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Review

Communication impairment in Parkinson's disease: Impact of motor and cognitive symptoms on speech and language

Kara M. Smith[a,*], David N. Caplan[b]

[a] University of Massachusetts Medical School, 55 Lake Avenue North, Worcester, MA 01655, USA
[b] Massachusetts General Hospital, 175 Cambridge Street, Boston, MA 02114, USA

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ABSTRACT

Communication impairment is common in Parkinson's disease (PD) and may have both motor speech control and cognitive-linguistic underpinnings. The neurobiology of communication impairment in PD is poorly understood, and work is needed to disentangle the relative contributions of motor and cognitive dysfunction. In clinical practice, cognitive-linguistic impairments are often overlooked despite the large body of research on this topic in neurocognitive and linguistics literature.

In this review, we will discuss the roles of motor speech changes, cognitive and linguistic impairment, and other related functions in the communication disabilities of individuals with PD. We will describe the various types of communication difficulties in PD and tools for measuring these symptoms. We will discuss specific deficits that may further understanding of the neurobiology of communication impairment in PD, including voice and speech acoustic changes, linguistic processing and production difficulties, and pausing. We will emphasize the importance of an interdisciplinary approach and the patient perspective on daily communication in guiding future research.

1. Introduction

Communication is one of the most important functions that defines humans as individuals, and loss of ability to communicate can have a devastating effect. Even mild communication difficulties may lead to impaired occupational function, social isolation, and depressive symptoms. Communication impairment is common in Parkinson's disease (PD), present in up to 90% of patients (Miller et al., 2007). Communication difficulties may be present early in the course of PD or develop in later stages (Miller, 2017). Individual with PD often report difficulties with daily communication, but subjective symptoms may differ from the objective deficits detected through standard clinical evaluation. The degree of communication impairment varies widely, but can progress to inaudible and unintelligible speech, preventing communication with loved ones, caregivers and healthcare providers. Functional communication, or the real-life daily communication experiences of the patient, is an important concept as it differs from communication deficits detected in controlled research settings. Functional communication may involve conversational, extemporaneous, or prepared speaking with various speakers (e.g. familiar and unfamiliar), in various physical settings (e.g. phone and in –person, social and occupational), and is therefore critical to activities of daily living. Communication deficits in PD are particularly complex because PD affects both motor and cognitive function. It is not entirely understood which communication deficits are based on effects on motor speech control and the musculature of the vocal apparatus, and which have a cognitive or linguistic basis. It is important to better understand the nature and the underlying pathophysiology of communication deficits in PD, in order to diagnose and monitor changes, predict prognosis, and develop new therapeutic interventions to combat these symptoms.

Although PD is primarily defined by its motor features of tremor, bradykinesia, and rigidity, it is widely recognized that cognitive impairment is prevalent. Cognitive impairment may emerge at any point in the disease course, and both the severity and evolution of deficits are heterogeneous. Subtle cognitive changes may even occur before the development of clinically apparent motor features (Postuma et al., 2012). At the time of initial PD diagnosis, mild cognitive impairment (MCI) may be present in up to 30–40% of patients (Yarnall, , 2014). Those with MCI are at high risk of progression to dementia within 5 years (Pigott et al., 2015). During a typical 15–20 year disease course, the majority of all individuals with PD will develop dementia (Hely, Reid, Adena, Halliday, & Morris, 2008).

Despite the prevalence of cognitive impairment in PD, the relationship of cognitive deficits and communication disability in PD has

* Corresponding author.
E-mail addresses: kara.smith@umassmemorial.org (K.M. Smith), dcaplan@partners.org (D.N. Caplan).

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been relatively overlooked in comparison with studies of motor function. Clinicians treating patients with PD often focus more on motor symptoms, especially in earlier disease when cognitive deficits are subtle, and may not screen for the entire range of possible communication deficits. Speech therapy programs designed for PD, such as the Lee Silverman Voice Training Program, also focus on motor aspects of speech (Sapir, Ramig, & Fox, 2011). New therapeutic approaches incorporating cognitive as well as motor aspects of speech and language may improve outcomes on functional communication. Before such therapies can be developed, research is greatly needed to explore the complex interplay between motor and cognitive function in all aspects of communication in PD. It will be critical for this work to involve interdisciplinary teams of researchers to bridge the gaps between clinicians (neurologists and speech-language pathologists) and neuroscience and linguistics researchers. This review will attempt to elucidate, to the extent of our current knowledge, the relative roles of motor speech changes, cognitive and linguistic impairment, and other related functions in the communication deficits of individuals with PD. We will first explore patient-reported communication symptoms in PD, their functional impact, and approaches for measurement. We will then discuss specific areas of impairment that may impact communication, including voice and speech acoustic changes, linguistic processing and production deficits, and pausing. Finally, we will discuss gaps and future directions in research with a focus on the patient perspective and quality of life.

2. Material and methods

We searched the PubMed database using search terms “Parkinson’s” and “language,” “speech”, “acoustics,” “voice,” “pause,” and “communication.” Inclusion criteria included English language, inclusion of human subjects with PD, and primary focus on communication or speech and language. Exclusion criteria included papers that only described technical aspects of measuring voice or speech, or computational algorithm development for speech analysis. Papers were hand-reviewed by K.S. and selected based on their relevance to the objectives of the review. Additional papers were searched and selected based on our areas of focus, including papers describing similar topics in neurological disorders other than PD for comparison.

3. Results and discussion

3.1. Common self-reported speech and communication symptoms in PD

Both quantitative and qualitative research methodologies have been used to understand the scope and nature of communication difficulties in PD. Some clinical scales require a speech and language pathologist to perform, and others are questionnaires based on patient response. One cross-sectional survey of PD patients in Sweden revealed that worsened speech was the second most common symptom endorsed overall in PD, equally prevalent in early and later disease (Schalling, Johansson, & Hartelius, 2017). Qualitative research by Miller et al. found that individuals with PD commonly report challenges in carrying on a conversation (Miller, Noble, Jones, Allcock, & Burn, 2008). These communication difficulties impacted perception of self-worth and led to avoidance of social interactions. Word finding difficulty and getting off topic during conversation are common patient-reported symptoms impacting communication in PD (Schalling et al., 2017). Word finding difficulty in PD was initially described as “tip-of-the-tongue” phenomenon by Fahn et al. and measured by confrontational and category naming (Matison, Mayeux, Rosen, & Fahn, 1982). However, when tested using general knowledge questions, subjects with PD had a similar percentage of tip-of-the-tongue instances compared with elderly controls and both groups were similarly accurate in predicting their ability to recognize the correct word within a list (Oh-Lee, Szymkowicz, Smith, & Otani, 2012). One study reported that PD subjects with a predominantly akinetic-rigid clinical phenotype had impaired tip-of-the-tongue response accuracy compared to tremor-predominant PD subjects (Yu, Wu, Tai, Lin, & Hua, 2010). There may well be a discrepancy between the anecdotally common patient-reported symptom of word finding difficulty and “tip-of-the-tongue” instances in an experimental setting. Future studies should address word finding difficulty in PD in the context of daily communication. Studies designed to assess the epidemiology and functional impact of this symptom beyond that of normal aging-related changes will be helpful to better understand and address this symptom in the clinical setting.

It has been hypothesized that word finding difficulty in PD is explained at least in part by decreased speed of processing, akin to the motor slowing characteristic of the condition. Another possible explanation is impaired access to, or content of, the lexicon. Although the evidence is mixed, most studies suggest that the lexicon, as measured by confrontation naming, is relatively preserved in PD without dementia (Yarnall et al., 2014). Lexical retrieval may therefore be impaired in PD because of dysfunction of the connections between the frontal cortex and basal ganglia needed to achieve efficient retrieval. This impairment would be most obvious when there were additional frontal executive demands, such as during a conversation with rapidly shifting topics. This hypothesis of frontostriatal dysfunction in word retrieval is supported by studies of verbal fluency in PD. Some but not all studies show that verbal fluency tasks requiring frontal executive function are most consistently impaired in PD (see Section 3.3.2.4 for further discussion of verbal fluency). Also in support of this hypothesis are the results of Yu et al. mentioned above. The PD subjects who had akinetic-rigid predominant motor symptoms and showed impaired tip-of-the-tongue response accuracy also had worse executive function. While evidence for a frontostriatal etiology of word finding difficulty is still preliminary, it suggests that testing fluency, executive function, and word finding in more challenging paradigms that reflect functional communication may be necessary to capture these subtle deficits.

3.2. Clinical assessment of communication in PD

Given that communication symptoms in PD vary considerably in type and severity, clinical assessment tools are needed to gather both individual and population-level data. It is difficult to directly observe and measure a patient’s range of communication difficulties in an office-based visit. Symptoms are likely to vary with the pace and complexity of the communication, the number and identity of speakers (familiar or unfamiliar), and the surrounding environment. Possible approaches to assessing communication symptoms include patient-reported and knowledgeable informant/caregiver-reported scales and questionnaires, and objective quantitative measures designed for use in the patient’s daily life. Overall there are few assessment measures designed to capture daily communication difficulties in PD. The most common quality of life scale in PD, PDQ-39, has one question on speech and one question on communication with other people (Jenkinson, Fitzpatrick, Peto, Greenhall, & Hyman, 1997). The Penn Parkinson’s Daily Activities Questionnaire (PDAQ) has a 50 item and a 15 item version. It was developed using item response theory to capture cognitive impact on instrumental activities of daily living in PD and includes several questions pertaining to communication (Brennan et al., 2016a, 2016b). However, it was validated for a knowledgeable informant to complete rather than the patient themselves. It is unknown how patient and knowledgeable informant perspectives on communication symptoms may differ, as these particular symptoms can be quite subjective in how they are experienced by the patient. Miller et al. administered a self-developed questionnaire about communication abilities to PD patients and their caregivers. The patients’ perceptions of communication abilities did not correlate with intelligibility, or with severity of motor or cognitive symptoms. Some PD patients perceived worse deficits than their caregivers reported, suggesting that subtle subjective difficulties may still impact the patient and that some