PRAGMATIC ABILITIES IN PARKINSON'S DISEASE

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RESEARCH FIELD*:* Clinical Pragmatics

What is clinical pragmatics? Pragmatics can be defined as the study of language in context and concerns the interplay of linguistic content, contextual information and general rules in guiding communication[1]. *Clinical pragmatics* is a field of pragmatic research that investigates the way in which language, gestures and other signals used in everyday situations and in social interactions are applied to patients suffering with impaired communication. In other words, clinical pragmatics explores the characterization, assessment and treatment of pragmatic disorders across the lifespan. This research field has been a major growth area in linguistics over the past two decades, since a significant number of patients with impaired language skills also show deficits in the pragmatic domain. These patients belong to different clinical populations, such as autism spectrum disorder, adults with left and right hemisphere damage, schizophrenia, traumatic brain injury and neurodegenerative disorders. Given their impaired pragmatic skills (including both verbal and non-verbal behaviour, such as the inability to interpret the meaning of figurative and ironic expressions, to respect turn-taking rules, or to use gestures properly[2]), their use of language is somehow *inappropriate* and therefore *less efficient*.

Why do we need to study clinical pragmatics? These communication deficits lead to a worsening of patients' quality of life, given the difficulty in interacting with others and in engaging in social relationships. Considering all these premises, it's of primary importance for clinical pragmatics to focus on a better characterization and understanding of pragmatic deficits, and to develop appropriate and comprehensive assessment tools. The implementation of new batteries for the evaluation of pragmatic competence is essential for the early identification of these deficits and for the development of ad-hoc rehabilitation programs (which could be domain-specific), whose outcomes could also positively impact subjects' quality of life.

TOPIC: Pragmatic Abilities

Pragmatic abilities refer to key conversational skills that allow speakers to use language *appropriately* according to different communicative situations[2]. Some of these skills concern the ability to communicate appropriate amount of information in the proper social context, making appropriate requests and commands, knowing how start, conduct and end a conversation, making socially appropriate requests and providing thematically cohesive narratives of relevant events[3]. Pragmatics typically investigates verbal phenomena in which there's a gap between the literal and the communicative meaning: listeners therefore need to integrate contextual information in order to understand the speaker's intended meaning. Metaphors, irony and non-literal language in general

are among the phenomena in which context plays a major role; however, there are also other important domains such as aspects of discourse (topic maintenance and coherence), in which speakers need to adhere to rules of appropriateness to context[4]. However, this research field investigates several non-verbal behaviors as well, such as intonation, eye contact, facial expressions, gestures and proxemics, which all contribute to an effective and goal-oriented communication.

As suggested by researches in clinical pragmatics, these communicative skills might be impaired in some clinical populations. Traditionally, deficits in this domain have been associated with damages in the right hemisphere or with specific conditions, such as autism spectrum disorder, schizophrenia and traumatic brain injuries[5]. Nowadays, it is well known that pragmatic impairment can be observed also in several neurological disorders[2], such as Alzheimer's disease (AD)[6] and Amyotrophic Lateral Scleroris[7]. Among the neurological conditions, disruption of pragmatic abilities has also been shown in patients with Parkinson's disease (PD)[3], although the existing literature still doesn't provide a clear picture of pragmatic impairment in this clinical population.

Besides the mere characterization of pragmatic impairment in different clinical conditions, there has been increasing interest for the neurological and cognitive substrates of pragmatic deficits. Although there is still considerable neurological evidence for a modular view, in terms of the lateralization of pragmatic abilities, a considerable part of the available literature considers pragmatic deficit as a more complex phenomenon[8]. This last view is supported by the growing awareness of the impact of executive functions (i.e. a cluster of cognitive processes that are involved in goal-directed actions) and Theory of Mind (i.e. the ability to attribute mental states to others) on pragmatic competence[9]. In light of these premises, some authors suggested that the listener needs to process the sentence on a higher cognitive level in order to understand communicative intentions and to reach the sense of the utterance: growing evidence supports the hypothesis that pragmatic abilities rely on the higher-order interaction of several cognitive functions, which support context-dependent language processing[5,9].

TOPIC: Parkinson's Disease

Parkinson's disease (PD) is a chronic, neurodegenerative disorder, which affects about 1% of the population aged 65 years and over[10]. It is considered a movement disorder, characterized by the loss of dopaminergic neurons in the corpus striatum[10], which leads to several debilitating extrapyramidal motor dysfunctions[11]. The primary motor impairments associated with the disease include muscle rigidity, bradykinesia, resting tremor, and postural instability. However, several non-motor dysfunctions have been reported as well, such as mood alterations, sleeping problems, and cognitive changes[11]. With regard to cognitive symptoms, they could be mild, thus not affecting everyday life, or more severe, leading to a clinically evident condition of dementia[12]. To date, the impairment of executive functions has been well documented in PD patients, and it typically encompasses several domains, such as planning, shifting, inhibition, conflict resolution, decision making, and dual task performance[12]. Executive dysfunctions have been associated with the dopamine depletion in the striatum, which leads to a disruption of the frontal-striatal circuitry[12]. The strong connectivity of the striatum with cortical – mainly frontal and limbic – sites may also explain the vulnerability of many functions related to language and non-verbal communication in patients with PD[11,12].

WHAT WE KNOW: pragmatic abilities in Parkinson's disease

What exactly do we know about pragmatic abilities in Parkinson's disease? With regard to language, several studies suggested that PD patients show an impairment at the semantic and (morpho-)syntactic level[13]. Only a few studies investigated pragmatic abilities in PD. Yet, the existing literature already suggests that pragmatic skills might be impaired, as individuals with PD can display both language comprehension and production deficits[14]. Pragmatic comprehension, i.e. the understanding of meanings that can't be derived exclusively from the sentence meaning, has often been reported as impaired in this clinical population[2], especially the understanding of figurative language and other implicit contents[11,12]. Thaler et al. (2012) showed that PD patients have a significantly poorer sense of humor than control participants[15]; in addition, Monetta and Pell (2007) showed that PD patients with impaired working memory were significantly slower and less accurate than healthy controls in processing metaphors[16]. Furthermore, Montemurro *et al*. (2018) investigated the role of Cognitive Reserve in PD patients' general pragmatic comprehension abilities and found a significant correlation between the two[9]. Several researches also reported production deficits for both verbal (conversational initiation, turn taking, topic maintenance, response length and referencing skills) and non-verbal (intonation, eye contact, facial expressions, gestures and proxemics) dimensions[14]. Individuals with PD tend to produce syntactically simple language with lower information content and abnormalities in speech fluency in the form of prolonged and inappropriate pauses[14]. Furthermore, McNamara and Durso (2003) found a correlation between PD's compromised turn-taking abilities and disrupted frontal-lobe-functioning[3], while other studies highlighted a greater impairment for nonverbal dimensions, which is linked to mental status, motor severity and disease duration[14]. In sum, the available studies suggest that pragmatic abilities are impaired in this clinical population, with some of them highlighting a possible connection with executive dysfunctions.

Furthermore, some other researches suggest that impairments in pragmatics might be linked to patients' ToM abilities, which are often compromised in PD as well. As Bodden et al. (2010) claimed, the two components of ToM (cognitive ToM, i.e. the understanding of the difference between a speaker's knowledge and beliefs and the knowledge and beliefs of the listener, and affective ToM, i.e. the empathic appreciation of speaker's or hearer's emotional states) can be impaired independently[17]. With respect to the possible link between pragmatic abilities and ToM, Vachon-Joanette *et al.* (2013) reported significant correlations between metaphor comprehension and PD patients' ToM abilities[18].

Overall, these studies pave the way to the possibility that pragmatic impairments in PD might be bound to deficits in executive functioning, that is notably disrupted in this clinical population, as well as in ToM.

OPEN ISSUES: why do they need to be clarified?

What about pragmatic abilities in early PD? Most of the available studies enrolled PD patients ranging from 1 to 4 of the Hoehn & Yahr (which consists of a system with a scale of 1 to 5, with higher scores indicating a more severe impairment), thus not focusing on a specific stage of the disease[3,5,19]. Although there is growing evidence about the disruption of pragmatic skills in this clinical population, a clear picture of pragmatic impairment at early stages of the disease is still missing. In order to achieve a better characterization of these deficits in early PD, wider and more

comprehensive batteries for the assessment of this domain should be administered, instead of only focusing on some of the pragmatic abilities involved in communication.

What about the relationship with executive functions and Theory of Mind? As mentioned earlier, some authors suggest that pragmatic impairment in patients with PD might be due to a disruption in executive functioning and ToM abilities, but the existing evidence about this link is still somehow conflicting. Hence, it is crucial to investigate the nature of pragmatic impairment: in order to strengthen the hypothesis that it is linked to other domains, it's important to clarify whether it might stem from ToM difficulties or executive dysfunctions. With respect to this premise, the relationship between pragmatic competence and its suggested underlying mechanisms needs to be further investigated through a more comprehensive assessment of executive functions (both screening batteries and domain-specific tests should be administered) and ToM (both its cognitive and affective components).

How does pragmatic impairment evolve over time? Few studies concerning pragmatic language changes are available on normal aging[20], while the progression of pragmatic deficits in patients with PD hasn't been investigated yet. From a clinical point of view, the lack of a monitoring system of pragmatic language skills is somewhat limiting, as patients' quality of life, which slowly worsens due to motor impairments, is also affected by the ability to communicate effectively with others. With respect to these premises, longitudinal studies are needed in order to monitor the progression of pragmatic impairment over time. Moreover, a characterization of pragmatic deficits in patients with advanced PD could be of primary importance in order to outline a clear picture of these abilities, their relationship with severe motor dysfunction and the way they affect patients' daily living.

STUDY 1

PRAGMATIC ABILITIES IN EARLY PARKINSON'S DISEASE

MAIN GOAL

This study addresses two of the open issues discussed above, and its aim is twofold: the first goal is to outline a comprehensive characterization of pragmatic abilities in early PD patients, while the second one is to investigate if any pragmatic deficit might stem from an impairment in a wider cluster of selected cognitive functions[5]. Based on previous findings, we predict that executive functions and ToM might prominently impact PD patients' pragmatic comprehension skills.

METHODOLOGY

Population and Recruitment: 20 patients with early Parkinson's disease (Hoehn&Yahr scores 1,5-2,5) from *San Martino Hospital* and 20 healthy elders (matched for gender, age and education) from *Creamcafè* were enrolled in this study. Clinical subjects were pre selected by the specialists of San Martino Hospital.

Assessment: All participants were assessed for demographic characteristics, pragmatic abilities, cognitive performance and depression status. Patients with Parkinson's disease also underwent a clinical evaluation.

- *Demographic and clinical assessment*: age and education (as number of successfully completed years of school and university courses) were considered as demographic variables. Two additional clinical variables were included, i.e the Hoehn and Yahr (H&Y)[21] scale and the Unified Parkinson Disease Rating Scale (UPDRS-III)[22] for the evaluation of the severity of extrapyramidal symptoms. The H&Y is based on a scale of 1 to 5, with higher scores indicating a more advanced stage of the disease. Only patients at early stages of the disease (i.e. ranging from 1,5 to 2,5 of the H&Y) were enrolled in this study. The UPDRS ranges from 0 to 108 and consists of a classification of the severity of the disease based on tremor, slowness (bradykinesia), stiffness (rigidity) and balance, with higher scores suggesting a more severe impairment. Duration of illness was also included as a clinical variable and it was quantified as the number of years from onset.

- *Pragmatic skills:* all participants underwent a pragmatic ability evaluation through the Assessment of Pragmatic Abilities and Cognitive Substrates (APACS)[4], which explores both productive and receptive pragmatic skills with six subtests.
    - Interview (production): a semi-structured interview based on autobiographical topics, which assesses discourse organization and engagement in conversation. It evaluates different dimensions of discourse, such as speech (e.g., repetition, echolalia, incomplete utterances…), informativeness (over- or under-informativeness), information flow (missing referents, wrong order of the discourse elements…) and paralinguistic aspects (intonation, fixed facial expression, gesture abuse…). The frequency of occurrence of each type of communication deficit is reported (always/sometimes/never) and the relative score is assigned (0/1/2). The maximal score for task 1 is 44.
    - Description (production): this task measures the ability of producing informative descriptions of different photographs representing scenes of everyday life. The ability of mentioning the salient elements of the pictures is quantified with a score (0/1/2), with 0 indicating a missed identification, 1 a partially correct identification and 2 a good identification. The maximal score for task 2 is 48.
    - Narratives (comprehension): participants listen to 6 stories, inspired by real newspaper, which are read by the experimenter. Each story is followed by comprehension questions on explicit and implicit contents and accuracy scores are registered (either 0/1 or 0/1/2). The maximal score for task 3 is 56.
    - Figurative language 1 (comprehension): participants are presented with multiple choice questions following the presentation of idioms, novel metaphors and proverbs and the ability to infer non-literal meanings is measured. Accuracy scores are registered (0/1). The maximal score is 15.
    - Humor (comprehension): participants are asked to pick the best punch line of a story. The subtest measures the ability to comprehend verbal humor through a multiple-choice task. Accuracy scores (0/1) are registered. The maximal score is 7.
    - Figurative language 2 (comprehension): participants are asked to explain the meaning of different figurative expressions (i.e. idioms, novel metaphors and proverbs). The task measures the ability to infer non-literal meanings and accuracy scores are registered. The maximal score (2) is assigned when the participant provides a good description of the meaning of the figurative expression; a intermediate score (1) is given when the subject provide an incomplete explanation or an example; a score of 0 is assigned when the

participant provides a literal explanation, a paraphrase or doesn't know the meaning at all. The maximal score is 30.

- *Neuropsychological assessment*
  - Digit Span forward (verbal short-term memory): the experimenter reads a list of digits and participants are required to immediately repeat the list in the same order[23]. After each list, if participants succeed in repeating it, another list one digit longer is presented; if they fail, a second list of the same length is presented. If subjects are successful on the second list, a list one digit longer is presented, but if they also fail on the second list, the test is ended. The length of the digit sequences gradually increases, starting from three numbers to a sequence of maximum 9 items. The span is considered as the length of the longest list correctly recalled.
  - Digit Span backward (working memory): the procedure is the same described for the forward version, except that in this case participants have to repeat the sequence of digits in the reverse order and the longer list consists of eight items[23].
  - Corsi Span forward (visuo-spatial short-term memory): the examiner touches a sequence of three blocks at a rate of approximately one block per second, according to the numerical sequence that corresponds with the numbers on each block. Participants has to touch the blocks in the same order immediatley after the presentation of the sequence. If they fail, a second sequence of the same length is presented and, if they succeed, a sequence one block longer is given. The test is ended when participants fail on two consecutive sequences of the same length. There is a maximum of 9 items and the span is considered as the length of the longest sequence correctly reproduced[23].
  - Corsi Span backward (visuo-spatial working memory): the procedure is the same described for the forward version, except that in this case subjects have to reproduce the sequence of blocks in the reverse order and the longest list includes eight items[23].
  - Verbal fluency test (both phonemic and semantic cue): participants are required to produce as many word sas possible from a category in a given time (60 seconds). The category can be semantic, including objects (usually animals, fruits and car brands) and phonemic, including words beginning with a specific letter (usually F, P and L).
  - Trial Making Test (TMT- shifting): this task is made up of two separate parts. In Part A, participants are required to connect 25 numbered circles with direct line in ascending order (i.e., 1-2-3-4…); in Part B, subjects have to connect numbered and lettered circles in alternated numerical and alphabetical order (i.e., 1-A-2-B-3-C…). Time of completion is registered for both part A and B and a composite score B-A is calculated, providing an accurate measure of executive control[24].
  - Stroop Task (inhibition): participants are required to read three different tables as fast as possible. Two of them represent the "congrous condition", in which subjects have to read names of colors printed in black ink and name different color patches. In the third table, color-words are printed in an inconsistent color ink (for instance the word "blue" is printed in red ink). In this last condition, participants are required to name the color of the ink instead of reading the word. Reaction times and accuracy are registered for each task.
  - "Valutazione delle capacità di costruzione dello scheletro" and "Denominazione visiva"[25] (semantic memory): in the first task, participants are presented with several

types of animals and have to say if those animals are bigger or smaller than a goat. Then, subjects are presented with several types of objects and have to say if those objects have a bigger height or width extension. In the second task, participants are presented with a series of pictures and have to mention the name of each object in the pictures. A maximal score of 40 is assigned in the first task, while the maximal score for the second task is 64.

- *Screening tests*
  - The Montreal Cognitive Assessment (MoCA) test is a neuropsychological screening consisting of 8 subtests assessing different cognitive domains (i.e. memory, language, visuo-spatial skills, executive functions, time and space orientation). Accuracy is measured a maximal score of 36 is assigned[26].
  - The Parkinson's Disease-Cognitive Rating Scale (PD-CRS) is a cognitive screening battery that includes nine subtests assessing: immediate free-recall verbal memory, confrontation naming test, sustained attention, working memory, unprompted drawing of a clock, copy drawing of a clock, delayed free-recall verbal memory, alternate verbal fluency and action verbal fluency. A total score (score range 0-134) and two different sub-scores are provided: one assesses frontal subcortical functions (i.e. sustained attention, working memory, alternating and action fluencies, clock drawing and immediate and delayed free-recall verbal memory, score range 0-104), and the other assesses instrumental cortical functions (i.e. naming and copying a clock, score range 0-30)[22].

- *ToM assessment*
  - Emotion Attribution test: participants are presented with 35 short stories and are asked to identify characters' emotions. A score of 1 is assigned for each emotion correctly identified, leading to a maximum score of 35.
  - Strange Stories: this test assesses double bluff, white lies and persuasion. Participants are presented with 13 short stories and are asked to explain why the main character acted in a particular manner. A score of 1 is assigned for each correct response, leading to a maximum score of 13.
  - Reading the Mind in the Eyes test: participants are presented with 36 gray-scale photos of people, in which only the area around the eyes can be seen. Each photo is surrounded by four mental state terms and the subject is instructed to choose the word that best describes what the person in the photo is thinking or feeling. Only one of the four items is correct.

- *Depression status:* Beck Depression Inventory II (BDI-II) scale is a 21-item self-report inventory designed to assess the presence and severity of depressive symptoms. Each item is rated on a 4-point Likert scale ranging from 0 to 3, based on the severity in the last two weeks. The total score ranges from 0 to 63, with higher scores indicating more severe depressive status.

Procedure. To investigate pragmatic abilities in patients with early Parkinson's disease we proceeded as follows: a complete battery focusing on pragmatic competence was administered in two separate groups – i.e. early PD patients and matched healthy controls - and significant between-

group differences in the pragmatic performance were analysed. Then, in light of the suggested link between pragmatic abilities and cognitive functions, an extended evaluation (with neuropsychological tests) of both executive functions and ToM was provided, in order to sketch a clear picture of neuropsychological performance in the two groups and to identify the predicting factors of pragmatic abilities.

PROVISIONAL STATISTICAL ANALYSES

Provisional statistical analyses were performed with a smaller sample. First, a comparison between patients' and healthy controls' performance in APACS, in the other neuropsychological tests and in the BDI-II was performed. Furthermore, a multiple regression analysis was performed to analyze predictors of pragmatic abilities.

PROVISIONAL RESULTS

Comparison between patients with PD and healthy controls

A Wilcoxon rank-sum test was performed in order to compare PD patients' and healthy controls' performance in APACS, in the other neuropsychological measures and in the BDI-II scores. Significant between-group differences emerged in the domains of short-term verbal memory ($p=0.039$), inhibition ($p=0.035$) and in the PD-CRS global score ($p=0.0018$). Furthermore, between-group differences in other neurocognitive measures such as shifting ($p=0.057$), visuo-spatial working memory ($p=0.054$) and the global performance at the APACS test ($p=0.057$) approached statistical significance.

Multiple regression analysis

The multiple regression analyzing predictors of pragmatic abilities showed a significant contribution of short-term verbal memory ($p=0.046$), inhibition (accuracy- $p=0.024$) and the PD group ($p=0.027$), while the contribution of the global score of the Emotion Attribution test ($p=0.052$) approached statistical significance. Within the PD group, inhibition (accuracy- $p=0.027$) was the main predictor of patients' performance in APACS, while the contribution of short-term verbal memory ($p=0.055$) and semantic fluency ($p=0.057$) approached statistical significance.

CONCLUSION

Although the statistical analyses were performed with a smaller sample, we believe that these preliminary results are somewhat encouraging, as they confirm previous findings and pave the way to the possibility that pragmatic abilities rely on both ToM (especially its affective component) and executive functions. More in-depth, a predominant role of inhibition emerged, as it seems to be an important predictor not only of pragmatic competence in general, but also of PD patients' pragmatic skills. Furthermore, once the sample is complete, we would also expect to observe a significant between-group difference in the Figurative Language 2 task of the APACS test, as the more data are collected, the more this between-group difference seems to emerge. Patients' difficulty in providing a good explanation of figurative expressions could be linked to their impaired performance in the inhibition task, compared to controls; if confirmed, this finding could reflect patients' difficulty in suppressing the literal meaning of those expressions, compared to their healthy counterpart.

In sum, if confirmed by the final stats, these findings could contribute to a better characterization of pragmatic impairment in earlier stages of PD, leading to the possibility to monitor its progression over time. Moreover, the hypothesized link between figurative language and inhibition needs to be further investigated, in order to understand if the comprehension of figurative meanings can rely on the ability to first inhibit the literal meaning of that given expression.

STUDY 2

PRAGMATIC LANGUAGE CHANGES IN PARKINSON'S DISEASE: A ONE-YEAR LONGITUDINAL STUDY

RESEARCH QUESTION AND AIM

Study 1 laid the groundwork for a deeper exploration of pragmatic language changes in PD. The way pragmatic skills evolve over time in patients with PD still lacks solid evidence, as none of the existing research studies has addressed this issue yet. Few studies concerning pragmatic language changes focused on normal aging, highlighting a natural decline of pragmatic skills, which leads to an increasing difficulty in engaging in social relationships[20]. From a clinical point of view, the lack of a monitoring system of pragmatic language skills is somewhat limiting, as patients' quality of life, which slowly worsens due to motor impairments, is also affected by the ability to communicate effectively with others in different contexts. With respect to these premises, the present study aims at investigating the progression of pragmatic impairment over time by monitoring the patients enrolled in Study 1 one year after their baseline evaluation.

METHODOLOGY

Population and Recruitment: 20 patients with PD from *San Martino Hospital*, who already participated in Study 1.

Assessment. After a demographic and clinical assessment, pragmatic abilities, cognitive performance and depression status will be measured (For a detailed description of each test, see Study 1).

Demographic and clinical assessment	AGE EDUCATION H&Y scale UPDRS-III
Pragmatic skills	APACS
Neuropsychological assessment	DIGIT SPAN FORWARD + BACKWARD (verbal WM) CORSI SPAN FORWARD + BACKWARD (visuo-spatial WM) VERBAL FLUENCY TEST TMT (shifting) STROOP TASK (inhibition)

	"VALUTAZIONE DELLE CAPACITÀ DI COSTRUZIONE DELLO SCHELETRO" AND "DENOMINAZIONE VISIVA" (semantic memory)
Screening tests	MoCA PD-CRS
ToM assessment	READING THE MIND IN THE EYES TEST EMOTION ATTRIBUTION TEST STRANGE STORIES
Depression status	BDI-II

Procedure. All patients enrolled in Study 1 will undergo the same evaluation one year (T1) after their baseline assessment (T0). A repeated-measures Anova will be run in order to compare patients' performance at T0 and T1.

PREDICTIONS

In line with Messer's analysis of pragmatic language changes in normal aging[20], we would expect to find a decline of pragmatic skills in patients with PD as well, one year after their baseline evaluation. The reason behind this prediction is mainly related to the way motor and cognitive skills evolve over time in PD and to their link with pragmatic abilities. As the disease progresses, motor dysfunctions become more invalidating, along with significant changes in patients' cognitive skills, which could all be associated to difficulties in both language production and comprehension, as well as nonverbal domains.

STUDY 3

PRAGMATIC ABILITIES IN ADVANCED PARKINSON'S DISEASE: A FOCUS ON QUALITY OF LIFE

RESEARCH QUESTION AND AIM

Advanced stages of PD are characterized by a worsening of motor disabilities, which become more and more invalidating, as well as more significant cognitive changes. It might be hypothesized that pragmatic abilities undergo a severe compromission as well, but what really happens in advanced PD is still a matter of debate. The aim of Study 3 is to outline a comprehensive characterization of pragmatic impairment in a more advanced stage of PD (compared to Study 1), with a specific focus on the relationship between pragmatic competence and quality of life.

WHY IS STUDY 3 DIFFERENT FROM THE PREVIOUS ONES?

Study 1 paved the way to a better characterization of pragmatic impairment in patients with PD, considering early stages of the disease. The aim of Study 2 is to look at the progression of pragmatic language deficits over time in patients who haven't necessarily reached a more advanced

stage, with the only goal consisting in monitoring their evolution one year after the baseline evaluation. The aim of Study 3 is to outline a characterization of pragmatic impairment in patients who reached advaced stages of PD, with a particular focus on its relationship with motor deficits, which are extremely debilitating at these stages, and daily living.

METHODOLOGY

Population and Recruitment: 20 patients with advanced PD (H&Y scores 3-4) from *San Martino Hospital.* Clinical subjects were pre selected by the specialists of San Martino Hospital.

Assessment*:* After a demographic and clinical assessment, pragmatic abilities, cognitive performance, depression status and quality of life will be measured (For a detailed description of each test, see Study 1).

Demographic and clinical assessment	AGE EDUCATION H&Y scale UPDRS-III
Pragmatic skills	APACS
Neuropsychological assessment	VERBAL FLUENCY TEST TMT (shifting) STROOP TASK (inhibition) "VALUTAZIONE DELLE CAPACITÀ DI COSTRUZIONE DELLO SCHELETRO" (semantic memory)
Screening tests	MoCA PD-CRS
ToM assessment	EMOTION ATTRIBUTION TEST
Quality of life assessment	39-ITEM PARKINSON'S DISEASE QUESTIONNAIRE (PDQ-39)

Procedure. Performance in the APACS tasks will be compared between different stages of the disease (patients with early vs advanced PD). Moreover, predictors of pragmatic abilities in advanced PD will be explored, as well as the impact of pragmatic competence on patients' quality of life.

PREDICTIONS

With respect to the results emerged in Study 1, it is possible to predict that Study 3 will show a more widespread pragmatic impairment in patients with advanced PD. A more severe motor dysfunction and significant cognitive changes can be observed at these stages; hence, an impairment in a wider range of domains assessed by the Apacs test could emerge. In particular, we would expect to find a severe compromission in pragmatic language production, which did not emerge in Study 1. The Interview task of the Apacs test measures several linguistic (such as incomplete utterances, underinformativeness, loss of verbal initiative..) and paralinguistic dimensions (such as altered intonation, loss of eye-contact, fixed facial expression…), which can be linked to motor impairments. Thus, a disruption of production abilities could be observed.

Moreover, with respect to the suggested link between inhibition and figurative language (see Study 1), it is possible to hypothesize that, as the impairment in this executive domain worsens, the difficulty in suppressing the literal meaning of a figurative expression becomes more severe. We could then expect to find a compromission not only of the Figurative Language 2 task (in which patients are required to produce an explanation of different figurative expressions), but also of the Figurative Language 1 subtest (in which patients are required to choose the correct interpretation of figurative expressions through a multiple choice task), which did not emerged as compromised in Study 1.

It is also possible to predict a significant link between everyday functioning and pragmatic competece: a severe and widepread disruption of the latter could be responsible for a worsening in patients' quality of life, which could be due to a difficulty in engaging in social relationships and in communicating effectively with others.

STUDY 4

METAPHOR COMPREHENSION IN PARKINSON'S DISEASE: THE ROLE OF INHIBITION

RESEARCH QUESTION AND AIM

In light of the emerging difference between PD patients and healthy controls in providing good explanations of figurative expressions in Study 1 and the predominant role of inhibition in predicting general pragmatic abilities, a step forward involves a deeper exploration of the inhibition mechanism in the understanding of metaphors, taking into account their degree of familiarity. Typically, people do not construct the meaning of conventional metaphors, but retrieve the sense of the metaphorical expression from the lexicon. Conversely, the comprehension of novel metaphors is more demanding, as more cognitive skills are involved[6]. The primary aim of this study is to test the hypothesis that patients with PD are more impaired in the comprehension of novel metaphors, compared to high-familiar ones. The secondary aim is to investigate the relationship between metaphor comprehension and patients' performance at the Stroop task.

METHODOLOGY

Participants. 20 non-demented PD patients from *San Martino Hospital* and 20 matched healthy elders. Clinical subjects will be pre selected by the specialists of San Martino Hospital.

Materials. *Familiar metaphor comprehension task*: 30 familiar metaphors will be presented to the subject who will give a verbal explanation of their meaning. Familiarity of these metaphors will be tested within a preliminary experimental phase.

Novel metaphor comprehension task: 30 novel metaphors (unconventionality will be previously tested) will be presented and the participant will explain their meaning.

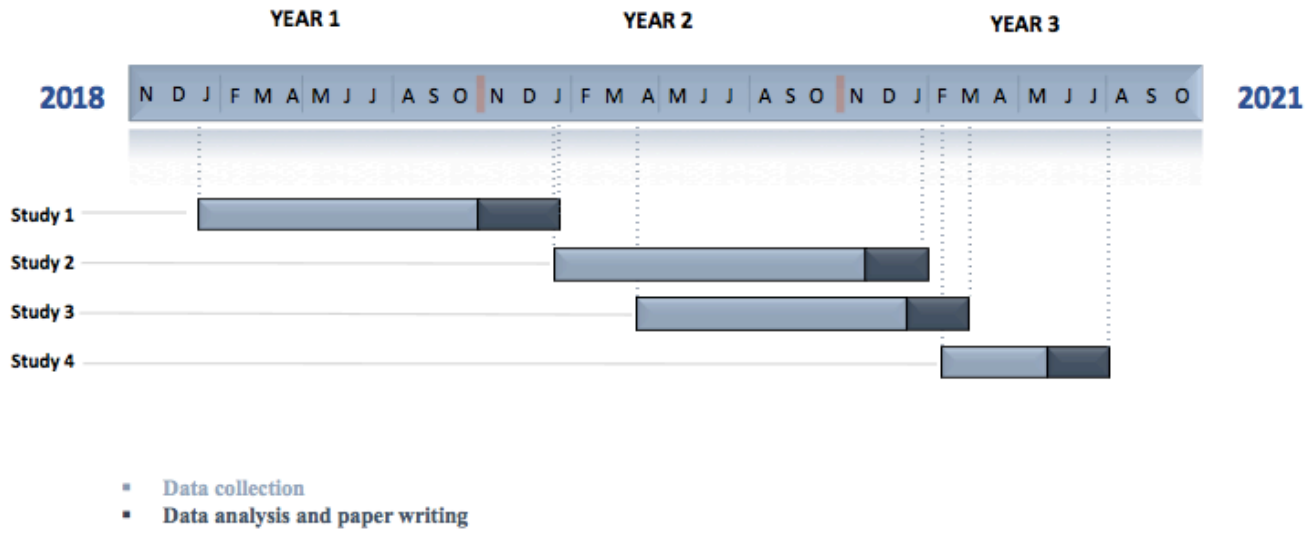
Procedure. Metaphors will be read one at a time to the subjects, who will have to verbally explain the meaning of each of them. Accuracy will be measured: each item will be scored either 2 or 1, according to the accuracy of the explanation, and 0 if a wrong or literal explanation is given or no answer is produced. Participants will be then assessed with the Stroop task, which is a good

measure of inhibition, while cognitive deterioration will be excluded by the administration of the MoCA screening test.

PREDICTIONS

Considering PD patients' difficulty in providing a good explanation of figurative expressions in the APACS test (in which novel metaphors were presented -see Study 1), it is possible to hypothesize that a lower accuracy will be registered for unfamiliar metaphors, compared to the conventional ones. Conversely, within the control group, we wouldn't expect to observe any difference in the understanding of metaphors, regardless of their degree of familiarity. Moreover, it is possible to hypothesize that participants' performance in the Stroop test could be a predictor of the ability to understand metaphors, as cognitive control, which is important in guiding actions when no pre-established schemas are available, as well as suppression of task-irrelevant information are considered crucial aspects for novel mataphor comprehension[6].

TIME CHART



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