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Research Report

Mental verbs and pragmatic language difficulties

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Abstract

Background: Pragmatic language impairment has recently been the subject of a number of studies that attempted to illuminate classification and diagnostic issues, and identify the profile of children with pragmatic language difficulties. Although much progress has been made, the nature of pragmatic difficulties remains unclear.
Aims: To contrast typically developing children with those with pragmatic difficulties and specific language impairment as well as their ability to produce and comprehend pragmatic inferences about given or presupposed knowledge in mental state verbs; and to explore the general hypothesis that children with pragmatic difficulties make some, but not all, of the pragmatic inferences necessary for successful communication.
Methods & Procedures: Study groups consisted of 18 children with pragmatic language difficulties, 28 children with specific language impairment and 40 typically developing children. The groups were matched on non-verbal intelligence and age and differed in verbal intelligence, language achievement and pragmatic ability.
Outcomes & Results: The language-impaired groups performed significantly more poorly than typically developing children on all mental verb measures. In addition, significant differences between specific language impairment and pragmatic difficulties groups were found in composite score performance, but not on individual test performance.
Conclusions: Both inferential mental verb tasks (pragmatics) and non-inferential mental verb tasks (semantics) were more difficult for the children with language impairments compared with typically developing peers. Inferential and non-inferential abilities showed significant differences between the two language-impaired groups in favour of the children with specific language difficulties. Children's Communication Checklist scales in conjunction with mental verb measures were found to classify the three groups well.

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Introduction

According to Bloom and Lahey (1978), language consists of three fundamental components: form, content and use. The form and content components characterize the structure of language; the use component of language pertains to the ability to integrate language and contexts. The use of language belongs to the field of pragmatics. Pragmatic skills are concerned with inferring meanings from the 'context' (extra-linguistic sources of information), such as speaker intentions, listener's knowledge, attentional focus, etc. Pragmatic skills bridge language with communication in that the ability to communicate relies, to a great extent, upon pragmatic skills. In this sense, the 'pragmatic system' of either language or communication complements the structural aspects of language. The focus of this paper is on school-aged children whose 'pragmatic system' of language is defective.

The classification and terminology in the topic of developmental language disorders has been a matter of controversy and much debate (Hall and Aram 1996). The lack of consensus on an acceptable system of classification and terminology stems partly from the fact that different scientific fields are involved (neurology, psychiatry, psychology, paediatrics, pedagogy) in studying developmental language disorders, and partly by virtue of the complex nature of developmental language disorders. Thus, some theorists argue there is a group of children who demonstrate deviant language development although their cognitive, neurological and sensory status is at the normal level (Bishop 1997, Leonard 1998). Children with this abnormal developmental language profile are characterized as specific language impaired (SLI). In turn, SLI emerged as a highly heterogeneous disorder and the differentiation of language-impaired children constitutes an issue of great theoretical and practical interest.

In particular, one diagnostic category of developmental language disorder that has drawn the attention of researchers in the last two decades is the so-called 'semantic–pragmatic disorder' (SPD) (Rapin and Allen 1983, Bishop and Rosenbloom 1987) or 'pragmatic language impairment' (PLI) (Conti-Ramsden and Botting 1999, Bishop 2004). According to this taxonomy children with SPD exhibit higher-level language impairments, i.e. they present word-finding difficulties, narrative deficits, comprehension deficits, over-literalism, poor inferential ability, and difficulty to remain within the current topic during a conversation. Because children in the SPD subgroup present an unclear nature of deficits, the differential diagnosis is thought difficult to establish consistently. Specifically, because of this difficulty some researchers attempt to differentiate children with pragmatic difficulties from autistic spectrum children (Botting and Conti-Ramsden 2003) and/or children with other developmental disorders (e.g. ADHD) (Geurts *et al.* 2004); whereas some others are inclined to discriminate children with pragmatic difficulties from children with specific language impairment (SLI) (Bishop and Baird 2001).

In line with the reasoning adopted by the first stream of research, genetic (Tomblin *et al.* 2003) and phenotypic findings (Kjelgaard and Tager-Flusberg 2001) show, indeed, that there are similarities between autistic and non-autistic children having semantic–pragmatic deficits on language development. This evidence may

offer further support to those investigators who argue that individuals with semantic–pragmatic disorder cannot be distinguished from those with autism (Gagnon *et al.* 1997).

According to some other investigators (Conti-Ramsden *et al.* 1997, Conti-Ramsden and Botting 1999) there are children whose pragmatic ability is significantly better compared with their structural language, evidence which suggests that the two faculties are dissociable, to some extent, or pragmatics can be separate or even coincide with other language difficulties (Bishop 2000). Further, in children who show pure specific language impairment the deficits are localized mainly in structural aspects of language, namely morphosyntax and lexical ability (Bishop 2000). Also, research into Cypriot Greek speaking children with SLI has revealed that they show morphosyntactic deficits in placing clitics in a non-adult post-verbal position (Petinou and Terzi 2002), while data on standard Greek speaking children with SLI indicated significant differences compared with typically developing children in assigning adult-like thematic roles in processing relative clauses (Stavrakaki 2001). More recently, Bishop (2000) and Bishop and Frazier Norbury (2002) theorize that the SLI group could be divided into two subgroups, one with pragmatic difficulties placed in the autistic spectrum and a second with pure structural language impairment; the latter is also referred to as children with typical SLI (cf. Conti-Ramsden and Botting 1999, Adams 2001).

Another approach to conceptualize that language disorders are based on the differentiation between primary and secondary impairments (Bishop 2000), where the former is the cause of the latter. Accordingly, pragmatic difficulties could be secondary impairments, i.e. the outcome of primary deficits in structural aspects of language and/or cognition. Thus, pragmatic functions are considered the most complex aspect of language because they require collaboration or synergy of all levels of language, and draw upon the interaction between cognition and language. The debate about the possible mechanisms underlying pragmatic dysfunctions, therefore, reflects all possible failures that could produce pragmatic disturbances.

In conclusion, one would maintain the argument that research and theoretical discussion about the possible causes of pragmatic impairment is extremely interesting, insofar as it could shed light on the relations between language levels, the relations of language ability, and social cognition, and broadly speaking on the relations of language development with cognitive development.

Pragmatic language difficulties, mental verbs, cognition and the concept of Theory of Mind

Martin and MacDonald (2003), in an effort to address some of the most significant issues in the literature of pragmatic disorders, concluded that highly complex constructs such as Theory of Mind, which are clearly associated with pragmatic ability, should be the focus of research if one wishes to account for the causes of communication impairments. According to Harris *et al.* (2005) there is a clear link between Theory of Mind and the language of mental state terms, namely the ability to talk about feelings, beliefs, intentions, and other internal states of self and others emerges at about the third year of age and continues to develop throughout adult life. The emergence and development of children's mental state language co-occurs and is associated with a host of other specific abilities, namely empathic concern for

others, increasing awareness of social rules, and other self-awareness and self-other differentiation skills (Beeghly and Cicchetti 1997). There is a wealth of evidence on the close link between Theory of Mind and language development, in general. Moreover, the role of mental state terms renders plausible Ruffman's (2000) suggestion that general language ability, at the syntactic and semantic level, influences implicit Theory of Mind-related knowledge. Harris *et al.* (2005) evaluated three mechanisms by means of which language is associated with Theory of Mind and proposed that the pragmatic aspects of language seem to play a key role in relating language with Theory of Mind. Mental state terms, and especially mental verbs, constitute a link between language, social cognition and Theory of Mind (Hughes and Leekam 2004).

At age 3–4 years, children begin to use and comprehend mental state verbs. A number of studies provide evidence that development of an understanding of mental states continues during the school years (Naigles 2000). Mental state verbs have interesting semantic, syntactic and pragmatic aspects. From the semantic point of view, mental verbs constitute a large part of the terms related to the 'language of mind' (Astington 2000). The language of mind or the mental states lexicon consists of expressions of desire, belief and intention, which appear to play a central role in fundamental developments associated with emerging self-awareness and interpersonal understanding. Insofar as the syntax of mental verbs is concerned, there is an ongoing debate that a specific language structure, sentence complementation, plays a role in Theory of Mind. Some researchers (De Villiers and Pyers 2002) propose that this specific language structure provides a representational tool for embedded propositions. They argued that the computation of false beliefs presupposes the ability to entertain embedded propositions. Furthermore, mental verbs have multiple pragmatic functions, such as connecting words to real world knowledge (e.g. understanding what the use of mental verbs presupposes), maintaining text coherence (e.g. bridging the unstated events in text), elaborating the text in order to achieve a richer mental model (e.g. by figurative language), and indicating the speaker's attitude toward the statement in the subordinate clauses, e.g. marking the degree of speaker's certainty (Montgomery 2002).

In summary, knowledge regarding the contribution of pragmatic disabilities in differentiating types of developmental language disorders is still at its early stages. The use of language appears to be an area of particular difficulty for many children with developmental language disorders. The identification of the subtype of semantic–pragmatic disorder remains controversial. Shields *et al.* (1996), for example, found that children with semantic–pragmatic difficulties were outperformed by normally developing children and language-impaired children with problems in phonology and syntax on a Theory of Mind measure. Dennis *et al.* (2001) in a small sample study of high-functioning children with autism (HFA) concluded that although HFA children appear to be capable, to a certain extent, to understand mental verbs and make inferences from mental verbs to given knowledge, they often fail to make contextual inferences about thoughts. Conversely, Miller (2004) found that children with SLI performed similarly to age-matched peers on a Theory of Mind measure, but performed more poorly on understanding of sentence complements. However, Miller's results are rather puzzling because the participants studied were preschool children with problems in morphosyntax and phonology.

Thus, in spite of substantial research conducted in this area, it is still unclear whether pragmatic difficulties characterize all children with SLI, or only a subgroup

with specific characteristics, and whether all of the members of this latter subgroup have autistic characteristics. Also, there is room for research of the developmental pathways taken by children with language disorders in their acquisition of language of mind. There is still much to be learned about the causal relationships of linguistic and pragmatic knowledge and particular components of Theory of Mind in typically and language-disordered children.

Current study

The present study was designed to do the following. (a) To investigate the possibility of deriving different subgroups within a pool of children with language impairments on the basis of *mentalizing ability*, as it is measured through mental verbs; it is worth of noting that with the term 'mentalizing ability' we refer to someone's ability to produce and comprehend words of mental state language, in other words the ability to use and understand words that refer to cognitive states, desires, and emotional states. (b) To investigate the hypothesis proposed by Bishop (2000) that there is a subgroup of children who show pragmatic impairment, whereas their structural aspects of language may not be deficient, in view of the competing hypothesis that the children of this subgroup are children with high-functioning autism. At this stage, it should be stressed that the measurement of pragmatic skills for a number of known reasons (e.g. lack of normative data, vagueness in the definition of pragmatic skills) is a difficult task. In this respect, we intend to adapt and use a recently developed tool as complementary measure of pragmatics, the Children's Communication Checklist (CCC; Bishop 1998; cf. the Methods section) in order to discriminate within a sample of non-clinical referrals a subgroup of participants with putative pragmatic deficits for the study to be reported. In order to support hypotheses (a) and (b), the CCC was used as a complementary measure of discriminant diagnostic means.

Methods

Participants

Fifty participants with language impairments were derived from an initial sample pool of 270 children in grades 3–6, from 22 public elementary schools, randomly chosen among schools in the metropolitan area of the city of Nicosia in Cyprus, partly through an explorative testing means and partly though their teachers' suggestions that they experienced language difficulties. These 50 children were not clinical referrals and were not formally diagnosed as such by local educational authorities. However, to obtain a gross estimation of their general language ability, their teachers were asked to provide an assessment of language achievement level (reading and writing ability). This group of children was the experimental one. In addition, another group of 50 participants was derived from the same pool of children as a control group (or typically developing children, henceforth TDC). The following criteria were applied for forming of the two groups. For a child to be assigned to the experimental group her verbal intelligence measured by the WISC-III standardized version in Greek (1997) should differ from the mean VIQ at least by 1 standard deviation (SD), whereas her score on performance IQ had to be

within the normal range. Consequently, children with the putative specific language difficulties (SLD) scored in the range of 71–85 (mean=82.2; SD=3.7) on VIQ and in the range of 92–126 (mean=101.6; SD=9.7) on performance IQ. No participant in the experimental group had diagnosed neurological, sensory, emotional or social impairment according to their school records. The experimental group was matched with the control group on performance IQ (range 90–117; mean=104.4; SD=6.8) [$t(88)=-1.63$, $p=0.11$], on age (range 96–143 months; mean=119.1; SD=12.3 for control group and range 98–142 months; mean=121.7; SD=10.7 for experimental group) [$t(98)=1.47$, $p=0.14$] and sex [$x^2(1)=1.78$, $p=0.18$]; it was of similar socio-economic status (SES) and significantly different from control group in verbal IQ (range 92–136; mean=107.1; SD=9.07) [$t(88)=-17.97$, $p<0.001$] and in language achievement level (range 1–5; mean=2.8; SD=1.5 for control group and range 1–3; mean=1.5; SD=0.6 for experimental group) [$t(65)=-5.97$, $p<0.001$] according to teachers' report. Five participants, one in the control group and four in the experimental group, were left out of further analyses due to missing data regarding the complementary CCC measurement.

Further, in order to discriminate the children with pragmatic difficulties, we adopted a group selection process similar to that used by Norbury and Bishop (2002). Children with scores below 133 on the CCC pragmatic composite score were classified as children with pragmatic difficulties. The ratio interval of range 108–150 of the scale in our CCC pragmatic composite score is equivalent to Bishop's possible 86–162 ratio interval in CCC pragmatic composite score. Children who had a pragmatic composite score greater than 132 were classified as having no pragmatic difficulties. Thus, 40 out of the 49 children in the TDC group had a composite score greater than 132; they formed the final TDC group. The remaining nine children showed extremely complex language profiles which warrant further consideration which is ongoing and not included here. A total of 18 out of 46 children in the SLD group had a pragmatic composite score below 133. These 18 children formed the group with pragmatic difficulties (PLI group). The remaining 28 participants from the original SLD group formed the group of children with structural deficits of language according to language level assessed by teachers. Bishop and Norbury (2002) classified these children as 'typical SLI' children (SLD-T group). Thus, following this procedure three groups emerged: a TDC group that included children with normal verbal ability and no pragmatic language impairment; a SLD-T group that included children with lower than normal VIQ but no pragmatic language impairment; and a PLI group with both below normal VIQ and pragmatic language impairment.

Table 1 shows data on age, non-verbal intelligence, verbal intelligence, and pragmatic composite of CCC. The three groups were well matched on age [$F(2,85)=1.28$, $p=0.28$] and performance IQ [$F(2,85)=1.49$, $p=0.23$]. Conversely, as expected, there were significant differences amongst the groups on verbal IQ [$F(2,85)=143.14$, $p<0.001$]. Tukey HSD post-hoc tests revealed that the TDC had higher scores on verbal IQ than PLI and SLD-T children ($p<0.01$); PLI children did not differ significantly from SLD-T children on verbal IQ ($p=0.98$). Also, the Pragmatic Composite Score showed, overall, a significant effect of group [$F(2,85)=67.32$, $p<0.001$]. As expected, all groups differed significantly from each other, with the TDC group having the highest score and the PLI group the lowest. Tukey HSS post-hoc tests showed that the TDC had significantly higher score on pragmatic composite on CCC than both PLI and SLD-T children, and SLD-T children had significantly higher score than PLI children ($p<0.01$) (tables 1 and 3).

Table 1. Means (standard deviation) on background measures

	SLD-T (n=28)	PLI (n=18)	TDC (n=40)
Age (months)	122.82_x (8.82)	117.94_x (11.72)	119.30_x (12.18)
Verbal IQ	82.71_x (3.47)	83.06_x (2.46)	108.00_y (9.47)
Performance IQ	102.68_x (10.74)	101.06_x (8.43)	105.03_x (6.72)
Pragmatic composite of CCC	138.57_x (3.65)	124.78_y (5.77)	142.42_z (6.17)

$_{xyz}$Means with differing subscripts are significantly different at the 0.05 level.

Measures

Children's Communication Checklist (CCC)

The CCC has been shown to have very good psychometric characteristics and has become a common used way to identify and subgroup children with language impairments (Botting 2004). The CCC measures two aspects of language, structure and use (Bishop 1998). It consists of nine scales: Speech, Syntax, Inappropriate Initiation, Coherence, Conversation, Context, Rapport, Social Behaviour, and Interests. The first two scales (Speech, Syntax) measure understanding of structural aspects of language, the remaining seven relate to understanding of communicative aspects of language and social cognition, in general. Specifically, the scales of Initiation, Coherence, Conversation, Context, and Rapport are cumulated to estimate a pragmatic composite score, whereas the scales of Social Behaviour and Interest assess social cognition. The composite score is considered (as is the case in this paper) as a general indicator of child's pragmatic ability.

The original checklist consisted of 70 items making up nine scales (Bishop 1998). Of the 70 items, nine (30, 31, 37, 38, 45, 46, 47, 64, 65) were reallocated due to their internal consistency to subscales other than those originally intended by the author (Bishop 1998, appendix, 2). Next, 57 were preserved to be adjusted for use in this study, after four items (2, 63, 67 and 70) were left out because of difficulties the teachers faced to respond. Further, the instrument was translated into Greek, the target language, independently by two bilingual psychologists and back into English. In addition, the same persons examined the forth and back translation and then constructed the final Greek version. Any phrase-conceptual differences were resolved by consensus. The Greek CCC adjusted version maintains the original scoring system, with each item rated on a five-point rating scale, as described in detail in Bishop (1998).

To check the validity of Greek version of CCC, we computed Cronbach's α coefficients for the nine scales. Alphas for each scale are shown in table 2. The coefficient for scale 'Interests' was below 0.65 (Nunnaly 1978), so these items finally were discarded from all subsequent analyses.

Language achievement

Teachers were asked to rate the overall academic language achievement of each student, on a one-to-five scale, where 1=poor and 5=excellent, taking into consideration all taught aspects of language (reading and writing). This rating was used for assignment of children to TDC and SLD groups, respectively, as described above.

Table 2. Means (standard deviation) on mental verbs measures

	SLD-T (n=28)	PLI (n=18)	TDC (n=40)
MVST	20.29_x (6.08)	16.28_x (5.92)	25.20_y (6.96)
MVLT	14.39_x (4.33)	11.94_x (4.91)	18.73_y (3.85)
MVFNFT	6.07_x (1.58)	5.61_x (2.12)	7.25_y (1.37)
MVAT	7.54_x (4.88)	5.33_x (3.41)	12.00_y (6.52)
Non-inferential composite	21.93_x (7.20)	17.28_y (7.41)	30.72_z (8.93)
Inferential composite	26.36_x (7.19)	21.89_y (7.10)	32.45_z (7.79)

MVST, mental verb script task; MVLT, mental verb lexicon task; MVFNFT, factive and non-factive mental verb task; MVAT, mental verb association task.
$_{xyz}$Means with differing subscripts are significantly different at the 0.05 level.

Table 3. Overview of CCC scales with scale possible ranges, Cronbach's α coefficients, and mean (SD) scale scores for the three groups

Scales	Actual range	α	SLD-T (n=28)	PLI (n=18)	TDC (n=40)	F	p
Speech	18–30	0.84	26.93_x (2.05)	23.82_y (2.18)	28.59_z (2.35)	38.05	< 0.0001
Syntax	24–30	0.75	27.86_x (1.45)	26.88_x (1.83)	28.87_y (1.22)	12.97	< 0.0001
Inappropriate initiation	22–30	0.86	28.56_x (1.31)	25.8_y (1.85)	29.22_x (1.23)	40.93	< 0.0001
Coherence	20–30	0.84	26.28_x (1.76)	23.68_y (1.77)	28.27_z (1.96)	41.49	< 0.0001
Stereotyped conversation	22–30	0.80	28.14_x (1.38)	25.08_y (1.56)	27.88_x (1.79)	22.68	< 0.0001
Use of context	22–30	0.78	27.59_x (1.53)	25.45_y (1.57)	28.89_z (1.21)	36.18	< 0.0001
Rapport	22–30	0.78	27.80_x (1.72)	24.93_y (1.94)	28.62_x (1.69)	20.38	< 0.0001
Social relationships	16–30	0.85	26.60_x (2.53)	21.35_y (2.42)	27.56_x (2.79)	27.02	< 0.0001
Interests	24–30	0.19	–	–	–	–	–
Speech and syntax composite score	42–60	0.72	54.78_x (3.07)	50.93_y (3.47)	57.42_z (2.97)	27.33	< 0.0001
Pragmatic composite	108–150	0.93	138.57_x (3.66)	124.78_y (5.77)	142.42_z (6.17)	81.18	< 0.0001

$_{xyz}$Means with differing subscripts are significantly different at the 0.05 level.

Non-inferential tasks

Mental verb lexicon task (MVLT). Mental state verbs are a class of words whose meanings signify various mental states of a sentence agent (Naigles 2000). The present task consisted of 25 instances of mental verbs such as: compare, guess, decide, believe, agree, think, etc. aiming to measure knowledge of semantics linked with understanding and production of this class of verbs.

All mental verbs used in the tasks were derived from grade-appropriate reading textbooks, due to a lack of published norms of word frequency in Greek, after they were evaluated in a pilot study with 53 children of the same grades as those of the participants in the study. To test knowledge of the selected verbs, all children were presented with all verbs one at a time and asked to give at least one synonym verb to the one presented. Accordingly, only verbs that were understood by more than 90% of the children in this sample were finally used for the current study. A representative example of the mental verbs used is included in the appendix.

Mental verb association task (MVAT). The task was intended to investigate differences in word organization in mental lexicon between children with language difficulties and typically developing, relative to two main principles, meaning and grammatical class, which are suggested in the literature (cf. Reeves *et al.* 1998) with children and adults. In particular, the task consisted of 15 mental verbs, and the children were instructed to say as many similar words as they could, after they were presented with two examples, and told to avoid repetitions of the same words, use unrelated words and phrases and the same words in negative form. A concordance criterion based on inter-rater reliability (94–98%) between two blind research assistants was applied for scoring. A representative example of the mental verb used is indicated in the appendix.

Inferential tasks

Mental verb script task (MVST). The aim of the task was, in comparison with the non-inferential, to assess the children's competence in taking advantage of preceding context in order to select the most appropriate mental verb out of four and fill in the blanks of sentences derived form the preceding context. The task consisted of 35 mental verbs (25 also used in the non-inferential and ten new ones) for which an equivalent number of short stories (vignettes) dramatized simple everyday life episodes with two to three children as 'heroes' whose sex was balanced across the presentation. The children were informed that they would read very short fictitious stories on the computer screen that sometimes might appear funny. They were instructed to read each story carefully and then complete the missing part of the following sentence by choosing the word (verb) that fitted best the entire story. The particular objective was twofold: first, to compare the performance of the children with and without language difficulties; and, second, to compare performance on either group of children between non-inferential and inferential conditions. A representative example of the mental verbs used is displayed in the appendix.

Factive and non-factive mental verb task (MVFNFT). Its particular objectives were to measure children's ability to infer the implications entailed by factive mental verbs (*know*, *remember*, *understand*, *learn*, *forget*) that the event described in the complement clause (infinitival and/or nominal) is true in comparison with non-factive verbs, such as *promise*, *agree* ('commissives') denoting an obligation or declaring intention; and *think*, *imagine*, *believe* ('expositives') stating reasons, arguments and communications, respectively (Austin 1962/1975, pp. 151–164; cf. also Searle 1969/1988). It was assumed that typically developing children would be able to indicate higher command of drawing inferences relative to mental verbs, factive and non-factive according to some earlier studies (Natsopoulos 1987) in comparison with children who have language difficulties. As with the previous task children had to read carefully very short stories on the screen and select one of the three answers that would best fit in the meaning of the story. Two examples, one with a factive and one with non-factive mental verb, are shown in the appendix.

Procedure apparatus

The testing of all participants was individual and took place in the schools at rooms especially provided by the school principals and after an informed consent was

obtained from the school authorities, the children and their parents. All testing was performed by the first author.

All tasks except the Mental Verb Association Task (MVAT) were presented to participants on a 14-inch monitor of a Pentium III-compatible laptop computer using E-prime software (Schneider *et al.* 2002). Participants before proceeding to the main test were familiarized with the principal investigator and the experimental procedure. The time the participants took in giving their answers was measured.

Scoring

For all participants a correct answer was credited with a score of 1; an incorrect answer was credited with a score of zero: The score range on tasks was as follows: for MVLT, 0–25; MVAT, 0–33; MVFNFT, 0–10; and MVST, 0–35.

Results

Mental verb measures

To determine the differences of the three groups on each of the four mental verb tasks, a one-way multivariate analysis of variance (MANOVA) was conducted with groups as the between-subjects variable. The overall significant multivariate main effect was found for group according to Wilk's criterion [$F(8,160)=4.93$, $p<0.001$, $\eta^2=0.20$]. Also, univariate analyses revealed a significant main effect of group for MVLT, [$F(2,85)=18.44$, $p<0.001$, $\eta^2=0.31$]; MVAT [$F(2,92)=10.95$, $p<0.001$, $\eta^2=0.21$]; MVFNFT [$F(2,92)=7.97$, $p<0.005$, $\eta^2=0.16$], and MVST [$F(2,92)=12.79$, $p<0.001$, $\eta^2=0.24$]. As table 2 illustrates, the TDC group outperformed the other two on all tasks, whereas the two language-disordered groups did not differ significantly one from another, which is evidence similar to that reported by Bishop and Adams (1992) and Botting and Adams (2005) on children with pragmatic difficulties and those with typical SLI.

However, further analysis focused on the two language-impaired groups (SLD-T versus PLI) by using composite scores on inferential and non-inferential mental verb measures indicated that the SLD-T group outperformed the PLI group of children [$t(44)=2.14$, $p<0.05$; and $t(44)=2.07$, $p<0.05$, two-tailed, respectively].

Also, a one-way analysis of variance (ANOVA) was performed on the reaction time taken by the children of three groups relative to three mental verb tasks. It should be noted that the time on MVAT was fixed for all participants. The analysis showed that the main effect of group was statistically significant on MVLT [$F(2,85)=4.15$, $p=0.019$] and MVFNFT [$F(2,85)=4.02$, $p=0.022$]. The differences between PLI and TDC group were significant ($p=0.015$ and 0.015, respectively). Differences in reaction time between PLI and SLD-T group, although favoured the latter group, were not significant.

CCC complementary measures

With regard to CCC complementary measures, a one-way MANOVA was used with the three groups as the between variable and the nine scales of CCC as the within variable. Overall, the group effect was significant according to Wilk's criterion

[$F(18,150)=7.07$, $p<0.001$, $\eta^2=0.46$]. The differences between groups on all univariate *F*-tests are shown in table 3. The three groups differed in all scales, except syntax. That is, the TDC group achieved significantly higher scores than the other two groups in speech and syntax scales. The SLD-T children, as TDC, outperformed the PLI group on speech and syntax composite score and the TDC were also significantly different from SLD-T in speech and syntax composite score as table 3 indicates.

Correlational analyses

Table 4, panel A, displays intercorrelations between the four mental verb tasks; panel B displays between composite scores of mental verbs, syntax and speech composite score, pragmatic composite score, and social relationships scale of CCC on the three groups.

Overall discriminant function analysis

A discriminant function analysis (DA) was used to classify the participants on the basis of scores on the two composite scores on inferential and non-inferential mental verb measures, the composite of syntax and speech scales, and the social relationships scale of CCC as predictors and the three groups (SLD-T, PLI, TDC) as the dependent variable. The DA analysis produced two significant functions. The first discriminant function yielded: $x^2(8)=70.39$, $p<0.001$, accounting for 86.8% of the between-group variability and it was closely associated with speech and syntax composite score, social relationships scale, and inferential composite score. The second discriminant function gave: $x^2(3)=12.12$, $p=0.007$, accounting for 13.2% of the between-group variability and it was linked with the non-inferential composite score. The loading matrix of correlations between predictors and discriminant functions suggests that the successful differentiation of the PLI group from the other two groups was largely based on the scores of the speech and syntax composite core, social relationships scale, and inferential composite score and to a certain extent on the non-inferential measures (figure 1). As table 5 shows, 68.6% of cases were classified correctly. Most typically developing children (80%) were grouped together; 11 (39.3%) cases of the SLD-T group, and one (5.6%) case of the PLI group were misclassified in the TDC group. Twelve (66.7%) cases of the PLI group were classified correctly; two (7.1%) cases of the SLD-T group, and three (7.5%) of the TDC group were misclassified into the PLI group. The least discriminated group was the SLD-T children, i.e. 15 (53.6%) cases were grouped together. Five (27.8%) cases of the PLI and five (12.5%) of the TDC group were misclassified into the SLD-T group.

Discussion

The first objective of the study was to examine the adequacy of the mentalizing ability in distinguishing between different groups, namely PLI, SLD-T and TDC derived from a population of Greek-speaking children according to CCC, using the pragmatic composite score as an index. The subsequent use of discriminant function analysis applied on the composite score of the four mental verb measures, speech

Table 4. Interrelations of the inferential, non-inferential composite scores, syntax and speech composite score, social relationships and pragmatic composite score of the CCC in TDC, PLI and SLD-T groups

	TDC (n=40)			PLI (n=18)			SLD-T (n=28)		
	2	3	4	2	3	4	2	3	4
Panel A									
1. MVLT	0.45**	0.37*	0.82**	0.57**	0.41	0.61**	0.22	0.76**	0.71**
2. MVAT		0.27	0.51**		0.44	0.66**		0.22	0.43*
3. MVFNFT			0.54**			0.44			0.63**
4. MVST									
Panel B									
1. Inferential mental verbs (composite)	0.71**	0.57**	0.40*	0.24	0.73**	−0.10	0.32	0.22	0.74**	0.32	0.32	0.17
2. Non-inferential mental verbs (composite)		0.52**	0.32	0.26		0.07	0.37	0.46*		0.46*	0.31	0.29
3. Syntax and speech (composite)			0.62**	0.65**			0.18	0.57**			0.17	0.25
4. Social relationships				0.57**				0.68**				0.45*
5. Pragmatics (composite)												

MVST, mental verb script task; MVLT, mental verb lexicon task; MVFNFT, factive and non-factive mental verb task; MVAT, mental verb association task.
*p<0.05, **p<0.01.

and syntax, and social relationships of CCC as predictors confirmed the existence of three separate groups, although the two language-impaired groups were not as clearly distinguished from each other as was assumed. The results produced by ANOVAs indicated clearly that the children in the TDC group were significantly better able to perform on the four main tasks compared with children with language difficulties in the group of PLI and SLD-T. These results confirm hypothesis (a) that predicted TDC would exceed the two groups in performance on tasks with mental verbs demanding inferential and non-inferential processes (cf. table 2). Univariate comparisons of performance in the four tasks did not show significant differences between the PLI and SLD-T group of children, despite an observed trend in favour of the SLD-T group, evidence which is in contrast with the initial rationale of hypothesis (b) derived from Bishop (2000). The comparison, however, between the two groups using composite scores for inferential (pragmatic) and non-inferential (semantic) task indicated reliably that the PLI children were less able than the SLD-T in pragmatic and semantic competence.

Indeed, children in the PLI group manifested a limited capacity to take advantage of the preceding context and select among the four alternative mental verbs the one fitted best the instance at hand. This observed weakness related to two apparently different tasks, the MVLT and MVAT, which, however, proved to demand very similar sources of mentalizing ability and computational process.

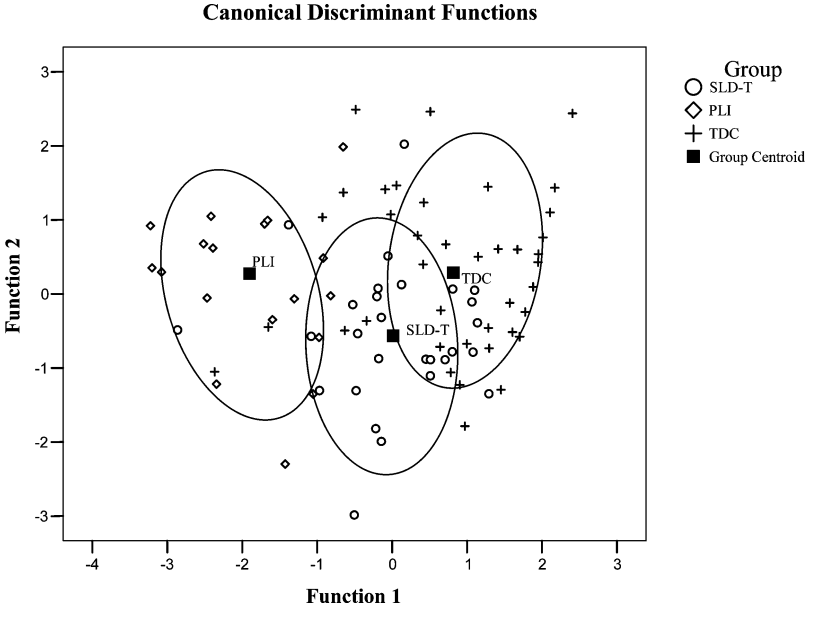

Figure 1. Plots of the three groups' centroids on two discriminant functions derived from the three composite scores and social relationships scale of CCC.

Specifically, the first task required engagement of the working memory sources on the children's part to keep the preceding context alive while computing the meaning of the four mental verbs in order to be able to select the most appropriate of them and fill in the short story. A decision for adopting the most appropriate verb meaning might also require all children in the three groups to generate the meaning for each mental verb and, subsequently, to assess their semantic distance relative to preceding context before finalized their answer. Also, the time taken by the PLI children to reach their decision appeared significantly longer (p=0.015) compared with that by TDC and longer, although non-significant, than that required by the SLD-T. This difference in time might suggest that PLI children were slower in processing their answers either due to uncertainty they experienced in finding out the meaning of the most appropriate verb for the preceding context or due to limited semantic sources on which the children with PLI seem to draw their inferences.

Table 5. Classification results of discriminant function analysis based on inferential and non-inferential composite, score, speech and syntax composite score and the CCC scale of social relationships

	Predicted group membership		
Actual group membership	SLD-T	PLI	TDC
SLD-T	15 (53.6%)	2	11
PLI	5	12 (66.7%)	1
TDC	5	3	32 (80%)

A total of 68.6% of originally grouped cases were correctly classified.

The latter argument could be further maintained if one considers the PLI children's performance on the second part of the non-inferential task, the MVAT task. The mean mental verb association within the same restrictions of time (cf. table 2), although not significantly different from that of SLD-T (5.33 versus 7.54) was clearly lower. The fact that the correlation between the MVLT and MVAT was quite strong in PLI group ($r=0.57$) in comparison with SLD-T ($r=0.22$) indicates that organization of mental verb clusters may be weaker to a very similar extent across the semantic space of long-term memory, and the two tasks may tap similar processes (MVLT versus MVAT) in the former group (table 4, panel A).

This evidence, although it appears to contrast with the prediction that semantics as a structural component of language ability may differ between those with PLI and SLD-T (Bishop 2000), also seems to espouse another argument by Bishop (2000, Bishop and Norbury, 2002) that semantics is the prerequisite for pragmatic competence. By the same token, the differences observed between the PLI and SLD-T children in the MVLT and MVAT composite score analysis provide some support for the argument that more effective organization of semantic or cognitive sources in the mental lexicon may also influence mentalizing ability accounting for pragmatic differences between the two groups (also Norbury and Bishop 2002). In line with this reasoning, two analyses of the data were conducted: one on each individual task and the other on composite score in the PLI and SLD-T groups (cf. table 2).

The individual task analysis demonstrated no significant differences in drawing inferences on MVST and MVFNFT, although SLD-T children showed higher performance than the PLI. The composite score analysis demonstrated that SLD-T children were significantly better able to draw inferences on MVST and MNFNFT. Overall, SLD-T could bridge the preceding context on the MVST by inferring the semantic affinity of the key word(s) in the brief story with the most appropriate meaning implied by one of the four alternative mental verbs. As with the MVLT and MVAT, the children had to keep in working memory the preceding context and the key word(s) in order to be able to bridge one with the other.

Relative to the MVFNFT, the children in the PLI and SLD-T groups had to perform a twofold computation: first, to infer the truth of the complement clause event when the main clause verb was either explicitly (*know*) or implicitly positive (*remember*) or implicitly negative (i.e. *forget*); and, second, to infer whether the event described in the complement clause following non-factive verbs (agree, believe, think) could only be intended or conceived of as possible.

Inspection of scores in table 2 indicates that TDC children were consistently more felicitous in drawing inferences by linking the preceding context with those mental verbs in MVST, fitting best the pragmatic presuppositions. On the same task, the SLD-T children were next better able to assign the most appropriate mental verbs to the preceding context and fill in the sentences, and PLI the least able of the three groups to deal with the same task, although the differences between the two latter tasks were not significant. The same picture of differences in inferential ability also prevailed with MVFNFT in the three groups: the children with PLI were the least able to process inferences relative to factive and non-factive mental verbs, the SLD-T better than the PLI although not significantly, and the TDC group significantly better than the former two groups. What, however, is worthy of noting is that the category of non-factive verbs appeared difficult for the children in the

three groups and more so for those in PLI to infer the 'possible' (or 'indeterminate') status of the event implied by the complement clause.

Going back to the argument that semantics or cognition could be the primary source for pragmatic competence, the strong correlations found between inferential and non-inferential composite scores in the three groups (cf. table 4, panel B) seem to support such a contention. Further, our findings are in agreement with recent work suggesting that language-impaired children may exhibit poor knowledge of mental state terms, especially when facing tasks with high linguistic demands (Farmer 2000, Miller 2004).

Also, the present data are in keeping with those reported by Conti-Ramsden *et al.* (1997) and Rapin (1996) who also argue that many children with poor linguistic skills display pragmatic deficits, and with other evidence suggesting that social deficits may co-occur with language impairments (Redmond and Rice 1998). The significant correlations found between the social relationships and pragmatics may attest to cognitive affinity underlying both of them and the role they play in language impairment relative to understanding and producing verbs of mental states (cf. table 4, panel B).

On the other hand, these findings despite similarities to data mentioned previously show some notable differences. Namely, the PLI group did not differ in structural aspects of language from SLD-T as initially was assumed; instead, the CCC scale of speech favoured the SLD-T group and the syntax scale did not favour the PLI, as was also initially hypothesized. Further, the composite non-inferential measure that tapped semantic competence, also a structural component of language ability, favoured the SLD-T group, providing additional support for Bishop's (2000, Bishop and Norbury, 2002) modified view that knowledge of semantics may be the prerequisite for pragmatics. In this respect, the reported data are different from those in Marton *et al.*'s (2005) study, which argues that children with pragmatic impairment did not differ in inferential ability from SLD peers, and social pragmatic deficit is not causally related to language impairment even if they co-occur. In particular, the fact that the discriminant analysis used classified the children in PLI, SLD-T and TDC group on the basis of their performance in inferential pragmatics, structural linguistic ability and social pragmatics suggests that the distinction between groups is a result of synergy of these factors despite the non-typical, to a certain extent, simple intercorrelations matrix displayed in table 5.

Be this as it may, the present data indicate that children with PLI in addition to pragmatic deficits, as measured by the CCC, are also suffering from semantic-structural weakness, as suggested by the composite speech and syntax score and social pragmatics either, evidence compatible with Bishop's (2000) view who argues that pragmatic impairment is dissociable from (or co-exist with) other language difficulties. Our findings also speak of children with PLI as having a mixed profile of semantic–pragmatic and social cognition deficit.

In conclusion, the results of this explorative study show that there is a group of children who are clearly distinguished from other two groups of children in developing awareness of mental state verbs presupposing knowledge of pragmatics (Natsopoulos 1987) and aspects of social mind (Scholnick and Hall 1991). The group of PLI and SLD-T children, although non-clinical referrals, were also discriminated from the TDC group and from one another on the basis of the four main measures with one difference: The SLD-T had a stronger affinity with the TDC group compared with that manifested between the two language-impaired groups (cf.

table 5). A follow-up study could provide more decisive evidence whether these differences would continue to exist between the two groups or the SLD-T children would catch up with TDC, while PLI would pave their own course, demonstrating how the semantic and pragmatic system of mental state terms develops into a complex set of language and social constructs (Tager-Flusberg 2000).

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Appendix

1. Representative example for mental verb lexicon task (MVLT)

> Suppose you are recollecting the excursion you have enjoyed very much with your classmates last week. Which of the following four words describes best the meaning of your feelings?
>
> 1. know 2. understand 3. remember 4. learn

2. Representative example for mental verb script task (MVST)

> John and Mary are siblings. They also have a younger sister, Catherine. Mary has lost her book. She asked John whether he might have seen it. John, in fact, saw Mary's book placed under his desk, but told Mary the book was under Catherine's desk.
>
> John Mary
>
> 1. know 2. trick 3. ignore 4. confuse

3. Representative example for mental verb factive and non factive task (MVFNFT)

3.1. John forgot to feed the dog:

(a) The dog has eaten some food.
(b) The dog has not eaten any food.
(c) The dog might have eaten some food.

3.2. John agreed with Mary to buy some sweets for her:

(1) John has bought some sweets for Mary.
(2) John might have bought some sweets for Mary.
(3) John has not bought some sweets for Mary.