parents, reported lower pragmatic abilities in children with SLD compared to their peers. Interestingly, Cardillo (Cardillo et al., 2018) found that both pragmatics, the comprehension of metaphors in particular, and ToM were crucial variables in identifying children with SLD from their typically developing children.

As far as we know only two studies focused on adults with SLD (Cappelli et al., 2018; Griffiths, 2007). Overall, the data showed differences in pragmatic tasks between university students with dyslexia (DD) and control group, with students with DD performing worse than their peers without DD. Cappelli et al. (2018) also found correlations between performance in pragmatic tasks and other cognitive abilities such as reading, vocabulary and WM but not with ToM and other EF. Given the limited studies, we focused on young adults with SLD.

Moreover, exploring the link between pragmatics and SLD and assessing whether the pragmatic difficulties observed in children with dyslexia persist into adulthood seems to have important clinical implications. In fact, pragmatic abilities are likely to be relevant not only for the comprehension of non-literal language, but for social life as well (Matthews et al., 2018). The impact of communicative and pragmatic impairments on social life has been described by several authors in the typical population and in different neurodevelopmental and psychiatric disorders (Cummings, 2014). According to some studies, pragmatic abilities in typically developing (TD) and atypically developing children, are positively correlated with psychological well-being, peer popularity and cooperativeness level and negative correlated with socio-emotional distress, behavioral difficulties and mental health problems (Camia et al., 2021; Helland et al., 2014; Murphy et al., 2014). Similarly, Whitehouse et al. (2009) found that more than half of adults with a history of pragmatic language impairment (PLI) did not have any close friendships at all and that the quality of friendships in these adults was significantly poorer than adults without any clinical condition. Studies regarding the psychological impact of pragmatic disorders in adults showed that impairments in pragmatic skills that appear in childhood have a long-term impact on relationship formation (Whitehouse et al., 2009), employability (e.g. Eaves & Ho, 2008), and behavioral, social, and emotional problems (e.g. St Clair et al., 2011). Recently, Bambini et al. (2016) found relationships between pragmatics and quality of life (QoL) in a sample of adults with schizophrenia. The analyses showed that the pragmatic abilities predicted the QoL. To the best of our knowledge, pragmatic competences in young adults with SLD have never been correlated with their QoL. According to previous studies the presence of SLD, seems to determine a higher vulnerability to externalizing behaviors, internalizing symptoms and lower psychological well-being (e.g. Benassi et al., 2022; McNamara et al., 2008; Scorza et al., 2018).

Thus, the investigation of the relationship between pragmatic abilities and other psychological domains in people with SLD seems to be an important challenge in order to better understand their functioning and to define effective support.

Addressing gaps in the existing literature about adults with SLD, the present work had three main goals.

Firstly, we examined pragmatic comprehension in young adults with SLD. We aimed at expanding the limited data on this clinical population (Cappelli et al., 2018; Cardillo et al., 2018). Based on previous findings we hypothesised that pragmatic comprehension,

figurative language in particular, represents a significant challenge for young adults with SLD.

The second goal was to examine how ToM and EF affect pragmatic comprehension in these young adults with SLD. Until now, there has been no clear conclusion on the relationship between pragmatic aspects of language and other cognitive functions in adults with SLD as well as in typically developing adults. Thus, since previous research is still scant and inconclusive, we preferred not to formulate a predictive hypothesis concerning the relationships between these domains.

The third goal was to analyze the effect of pragmatics abilities on the quality of life in young adults with SLD. To the best of our knowledge, this is the first study exploring the link between pragmatic abilities and QoL in young adults with SLD. According to previous literature on healthy subjects and on other clinical population, we hypothesized a significant influence of pragmatic abilities on QoL also in adults with SLD.

2. Method

2.1. Participants

Fifty-six young adults took part in the study: 26 young adults who had been diagnosed with Specific Learning Disorders (SLD group) by experienced clinicians (*mean age* = 20; *SD* = 1.9) and 30 typically developing adults (*mean age* = 23; *SD* = 2.5) as the control group (C group). The years of education for SLD group was 14.35 (*SD* = 1.1) and for the control group were 15.13 (*SD* = 2.0); the years of education were not significantly different between the two groups when compared with Mann Whitney test ($U = 347.5$; $p = .473$; $r = 0.096$) (see Table 1 for sample's details).

Adults with SLD were recruited from the Specific Learning and Disabilities Service of the University and from private clinical centers in Italy. All participants received a diagnosis based on the ICD-10 (World Health Organization, 1993) coding system and met the criteria indicated in the National Italian Consensus Conference on SLD published by the Italian Ministry of Health (Istituto Superiore di Sanità, 2010). The diagnoses of SLD were distributed as follows: 42.3% ($n = 11$) with dyslexia, 15.4% ($n = 4$) with dyslexia and dysorthography, and 42.3% ($n = 11$) with mixed disorder (dyscalculia + dyslexia + dysorthography).

The controls were selected from the general population. To exclude any possible difficulty due to specific medical conditions, we defined as exclusion criteria the presence of major neurological or psychiatric history. Finally, none of the participants had visual or hearing impairments, and all the subjects were Italian native speakers.

2.2. Procedure

The study was conducted in accordance with the Declaration of Helsinki. The participants were informed in detail about the aims of the study, the voluntary nature of their participation, their right to withdraw from the study at any time and provided their informed written consent for participation in the study, data analysis, and data publication.

The tests were administered individually by a psychologist, in a quiet room during a 2-h session in which pragmatic abilities were assessed using APACS test Arcara & Bambini, 2016, ToM and EF were measured using the following tests: Imposing Memory Task (IMT, Kinderman et al., 1998; Italian version by Valle et al., 2015) and Story based Empathy Task (SET; Dodich et al., 2015) for ToM; Digit Span (DS) subtest of the Italian adaptation of the WAIS-IV (Orsini & Pezzuti, 2013) and Stroop Test (Caffarra et al., 2002) for EF. QoL was assessed with a standardized and validated questionnaire, PedsQL™ 4.0 self-report (Varni & Limbers, 2009), completed at home by the subjects and sent back to the clinicians after one week.

2.3. Measures

2.3.1. Pragmatic abilities

Pragmatic of language was evaluated with APACS (Arcara & Bambini, 2016). We measured only the comprehension of pragmatics, and therefore we chose the four APACS subtests evaluating this domain.

- The “Narratives” task measures the ability to answer questions about narrative texts. It consists of 6 stories, inspired by real news articles, with increasing length and complexity. The stories are read aloud and at normal rate by the clinician to the subject. For each story, subjects are asked to answer an open question about the global topic of the story (rated 1 when correctly answered or 0), 2–4 yes-no questions about specific elements of the story (rated 1 when correctly answered or 0) and 2 questions requiring a verbal

Table 1
Socio-demographic characteristics of the SLD and the control groups.

	SLD group ($n = 26$)	C group ($n = 30$)
Male	7	9
Female	19	21
Workers (with college degree)	2	10
Workers (with bachelor's or master's degree)	1	4
University students	23	16
Mean age (SD)	20 (1.9)	23 (2.5)

explanation of 2 non-literal expressions included in the story (rated 2, 1, or 0 according to the level of the accuracy of the explanation). The maximal global score is 56.

- The “Figurative Language 1” task assesses the ability to infer non-literal meanings. Fifteen sentences are presented to the subjects, which have to choose between three possible interpretations. Options include one correct interpretation, and two incorrect interpretations (one literal and one unrelated with respect to the target word). Each item scores 1 or 0, and the maximal score is 15.
- The “Humor” task measures the ability to understand verbal humor. It consists of five brief stories with three possible endings each. The subject is asked to select the correct alternative (rate 1 when the answer is correct or 0).
- The “Figurative Language 2” that assesses the ability to understand familiar idioms, novel metaphors, and common proverbs. The subtest includes 15 items (5 highly familiar idioms, 5 novel metaphors and 5 common proverbs). The instruction is to explain the meaning of each expression. Three scores are possible: 2 when the subject describes the actual meaning of the figurative expression, 1 if the subject provides an incomplete explanation, 0 when the subject fails to explain the meaning (e.g. using paraphrases of the figurative expression or providing a literal explanation) (maximal score: 30).

Finally, a composite score, the “Pragmatic Comprehension” score (PCS), was derived from the four subtests. It was obtained transforming the original tasks’ scores in proportions, and averaging these proportions.

2.3.2. Theory of Mind

Mental state attribution skills were assessed with two tasks. First, we selected a non-verbal task, the Story based Empathy Task (SET) (Dodich et al., 2015) measuring the attribution of intentions and emotional states represented by comic strip. The test includes two main experimental conditions (identifying intentions, SET-IA and emotional states, SET-EA), and a control condition entailing the inference of causality reaction based on the knowledge of the physical properties of objects and human bodies (SET-CI). Each condition includes 6 stories. The subjects are asked to select the one out of three presented endings. The total score for each condition is calculated summing the number of correct answers given by the subjects for each cartoon (1 point for a correct answer, 0 for incorrect choice). The global score (SET-G) for the task is 18.

Second, we used the Italian version of the Imposing Memory Test (IMT) (Valle et al., 2015) in order to measure verbal ToM. IMT is composed of a series of four mentalistic stories and one control story. In each mentalistic story the perspective and the intentions of the characters could be understood only with effective recursive thinking. The subject is asked to choose the correct sentence between two possible alternatives, one true and one false: one correct and one incorrect. The questions collectively assess different levels of recursive thinking (from the first level to the fifth level of complexity). The total score, obtained by the sum of the score of all levels, has been proportioned and the possible score range is from 0 to 1.

2.3.3. Executive functions

Working memory was assessed with the Digit Span (DS) subtest of the Italian version of the WAIS-IV battery (Orsini & Pezzuti, 2013). The subtest included three tasks: the digit span forward, the backward and the sequencing.

The ability to inhibit cognitive interference was measure with the Stroop Test (Caffarra et al., 2002). The test includes 3 conditions: reading, naming, and color-word interference. The reading and naming conditions are used to measure the speed of information processing. The color-word interference condition is a measure of EF, in particular of the inhibitory control ability. Two scores are obtained. The first refers to the time interference effect (based on execution time, Stroop Test-Time), the second to the error interference effect (based on the number of errors, Stroop Test-Errors).

2.3.4. Quality of life

QoL was evaluated with the PedsQL™ 4.0 self-report (Varni & Limbers, 2009). The subject is asked to answer 23 items referring to problems during the past month. The items are grouped into 4 multidimensional scales: physical functioning (8 items) (QoL P), emotional functioning (5 items) (QoL E), social functioning (5 items) (QoL S), and school/work activities (5 items) (QoL W). These four scales could be grouped into 3 composite scores: a General Score (23 items) (QoL G), a Physical Health Summary Score (8 items) and a Psychosocial Health Summary Score (15 items). Among these composite scores, in the present study, we considered only the QoL G.

3. Statistical analyses

All statistical analyses were carried out using SPSS 23.0 for Windows with an alpha level of 0.05. Preliminary analyses were conducted to examine the distribution of the variables using the Kolmogorov-Smirnov test. With regard to the first goal, as some variables were not normally distributed, Mann Whitney tests were conducted to assess potential differences in APACS subtests scores between the adults with SLD and control group. The Effect sizes (r) for Mann–Whitney U tests were calculated using the formula $r = \frac{z}{\sqrt{N}}$ where N is the total number of participants in the whole sample; the standard values of r for small, medium and large effect sizes are 0.1, 0.3, and 0.5 respectively (Field, 2009, p. 550). To prove the second hypothesis, a Generalized Linear Model was applied to evaluate the interaction effect group by EF and group by ToM abilities on the pragmatic abilities. The Generalized Linear Model allows studying the main effect of the group on pragmatic abilities and the interaction effect group by EF and ToM on pragmatic abilities. In the Generalized Linear Model, the APACS total score was used as the dependent variable, the Group (SLD vs C) was used as a subject factor, and the EF (Digit Span, Stroop Test-Time and Stroop Test-Errors) and ToM (Story based Empathy Task and Imposing Memory Test) subscales were used as continues factors (covariates). The Generalized Linear Model assumes that the dependent variable is linearly

related to the factors and covariates via a specified link function. The effect sizes (Cramer's V) for Wald Chi-Square tests were calculated using the formula $V = \sqrt{\frac{\chi^2}{n \cdot df}}$ where df are the degrees of freedom and n is the number of subjects. The standard values of Cramer's V for small, medium and large effect sizes are 0.1, 0.3, and 0.5 respectively (Cohen, 1988). Moreover, the model allows for the dependent variable to have a non-normal distribution.

With regard to the third goal, a Multivariate Analysis of Covariance (MANCOVA) was performed to explore the effect of pragmatic abilities on the QoL in SDL and C group. The QoL subscales (QoL G, QoL P; QoL E; QoL S; QoL W) were considered as dependent variables, the group (SLD and C) as between-subject factor and the Pragmatic Comprehension (PCS) as the covariate. The analysis allowed evaluating the effect of pragmatic abilities on the QoL and the effect of SLD on QoL (independently from the pragmatics abilities).

4. Results

4.1. Pragmatic abilities in young adults with SLD compared with C group

Descriptive data are presented in Table 2. Using the Mann Whitney test, we found significant differences in the PCS and 3 out of 4 pragmatic tasks: Narratives, Figurative Language 1 and Figurative language 2. Compared to the control group, adults with SLD performed significantly lower in all of these tasks (see Table 2). No significant difference was found between the SLD and C group in Humor task (see Table 2). In order to test the hypothesis of a pragmatic deficit in adults with SLD, we conducted a descriptive analysis of the number of subjects who fell under the cut-off score on APACS test. Fifteen out of 26 (58%) adults with SLD demonstrated a performance below the cut-off in the PCS and 22 (85%) of them had a score below the cut-off in the Figurative Language 2 task. By contrast, only 2 (6%) adults of the control group performed below the cut-off in the PCS and in the task evaluating the comprehension of metaphors (Figurative Language 2).

4.2. Effect of ToM and EF on pragmatic abilities

The Generalized Linear Model returned significant level (Likelihood Ratio Chi-Square=44.27; $p < .001$; Cramer's $V=0.27$) attesting the fact that the factors considered (group, EF and ToM) significantly affected the Pragmatic Comprehension (PCS) when taken together. The effect of the group per se was not predictive of Pragmatic Comprehension (see Table 3). Only when considering the presence of SLD in interaction with Story-based Empathy Task (SET), a higher level of PCS was found in SLD group compared to control group (SLD (b)= 0.604; C(b)= 0.595). This result assumed that only in the SLD group, the effect of SET significantly improve the pragmatic abilities.

4.3. Relationships between pragmatics and quality of life

The MANCOVA showed a significant difference between SLD and C adults on QoL as a general effect ($F_{(5, 46)} = 3.982$; $p = .004$, Partial $\eta^2 = .302$). In particular, the SLD group showed a lower QoL S level and a significantly lower level of QoL W compared to C group (see Table 4) independently from the subject's pragmatic abilities. The PCS significantly predict the QoL if the different subscales were taken together ($F_{(5, 46)} = 2.634$; $p = .035$, Partial $\eta^2 = .223$). No significant effects were found for the single QoL subscales (see Table 4).

5. Discussion

This study aimed to shed light on pragmatic abilities in young adults with SLD. In particular, we focused on the comprehension of pragmatics (irony, narratives and figurative language) as a possible domain of deficit and target of clinical evaluation and intervention.

With regard to the first purpose, our results support the hypothesis of a pragmatic impairment in young adults with SLD; in fact, pragmatic comprehension was widely compromised in the group of adults with SLD. This evidence is consistent with our first

Table 2

Mean performance (and standard deviations) in the APACS comprehension tasks and comparison between the performance of adults with SLD and controls.

APACS tasks and composite score	SLD group Mean (SD) ($n = 26$)	C group Mean (SD) ($n = 30$)	Mann Whitney <i>U p r C I</i>			
Narratives (max score 56)	51.15 (4)	53.83 (1.94)	235	.010	-0.34	.000 – 4.000
Figurative Language 1 (max score 15)	14.46 (0.7)	14.93 (0.25)	235	.001	-0.43	.000 – 1.000
Humour (max score 7)	6.26 (0.87)	6.46 (0.77)	377.5	.335	-0.12	.000–1.000
Figurative Language 2 (max score 30)	19.61 (3.3)	25.97 (1.97)	38	< 0.001	-1.74	4.000–9.000

Note: Significant results are in bold.

Table 3
Effect of SLD and interaction effect between SLD and FE and SLD and ToM on Pragmatic Comprehension.

	PCS		
	Wald's Chi ²	p	Cramer's V
SLD	.000	.998	.000
SLD by DS	1.446	.485	.116
SLD by Stroop_E	1.560	.458	.120
SLD by Stroop_t	3.573	.168	.182
SLD by SET	6.276	.043	.241
SLD by IMT	2.256	.324	.145

Note: PCS: Pragmatic Comprehension; DS: Digit Span; Stroop_E: Stroop Test-Errors; Stroop_t: Stroop Test-Time; SET: Story based Empathy Task; IMT: Imposing Memory Test.

Significant results are in bold.

Table 4
Estimated marginal means (and standard errors_SE) of QoL subscales in young adults with SLD and control (C) group.

	SLD group Mean (SE)	C group	F	p	Partial η^2
QoL G	74.730 (2.093)	80.280 (1.784)	3.394	.071	.064
QoL P	81.633 (2.482)	82.519 (2.115)	.0620	.805	.001
QoL E	60.094 (3.363)	61.261 (2.861)	.0580	.810	.001
QoL S	80.693 (2.773)	91.469 (2.363)	7.290	.009	.127
QoL W	72.357 (2.593)	84.526 (2.210)	10.631	.002	.175

Note: Covariates appearing in the model are evaluated at the following value: PCS= .904.

QoL G: Quality of Life_General Score; QoL P: Quality of Life_physical functioning; QoL E: Quality of Life_emotional functioning; QoL S: Quality of Life_social functioning; QoL W: Quality of Life_school/work activities

Significant results are in bold.

hypothesis and with other studies (Cappelli et al., 2018; Griffiths, 2007) that showed difficulties in understanding the pragmatic aspects of language in university students with DD. Analyzing our data, we observed that the main difficulty concerned the comprehension and the verbalization of the meaning of figurative language (metaphors and proverbs). These findings are similar to those found by Cappelli and colleagues (Cappelli et al., 2018). The authors described a poorer performance in university students with DD compared to healthy university students in all pragmatic domains, and they found more severe impairments in the tasks evaluating the understanding of figurative language (Figurative Language 1 and Figurative Language 2 of APACS test). Deficits in the pragmatic of language were found in children with DD as well (Cardillo et al., 2018). These children with DD showed more difficulties in the understanding of metaphors and idioms compared to their TD peers. Pragmatic difficulties were also described by parents of children with DD (Ferrara et al., 2020; Lam and Ho, 2014). Consistent with this literature, our data seem to confirm that the difficulties in pragmatics are life long in SLD continuing to characterize these people also in adulthood.

The second goal of our study was to analyze the relationship between pragmatic abilities and other cognitive domains, namely ToM and EF. The rationale behind this second aim referred to the traditional hypothesis of problems in the pragmatics of language as related to impairment in other cognitive and socio-cognitive domains, especially EF and ToM deficits (Martin & McDonald, 2003), and to literature that shows that these relationships between different domains could vary across clinical populations (Bambini et al., 2016).

Concerning the social cognition domain, we found that in SLD group pragmatic comprehension abilities were related to the performance in the SET test, measuring attribution of intentions and emotional states. The only study that to our knowledge investigated this relationship in adults with DD was those by Cappelli et al. (2018) in which the authors did not find any correlation between ToM (SET task) and pragmatics evaluated with APACS test. Thus, our results provide new evidence supporting the association between pragmatics and ToM in adults with SLD.

Previous works have hypothesized that the link between metaphor interpretation and ToM progressively loses strength from childhood to adulthood in the healthy population (Lecce et al., 2019), whereas it remains strong in the neurodevelopmental disorders and in other clinical conditions such as schizophrenia (e.g. Bosia, 2015; Champagne-Lavau & Stip, 2010). Our data are congruent with these researches. Interestingly, in our study, pragmatic abilities in adults with SLD are in relationship with visual ToM and not with verbal ToM. A likely scenario is that in this clinical population, pragmatic comprehension abilities do not ground on semantic knowledge, often reached by reading, that is usually used by young adults to interpret others intention (Carriedo et al., 2016). Moreover, according to this evidence, it seems that pragmatic deficits cannot be completely explained by ToM abilities; instead, pragmatic difficulties appear to exist in adult with SLD independently of ToM (Bosco et al., 2018).

Another main result of this study regards the relationship between pragmatic comprehension and EF. Until now, there have been mixed results, and the literature on different populations remains contradictory. Some studies showed an association between pragmatic abilities and EF (Channon & Watts, 2003), whereas others did not (Martin & McDonald, 2005). In the typical population, verbal reasoning, updating in WM and inhibition have been related with language (e.g. Pettenati et al., 2015;) and metaphor interpretation (Lecce et al., 2019; Matthews et al., 2018); however, the strength of the relationship between EF and pragmatics seemed to decrease

from childhood to adulthood (Carriedo et al., 2016). Our data support the hypothesis of a plausible co-occurrence of EF impairments and pragmatic difficulties without correlation between them (Champagne-Lavau & Stip, 2010). In fact, we did not observe any relation between pragmatics and EF neither in adults with SLD nor in the control group (Fairchild & Papafragou, 2021). This finding is consistent with the result reported by Cappelli et al. (2018) in university students with DD; the authors did not find a link between pragmatics and high-level EF. More generally, our result is in accordance with Karmiloff-Smith's model of the progressive modularization and specialization of cognitive skills (Karmiloff-Smith, 1995).

Regarding the last aim of the study, adults with SLD showed an impaired QoL compared to C group. More specifically, adults with SLD reported significantly lower scores in the quality of the relationship with peers and in their work or studying setting than in controls. The differences between SLD and C group in the QoL subscales are found net of pragmatic abilities, ie they do not depend on the pragmatic skills of the subjects belonging to the two groups. These results are consistent with the literature that reports in patients with DD difficulties in finding friends or maintaining relationships (Gennaro et al., 2019), which could be due both to negative attitudes towards individuals and to cognitive impairments (Lisle & Wade, 2013; Livingston et al., 2018). Furthermore, the PedsQL™ scale concerning problems in work or studying mainly refers to planning activities and to organizing materials, and these aspects represent broad challenges for SLD adults due to their deficit in EF, WM in particular. These cognitive impairments, combined with increased feelings of nervousness, frustration and uncertainty during testing and working, have been considered a key contributor to decrease success (Heiman & PreceL, 2003). Moreover, not all the students or employees of the SLD group had the possibility to use strategies such as assistive technologies, learning technologies and support services in their university/work setting; this lack may have hindered their well-being in the study/work environment (MacCullagh et al., 2017). We also explored the relationship between pragmatic abilities and QoL. The results showed a link between pragmatics and general QoL independently from the presence of SLD. To the best of our knowledge, there are no data on literature concerning the possible effect of pragmatics on daily functioning in adults with SLD, and our study is the first in this direction. Previous studies on neurological and psychiatric patients reported relationships between pragmatic abilities and QoL (Galski et al., 1998). Interestingly, data from patients with schizophrenia (Bambini et al., 2016) suggested that performance in pragmatics, measured as APACS Total score, predicted quality of life. Our findings are in line with this evidence and support the interaction between pragmatic deficits and QoL. The observation of this relationship is of extreme interest for its potential clinical relevance as the interventions on pragmatic abilities could in turn, improve the patients' QoL. Unexpectedly, we did not find a strong relationship between pragmatics and any of the QoL aspects if considered separately. Thus, more research is needed to better understand the pragmatic factors that influence the QoL of adults with SLD.

The present study contains some limitations that need to be mentioned. We explored only pragmatic comprehension. Future studies should explore pragmatics production as well, investigating its relationship to cognitive skills and psychological aspects in adults with SLD. Another limitation regards our sample size that was relatively small, with a prevalence of university students in both groups (in the SLD group in particular) and of female rather than male adults. Future research with a larger and more heterogeneous sample would be interesting.

In conclusion, the main contribution of this study regards the description of impairments in the pragmatic competence in young adults with SLD. The main deficit concerns the comprehension of figurative language that remains a challenge in adulthood in these patients. Moreover, the study contributes to shedding light on the relationship between pragmatics, ToM and EF. The findings support recent hypotheses of close relationships between pragmatics and ToM, in clinical populations. Finally, this study provides new evidence showing impairments in the QoL of adults with SLD and their link with pragmatics. Taken together, these results highlight the importance of including in the clinical assessment of patients with SLD the evaluation of pragmatic abilities and of considering the pragmatic skills in the intervention plans. In fact, these difficulties appear still underestimated and rarely evaluated in clinical settings.

What this paper adds?

This study contributes to expand the knowledge on language pragmatic, behavioral and socioemotional difficulties in young adults with SLD. Despite pragmatics represents a domain of potential difficulties in children and adults with SLD, only few studies have investigated the comorbidities between pragmatic impairments and SLD. Furthermore, previous research on the relationship between pragmatics and other cognitive domains (i.e. ToM and EF) has focused mainly on children and findings on young adults with SLD remain scarce. Finally, to the best of our knowledge, this is the first study investigating the association between pragmatic language abilities and quality of life in young adults with SLD. Research on this topic for young adults with SLD is needed, as SLD has been described as lifelong condition associated with higher vulnerability to psychological problems.

Our results showed pragmatic language impairments in young adults with SLD and indicate a link between pragmatic comprehension and visual ToM. Interestingly, we also found that pragmatic abilities and quality of life are associated in young adults with SLD. Our findings highlight specific implications for clinical and support services, suggesting that pragmatic abilities should be included in the assessment of SLD.

CRedit authorship contribution statement

Michela Camia: Conceptualization, Data curation, Methodology, Writing - original draft, Writing - review & editing. **Erika Benassi:** Writing - review & editing. **Sara Giovagnoli:** Formal analysis. **Maristella Scorza:** Supervision.

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Conflict of interest

The authors report no conflict of interest.

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