Cognitive-Linguistic Difficulties in COVID-19

Louise Cummings

Department of English and Communication

The Hong Kong Polytechnic University, Hong Kong SAR, China

Abstract:

The COVID-19 pandemic has brought considerable death and economic hardship to populations around the world. Yet, its legacy may be in the form of Long COVID, a condition in which individuals who have had COVID infection continue to experience symptoms often for many months after their acute illness. One group of symptoms is described by sufferers as "brain fog". This expression captures a constellation of complaints that are cognitive-linguistic in nature, with affected individuals reporting a significant impact of these problems on their occupational functioning and daily lives. This chapter reports the findings of case studies of two adults with Long COVID. Both adults enjoyed good health prior to their COVID infection. Neither was judged to be unwell enough to require hospitalization during the acute phase of their illness. Yet, they each reported an incomplete recovery and the persistence of debilitating symptoms over many months. The case studies provide a detailed account of their pre-morbid functioning and lifestyle, the onset and progression of their COVID illness, and a comprehensive analysis of their language skills. Both adults had intact structural language skills in the presence of high-level discourse difficulties. Specifically, they struggled to harness their strong skills in structural language to produce *informative* discourse, the transmission of which is an important pragmatic function of communication. The language profile associated with these cases of Long COVID is discussed in relation to other conditions that are assessed and treated by speech-language pathologists.

Key words: cognitive-linguistic deficit; COVID-19 pandemic; discourse; informativeness; Long COVID; narration; pragmatics; speech-language pathology

Appears in: Cummings, L. (2023) 'Cognitive-linguistic difficulties in COVID-19', in A. Capone and A. Penna (eds.), *Exploring Contextualism and Performativity: The Environment Matters*, Perspectives in Pragmatics, Philosophy & Psychology 30, Cham, Switzerland: Springer, 141-161.

1. Introduction

COVID-19 is an illness or disease caused by the novel coronavirus SARS-CoV-2. Its emergence was first reported in a seafood or wet market in the central Chinese city of Wuhan in December 2019. It is unclear whether the market was the point of origin of the virus or an amplifier event for a virus that emerged elsewhere and was already undergoing human-to-human transmission. The virus quickly spread to other parts of the world and was declared a global pandemic by the World Health Organization (WHO) on 11 March 2020. As of 8 August 2022, the WHO reports that there have been 6,410,961 deaths worldwide from SARS-CoV-2. The two cases featured in this chapter live in the UK, where by 3 August 2022 there have been 177,977 deaths from COVID-19 within 28 days of a positive test and 200,137 cases with COVID-19 on the death certificate. Alongside these staggering death figures is an equally large impact of COVID-19 in economic terms. Although the World Bank reported that global economic output was expected to expand 4% in 2021, it remained more than 5% below pre-pandemic projections (World Bank Group, 2021). In the UK alone, GDP declined by 9.9 percent in 2020, the steepest drop since records began in 1948 (Harari and Keep, 2021).

Against the backdrop of these global health and economic impacts of this novel virus have been many millions of individuals who have been directly touched by the pandemic, in most cases through infection with SARS-CoV-2. It was apparent to doctors early in the pandemic that SARS-CoV-2 was more than simply a respiratory disease, with symptoms reported in every major organ and system in the body. Huang *et al.* (2020) reported pneumonia, fever, cough, myalgia (muscle aches and pain), fatigue, headache, gastrointestinal symptoms, haemoptysis (coughing up blood), and lymphopenia (reduced white blood cells) in 41 patients with laboratory-confirmed SARS-CoV-2 admitted to a designated hospital in Wuhan by 2 January 2020. Neurological symptoms beyond headaches were also identified early in the pandemic. They include anosmia (loss of smell), stroke, paralysis, cranial nerve deficits, encephalopathy, delirium, meningitis, and seizures (Fotuhi *et al.,* 2020). Given the presence of neurological symptoms, it is to be expected that language and cognitive difficulties may also arise following COVID-19 infection (Priftis, Algeri *et al.*, 2020; Priftis, Prior *et al.*, 2021).

Appears in: Cummings, L. (2023) 'Cognitive-linguistic difficulties in COVID-19', in A. Capone and A. Penna (eds.), *Exploring Contextualism and Performativity: The Environment Matters*, Perspectives in Pragmatics, Philosophy & Psychology 30, Cham, Switzerland: Springer, 141-161.

What has probably been less expected is the occurrence of these difficulties in people who were not severely ill when they first became infected with SARS-CoV-2, but who are reporting an array of symptoms several months after initial infection. Language and cognitive difficulties in people with so-called Long COVID are the focus of this chapter.

Clinical pragmatists have long been aware of the neurocognitive underpinnings of pragmatic language disorders. The pragmatic communication impairments of adults with traumatic brain injury (TBI) and right-hemisphere damage (RHD) are very familiar to speech-language pathologists. These impairments include most notably problems with the informativeness of discourse. Adults with TBI experience reduced informativeness during communication largely on account of the repetition and omission of information. Adults with RHD produce verbose, tangential, and egocentric discourse that similarly limits the informativeness of linguistic communication (see Cummings (2009) for a review). Reduced informativeness is also an early pragmatic marker of cognitive impairment in neurodegeneration (Cummings, 2020). If speakers with Long COVID also display reduced informativeness, then this has several implications for how we understand pragmatic disorders. One key implication is that we must start to conceive of the cognitive basis of pragmatic disorders in different terms. The 'hard' neurocognitive impairments associated with trauma- and stroke-induced brain injury may just be one part of the cognitive substrate of pragmatic dysfunction in adults. Long COVID may teach us that pragmatic language skills are also susceptible to disruption through more subtle and dynamic neurocognitive mechanisms than those observed in adults with acquired brain injuries (Cummings, 2021a).

The two individuals who are reported as case studies in this chapter both became infected with SARS-CoV-2 in March 2020. This was at the beginning of the first wave of the COVID-19 pandemic in the UK. It was a time when the country's health facilities were under considerable pressure to respond to the threat posed by novel coronavirus. The first subject is a 50-year-old male journalist. He was not tested for the virus at the height of the first wave in the UK as tests were only available to hospitalized patients at this time. However, he tested positive for

Appears in: Cummings, L. (2023) 'Cognitive-linguistic difficulties in COVID-19', in A. Capone and A. Penna (eds.), *Exploring Contextualism and Performativity: The Environment Matters*, Perspectives in Pragmatics, Philosophy & Psychology 30, Cham, Switzerland: Springer, 141-161.

SARS-CoV-2 antibodies in July 2020. The second subject is a 48-year-old woman who is an assistant psychologist in a psychiatric hospital in the UK. She did receive a positive virus test result. Both individuals were part of a larger study of cognitive-linguistic difficulties in adults with Long COVID, the results of which are published elsewhere (Cummings, 2021b, 2023). The characteristics of all participants in the study are shown in Table 1 in the appendix.

All participants in the study were recorded online as they undertook a total of 12 language tasks. Each participant was asked to recall a 100-word spoken narrative called Sam and Fred, both immediately and at the end of the session. This task examined immediate and delayed recall of verbal material. The ability to produce words beginning with the letters F-A-S and to generate the names of animals and vegetables, all in 60 seconds, was used to test letter (phonemic) fluency and category (semantic) fluency, respectively. Sentence generation was examined by giving participants two, three, and four words and asking them to put them into brief spoken sentences. Participants were asked to name 20 pictured items in a test of confrontation naming. The ability to characterise steps or stages in everyday activities (procedural discourse) was assessed by asking participants to describe how they would make a cheese and ham sandwich and write a letter to someone. The Cookie Theft picture from the Boston Diagnostic Aphasia Examination (Goodglass *et al.,* 2001) was used to assess picture description ability. A six-frame set of black-and-white line drawings called the Flowerpot Incident, and the Cinderella story were used to examine narrative production under different conditions of production. For further details on each of these tasks, the reader is referred to Cummings (2020).

2. Case study 1: 50-year-old journalist

Background: Nigel (not his real name) is 51 years old. He is married and has two sons, aged 11 and 14 years. He is a journalist and producer. Nigel has 14 years of formal education. He left school at 16 years of age and spent five years doing manual/casual work all over Europe. Nigel obtained a BA (Hons) Modern European Studies degree in 1994. A year later, he graduated with a Master of Social Science in Economic History. In 1997, Nigel obtained a

National Certificate in Journalism. Seven years ago, Nigel started working part-time to support his wife in her work and to be around his children, one of whom has Asperger's syndrome and requires additional support. Prior to this time, he had worked abroad for long periods of time. Nigel's work involves specialist research for documentaries and feature films which he can mostly undertake according to his own schedule. Occasionally, he films events and interviews and edits films, mostly short pieces, again according to his own schedule. Recently, he has been doing more writing. He has written scripts for documentaries and a feature film. He is raising finance to go into production.

Prior to contracting COVID-19, Nigel enjoyed excellent health. He had no chronic health problems, had never undergone surgery and was not taking prescribed medication. Nigel is 6 feet 1 inch in height and weighs 181 pounds, giving him a BMI of 23.9 (normal weight). He has the occasional glass of beer or wine (approximately once a month). He stopped smoking 14 years ago. Nigel has no food allergies and once had an allergic reaction to a paracetamol tablet. He has normal hearing. In the last couple of years, he has started wearing glasses for driving.

Prior to his illness, Nigel undertook regular exercise. He ran for half an hour, four times a week. He also did yoga once a week and cycled to and from meetings, a trip of 40 minutes in each direction. Nigel was also very active with his two children. He eats a well-balanced diet, consisting of fresh fruit and vegetables, whole grains and nuts, legumes, dairy products, occasional fish and lean meat. Nigel did not take vitamin and mineral supplements prior to COVID-19, but now takes vitamins B, C and D plus zinc, magnesium and a liquid form of iron. Nigel plays the violin in a Klezmer band. The band meets monthly for an afternoon of music making and occasional performances. He also enjoys cooking, adventuring, and reading. Nigel is a member of a Long COVID group on Facebook.

Nigel was first alerted to the possibility that he had contracted COVID-19 when he experienced a loss of power on 12 March 2020. This was at the start of the pandemic in the

Appears in: Cummings, L. (2023) 'Cognitive-linguistic difficulties in COVID-19', in A. Capone and A. Penna (eds.), *Exploring Contextualism and Performativity: The Environment Matters*, Perspectives in Pragmatics, Philosophy & Psychology 30, Cham, Switzerland: Springer, 141-161.

UK when testing was not widely available. Nigel was not tested for the virus until 20 July 2020 when he received a negative result. On 21 July 2020, he tested positive for COVID-19 antibodies. Nigel believes he was exposed to the virus at a yoga class, as other people from the same class developed COVID-19 symptoms a day later than him on 13 March 2020. Apart from the members of his yoga class, Nigel knows several other people who contracted the virus. At least thirteen of his neighbours developed illness, with one admitted to an intensive care unit in hospital. He also knows two music teachers who had the virus. Nigel's uncle, who lives more than 100 miles from him, has just died from COVID-19. Nigel's nephew, who also lives more than 100 miles away, recently contracted COVID-19 at a school where he teaches. He transmitted the virus to his father, Nigel's brother, who is now in hospital receiving oxygen for COVID-19. He in turn passed the virus to his mother (also Nigel's mother) and sister, both of whom have just tested positive for COVID-19. Several of these individuals have still not returned to full health and are experiencing symptoms of Long COVID.

Nigel was not under medical supervision when he had COVID-19. At the beginning of April 2020, he had a telephone consultation with a doctor. A full range of blood tests was ordered. They were all normal apart from vitamin B12, which was low. He received a three-month course of B12 injections but there was no follow-up. Nigel attended Accident and Emergency between 19 and 23 July 2020. He had a sudden headache and then blood appeared from his mouth and nose. He received a brain scan and lumbar puncture and nothing abnormal was detected. Nigel has been referred to a COVID Clinic. He has received a reply saying that the "respiratory clinic" is not the right place for him, and they do not have any treatments for his condition. He is waiting to hear from the doctor about what happens next. In terms of his mental health, Nigel experienced some anxiety when he developed gastrointestinal problems, but his anxiety dissipated when these problems improved. He describes occasionally having a mild panic when he thinks his health is not going to improve but he tries not to think that way. Nigel reports that his family has really suffered as a result of his illness as he had had to withdraw from a lot of family life. The impact on his eldest son who has Asperger's syndrome is most keenly felt.

Appears in: Cummings, L. (2023) 'Cognitive-linguistic difficulties in COVID-19', in A. Capone and A. Penna (eds.), *Exploring Contextualism and Performativity: The Environment Matters*, Perspectives in Pragmatics, Philosophy & Psychology 30, Cham, Switzerland: Springer, 141-161.

Clinical symptoms: Nigel experienced severe breathing difficulties during his acute COVID illness. He described how he woke up feeling severely starved of oxygen on several occasions. This occurred on and off for a period of four months. Although this symptom has now mostly resolved, Nigel still cannot exercise or exert himself. He gets short of breath and experiences chest pains when he overdoes things. Nigel also experienced severe chest pain and pressure. This coincided with his breathing problems. He had a severe, sharp pain in the side of his chest. He initially thought he was having a heart attack. The pains moved from left to right and then to the centre of his chest. His back also felt tight. The severe pains lasted about a month and have now mostly disappeared.

Nigel described how at the start of his illness his limbs were overwhelmed by an unbearable tingling sensation. He reported that it felt like "an army of fire ants was on the march". This sensation lasted about a month before disappearing and being replaced by chest pains. Nigel has also experienced headaches. At the start of his illness, there were a few nights where he had what he can only describe as "electrical" headaches. It felt like his brain and head were misaligned and like a razor blade was scraping inside his skull. While it was not very painful, it was unpleasant. Nigel was not able to sleep on those nights. He was also unable to concentrate for any length of time, particularly if a screen was involved. He still gets the occasional headache but the month where he had them every day has passed.

In September 2020, Nigel experienced acute vertigo. It lasted for a few days, subsided, but has not fully gone away. If he must concentrate for any length of time, his head starts to swim, and he begins to feel overwhelmed and must stop. There are times when he can feel "a sort of bubbling" going up the back of his head. If Nigel leans back and there is pressure on his neck, it triggers a sensation of head swimming or spinning which makes it difficult to sleep. Nigel also had some stomach pains for a week or so during September. He reports that he often struggles to get his food down: "it feels like it's not going down properly". The vertigo

Appears in: Cummings, L. (2023) 'Cognitive-linguistic difficulties in COVID-19', in A. Capone and A. Penna (eds.), *Exploring Contextualism and Performativity: The Environment Matters*, Perspectives in Pragmatics, Philosophy & Psychology 30, Cham, Switzerland: Springer, 141-161.

has mostly gone and even when it returns, it seems to have lost its power. But he is now suffering tinnitus in his left ear.

Less severe symptoms reported by Nigel include a rash on his forehead, the side of his face and down the back of his head. He also had some spots on his chest. This occurred a few months into his illness and has now mostly gone. A doctor said it looked like a chicken pox rash (Nigel had chicken pox when he was around 12 years of age). Although he did not experience a loss of taste or smell, Nigel frequently smells cigarette smoke. He also had a sharp pain in his elbow and occasional aches in his limbs. He still feels like he has no strength. Occasionally, his limbs feel very heavy and like they do not want to do anything. That is still the case today.

Daily activities: COVID-19 has affected all aspects of Nigel's daily life. Currently, he is not doing any paid work as he is unable to concentrate on written or intellectual work for long: "my head starts to swim". He is unable to do any physical aspect of his job. For the first half of 2020, he was unable to undertake any household chores. He has now started shopping, cooking and cleaning again. However, he needs to rest after he does anything: "Once [the children] are off [to school] I try and do an hour's work, then rest for half an hour, then another hour, then rest". If he tries to do too much, his chest becomes tight, the chest pains return, and he must stop doing anything until it lifts. In terms of exercise, Nigel is still unable to run but has started doing some light yoga again. He tries to do a half hour walk in the evening. He has also been able to start practicing the violin again. He needs to make lists to remember what he must do.

Medication: During the acute phase of his COVID illness, Nigel took Beclomethasone dipropionate, an anti-inflammatory corticosteroid spray used to treat nasal symptoms caused by seasonal or year-round allergies. Nigel bought it at the beginning of the year as he sometimes has a mild reaction to pollen and pollution in the spring.

Appears in: Cummings, L. (2023) 'Cognitive-linguistic difficulties in COVID-19', in A. Capone and A. Penna (eds.), *Exploring Contextualism and Performativity: The Environment Matters*, Perspectives in Pragmatics, Philosophy & Psychology 30, Cham, Switzerland: Springer, 141-161.

Communication: Nigel describes some changes in his language and communication skills since contracting COVID-19. He reports that he has never been good at remembering people's names and that there has been no deterioration in this ability following his illness. He can sometimes forget simple words during a conversation. Occasionally, he is not able to remember the topic of a conversation and follow what others are saying in conversation. He can read and write for short periods of time, but screens cause him difficulty. For example, he struggles to watch the television for any length of time. He reports no difficulty following the plot in a story or a film. Since his illness, Nigel has had less desire to participate in conversation with others and struggles to make the effort to communicate in some situations. He communicates with other people daily but when he does not feel well, he will go and lie down.

The author spoke to Nigel online for nearly an hour on 19 October 2020. It was 10am UK time. He was relaxed and appeared not to fatigue during the session. Nigel spoke with ease about his COVID illness and how he perceived his recovery to date. His mood was normal. He was responsive throughout the session and undertook all tasks willingly. Nigel displayed strong conversational skills. He took turns appropriately with the author and made informative, relevant contributions to conversation. His speech was fully intelligible. He spoke with normal fluency, rate, pitch, and loudness. There was no evidence of dysarthria or apraxia of speech, and he did not exhibit phonological impairment. His utterances were well formed and meaningful. Nigel's comprehension of language also appeared to be intact. He understood questions and followed all instructions used by the author.

Nigel's performance on the 12 language tasks used in the study is shown below, alongside the performance of the 16 healthy participants who had also taken part in the study by the stage at which he was recorded in October 2020 (Fig. 1):

Task	**Nigel**	**Healthy controls[ǂ] (N=16)**	**Healthy males[ϕ] (N=6)**

Appears in: Cummings, L. (2023) 'Cognitive-linguistic difficulties in COVID-19', in A. Capone and A. Penna (eds.), *Exploring Contextualism and Performativity: The Environment Matters*, Perspectives in Pragmatics, Philosophy & Psychology 30, Cham, Switzerland: Springer, 141-161.

Sam and Fred (immediate recall)¶	50%	66% (42-92%)	65%
Sam and Fred (delayed recall)¶	42%	64% (39-85%)	58%
Cookie theft picture description¶	50%	66% (54-83%)	62%
Sentence generation	83%	87% (66-100%)	83%
Letter fluency (F-A-S)	39	46 (30-67)	43
Category fluency (animals)	22	25 (18-37)	24
Category fluency (vegetables)	14	16 (9-24)	12
Flowerpot incident narration¶	55%	73% (55-100%)	70%
Cinderella narration¶	62%	67% (47-90%)	67%
Procedural discourse (sandwich)¶	75%	90% (68-100%)	92%
Procedural discourse (letter)¶	100%	79% (25-100%)	74%
Confrontation naming	100%	88% (65-100%)	88%

‡ Figures for healthy controls are means (range).
ϕ Figures for healthy males are means.
¶ Figures indicate informativeness as a percentage.

Fig. 1: Nigel's performance relative to healthy participants

Nigel displayed performance in the normal range in sentence generation and confrontation naming. He was able to encode auditorily presented words within a well-formed sentence (sentence generation) and could access the mental lexicon and retrieve the names of images (confrontation naming). These findings are consistent with his strong expressive and receptive language skills during spontaneous conversation. Nigel produced 22 animal names and 14 vegetable names in 60 seconds. His category fluency performances were consistent with the scores of healthy participants in the study and with published normative data for people of similar age, gender, and educational background (all figures are means) (Fig. 2):

Appears in: Cummings, L. (2023) 'Cognitive-linguistic difficulties in COVID-19', in A. Capone and A. Penna (eds.), *Exploring Contextualism and Performativity: The Environment Matters*, Perspectives in Pragmatics, Philosophy & Psychology 30, Cham, Switzerland: Springer, 141-161.

Animal naming (Tombaugh *et al.,* 1999): Age (50-59 years): 20.1 names Gender (male): 17.4 names Education (13-16 years): 19.0 names	*Animal naming* (Acevedo *et al.,* 2000): Age (50-59 years): 18.4 names Gender (male): 16.2 names Education (13-16 years): 16.3 names
Animal and vegetable naming (Clark *et al.,* 2016): 51 cognitively normal adults (mean age: 68.9 years) 22 animal names in 60 seconds 15 vegetable names in 60 seconds	*Vegetable naming* (Acevedo *et al.,* 2000): Age (50-59 years): 16.0 names Gender (male): 11.9 names Education (13-16 years): 14.0 names

Fig. 2: Normative values for category fluency

Nigel produced 39 words beginning with F-A-S in 60 seconds (F=14 words; A=16 words; S=9 words). His letter fluency performance was slightly below the mean score of healthy participants in the study and mean values for his age and education according to some published studies (Fig. 3):

Letter fluency (Tombaugh *et al.,* 1999): Age (50-59 years): 42.1 words Gender (male): 37.0 words Education (13-16 years): 42.6 words	*Letter fluency* (Clark *et al.,* 2016): 51 cognitively normal adults (mean age: 68.9 years) No. words produced in 60 seconds: F=16.8 words; A=15.6 words; S=16.9 words

Fig. 3: Normative values for letter fluency

Appears in: Cummings, L. (2023) 'Cognitive-linguistic difficulties in COVID-19', in A. Capone and A. Penna (eds.), *Exploring Contextualism and Performativity: The Environment Matters*, Perspectives in Pragmatics, Philosophy & Psychology 30, Cham, Switzerland: Springer, 141-161.

Nigel's category and letter fluency performances suggested that lexical generation and executive functioning were not areas of impairment for him. The same was also true of his performance on procedural discourse tasks. Nigel's procedural discourse score for the sandwich-making task was below the mean of healthy participants, but well above the mean for letter writing. He produced the steps for each of these tasks in the correct order.

The area where Nigel's performance was markedly reduced was the informativeness of his spoken discourse. Informativeness was measured in terms of the percentage of essential information units that Nigel was able to produce. Reduced informativeness was evident in Nigel's immediate and delayed recall of the 100-word Sam and Fred story, where he produced 50% and 42% of essential information units, respectively. However, verbal memory alone cannot account for Nigel's reduced informativeness. The retention of information in memory is not required to undertake the Cookie Theft picture description task and to narrate the Flowerpot Incident story. These tasks provide pictorial support during discourse production. However, Nigel's discourse in both cases was little more informative than his immediate recall of information from verbal memory: Cookie Theft (50%) and Flowerpot Incident (55%). Nigel's most informative discourse was his narration of the Cinderella story. This task uses a wordless picture book to jog an examinee's memory of the details of the story. The book is then closed, and the examinee is asked to tell the Cinderella story. Nigel performed best when his discourse production was supported by pictures that augmented his mental script of a well-known fictional narrative. His informativeness on Cinderella narration was 62%. This score placed Nigel's Cinderella narration within 1 standard deviation below the mean for healthy participants. This was his only discourse production score to fall within 1 standard deviation below the mean. Nigel's performances on immediate and delayed recall and Flowerpot Incident narration were all greater than 1 standard deviation below the mean for healthy participants, while his performance on the Cookie Theft picture description task was greater than 2 standard deviations below the mean (see Table 2 and Table 3 in appendix).

Appears in: Cummings, L. (2023) 'Cognitive-linguistic difficulties in COVID-19', in A. Capone and A. Penna (eds.), *Exploring Contextualism and Performativity: The Environment Matters*, Perspectives in Pragmatics, Philosophy & Psychology 30, Cham, Switzerland: Springer, 141-161.

Nigel had an extensive repertoire of structural language skills. However, he was unable to harness these skills to produce informative discourse. His reduced informativeness appeared to be related to the conditions under which he produced discourse. His informativeness was greatest when he was able to assimilate information from more than one source during discourse production (e.g., visual support in the form of pictures combined with a well-established story script). His informativeness was worst when the task required him to rely on only one source of information (e.g., verbal memory only during immediate and delayed recall, or pictorial support only during picture description). These conditions and their different cognitive demands served to increase or decrease Nigel's ability to construct informative discourse. We will return to this point in section 4.

3. Case study 2: 48-year-old assistant psychologist

Background: Sally (not her real name) is 48;9 years old. She has no children and is co-habiting with her partner. Sally has 12 years of formal education. She graduated in 1998 with a BSc (Hons) in Psychology. In 2004, she obtained a MSc degree in Health Psychology. Sally is currently an Assistant Psychologist in a psychiatric hospital in the UK where she is involved in acquired brain injury rehabilitation. Under the supervision of a trained Clinical Psychologist, she undertakes cognitive and behavioural assessments of adults with head injury and conducts individual and group therapeutic interventions. Her other duties include preparing draft reports, collecting and analyzing data, and conducting staff training. Prior to this role, she worked for over 20 years as a care worker or healthcare assistant in various health and care settings. Although she is not currently working, Sally enjoyed a healthy work-life balance before her COVID illness. Her interests include music and singing, cooking, gardening, reading, and walking. Singing particularly is Sally's "great passion". Before her COVID illness, she subscribed to the view that "my job is just a job. What I DO is sing".

Prior to contracting COVID-19, Sally had some health difficulties. Four years ago, she developed laryngitis. She continued to work and sing as she was trying to get a new band off the ground. After a year, however, she lost her voice. She could not speak for 7-8 months and

required speech therapy. It was 18 months before she could sing again. Sally had a long recovery time following this illness. She has had many bad colds, viral infections, and fatigue since this illness. Sally had "mostly recovered" from her post-laryngitis illness when she became infected with COVID-19. She was diagnosed with anemia in June 2020. This may be related to menorrhagia which she has had for at least 12 months. The exact cause of Sally's anemia is unknown. Her only other chronic health problem was a back condition. Over 20 years ago, Sally had surgery to remove a cyst from her wrist. Her hearing is normal, and she reports some age-related deterioration of her vision. Sally has mild asthma which normally only causes her difficulty when she has a chest infection. She is currently using two inhalers, one of which was prescribed for the first time during her COVID illness (see *Medication*). Sally is not taking any other form of prescribed medication.

Sally reports that she has a normal weight for her age, height, and gender. She does not smoke or vape and only consumes alcohol (a little red wine) at the weekend. Prior to her COVID illness, Sally ate a well-balanced diet. Since becoming unwell, it has been more difficult for her to eat well because of fatigue. She is relying on her partner for meals. He is not a "confident cook", although the recent purchase of a slow cooker has facilitated the preparation of meals. She thinks she is currently eating too much processed food and is turning to tray bakes with plenty of vegetables to work around this problem. Sally has no allergies to food or medication. For her back condition, her chiropractor recommended that she take magnesium citrate. Since developing COVID-19, Sally has been taking vitamin and mineral supplements. In June 2020, Sally started taking ferrous sulphate supplements. This was initially 200mg twice daily but dropped to 200mg once daily from the beginning of October 2020. In August 2020, she started taking a daily vitamin D supplement prescribed by her doctor, InVita D3 25,000units/1ml oral solution. This was taken in liquid form for 6 weeks and then in tablet form (1000u/25mcg). From November 2020, Sally has been taking vitamin B12 100mcg daily.

Appears in: Cummings, L. (2023) 'Cognitive-linguistic difficulties in COVID-19', in A. Capone and A. Penna (eds.), *Exploring Contextualism and Performativity: The Environment Matters*, Perspectives in Pragmatics, Philosophy & Psychology 30, Cham, Switzerland: Springer, 141-161.

Sally first developed symptoms of COVID-19 on 17 March 2020. She had a cough and a "scratchy" throat as well as a little breathlessness. She remained at home during this time. Sally was admitted to hospital on 9 April with breathing difficulties. She was given frequent nebulisers to assist her breathing. She also had a chest X-ray. Nothing abnormal was detected and Sally was discharged on the same day with steroids and antibiotics. Sally was also tested for COVID-19 while she was in hospital. Weeks later, there was some confusion about the result of the test, with Sally first being told the result was negative only to be told subsequently by her GP that it was positive. Sally thinks she contracted the virus in one of two environments. She works in a psychiatric hospital. There were several confirmed cases of COVID-19 among patients and her colleagues shortly before she became unwell. Also, she visited a busy pub a couple of weekends before falling ill. Sally's brother also tested positive for the virus.

Sally describes her recovery from COVID as slow. She reports experiencing a lot of "boom and bust" as she has had to adjust to her new circumstances. Sally reports that she has received frustratingly little support from her GP. She hopes that her condition might change for the better now that she is finally resting. Sally had a second chest X-ray on 29 October 2020 and has assumed in the absence of contact from her doctor that the result is normal. She is currently waiting for a referral to a chronic fatigue specialist.

Clinical symptoms: During her COVID illness, Sally had several severe symptoms. They included coughing, breathing difficulties, fatigue, and headache. Sally's cough lasted 2 months. Her breathing difficulties were most severe at the start of her infection. Currently, she has moderate breathing problems, with occasional flare-ups. Sally's fatigue and headaches have been ongoing since the start of her infection. Among her moderate symptoms were altered taste and smell which lasted a few days. Sally experienced odd and unpleasant smells like stale cigarette smoke and old rubbish. She also has fluctuating but ever-present aches and pains, chest tightness that becomes painful at times, and unusual sensations. For example, her skin has been sensitive to touch. She is currently experiencing

Appears in: Cummings, L. (2023) 'Cognitive-linguistic difficulties in COVID-19', in A. Capone and A. Penna (eds.), *Exploring Contextualism and Performativity: The Environment Matters*, Perspectives in Pragmatics, Philosophy & Psychology 30, Cham, Switzerland: Springer, 141-161.

tinnitus and mild, flu-like symptoms. Sally had a mildly sore throat that resolved when her coughing subsided. Sally's illness has also caused her anxiety, as she assesses the impact of COVID on her ability to work and resume activities of daily life.

Sally also reports cognitive-linguistic problems since developing COVID-19. She has problems finding words that she wants to use. Sally is not currently working. But when she was working from home, planning, and organizing her day was a real struggle. She found the initiation of tasks very difficult. There could sometimes be a 45-minute delay between thought and execution. Sally has memory problems and other lapses of cognition. For example, she recounted an episode when she mistakenly left a slow cooked chicken out of the fridge overnight and had to throw it out the following day. This type of forgetfulness, which she acknowledges most of us display occasionally, is now happening several times a day for her. From her work as an assistant psychologist, Sally recognizes that executive function has been compromised by her illness.

Daily activities: COVID has affected most of Sally's daily activities. She is currently off work due to her illness and is likely to remain so for some time to come. She has considerable anxiety about whether she will be able to return to her current role. Before COVID, Sally was planning a change of career to become a counsellor. She had started to gain relevant qualifications, but all these plans are now on hold. Sally can only manage a few minutes of light household chores at a time. Before her illness, she was very active, even though she did not regularly work out. She enjoyed hill walking and did lengthy hill walks with her partner about once a month. Sally described how walking was her "activity of choice". She was also a singer in a band and worked very long hours, both of which demanded considerable energy and stamina. Currently, Sally is undertaking very few activities that require physical exertion as she is fatigued and breathless. She is unable to sing, something that has caused her "a profound sense of loss". She is looking forward to the time when singing becomes a realistic option for her again. Sally is, however, trying to walk for 10 minutes every day.

Appears in: Cummings, L. (2023) 'Cognitive-linguistic difficulties in COVID-19', in A. Capone and A. Penna (eds.), *Exploring Contextualism and Performativity: The Environment Matters*, Perspectives in Pragmatics, Philosophy & Psychology 30, Cham, Switzerland: Springer, 141-161.

Sally's fatigue and breathlessness have also prevented her from meeting her friends socially. Since the start of national lockdown in the UK in March 2020, Sally has met one friend on two occasions and had a video call with another friend. Most social contact with her friends is now conducted online and she has distanced herself from some friends. Sally used Facebook to keep in touch with other people, share music, and network for musical contacts before her illness. This is no longer the case. She now uses social media to access Long COVID support groups. She can spend a maximum of 10-15 minutes at a time on leisure activities.

Medication: Before COVID, Sally occasionally used a Salbutamol inhaler for the treatment of mild asthma. She has been making more frequent use of this inhaler because of her COVID illness. She has also started to use a Fostair inhaler twice a day.

Communication: Sally also reports language and communication difficulties following her COVID infection. She cannot remember the names of people and things during conversation, and what others have just said in conversation. She also struggles to remember the topic of conversation and to follow what others are saying in conversation. Her writing is unaffected. She finds reading difficult due to a lack of concentration. This is particularly acute when there is background noise (e.g., the TV is on or her partner is playing his guitar or PlayStation). She has not attempted yet to watch a film and does not know if she could follow its plot. Both her desire to participate in conversation with others and the frequency with which she is communicating with others have reduced since her illness.

The author spoke to Sally online on 12 November 2020. It was 9:30am UK time and the meeting lasted one hour. Sally displayed significant distress during the session when she encountered difficulty with the first task. It was, therefore, decided to meet again the next day to complete the tasks that had not been conducted in the first meeting. The second meeting lasted 48 minutes and took place at 1pm UK time. Sally's distress in the first meeting occurred during immediate recall of the Sam and Fred story. Initially, she thought she may be "too good" to participate in the study, based on her experience of working with adults who

Appears in: Cummings, L. (2023) 'Cognitive-linguistic difficulties in COVID-19', in A. Capone and A. Penna (eds.), *Exploring Contextualism and Performativity: The Environment Matters*, Perspectives in Pragmatics, Philosophy & Psychology 30, Cham, Switzerland: Springer, 141-161.

have cognitive difficulties. It was upsetting to her to realise that she was struggling to complete this exercise:

> "Oh my gosh, I can't remember. Sorry, I'm just a bit shocked. I knew my memory wasn't great at the moment. Sorry. (*cries*) Do you know I thought, I thought that I might, I worried that I might be wasting your time […] I'm so sorry, I wasn't expecting to get emotional."

Sally was fully cooperative during both recordings and displayed normal mood, apart from her episode of understandable distress in the first meeting. Her speech was fully intelligible, and she spoke with normal fluency, rate, pitch, and volume. There was no evidence of motor speech disorder, either dysarthria or apraxia of speech, and Sally did not have a phonological impairment. Even though we worked at a gentle pace during both sessions, it was clear that the interaction and tasks on both occasions resulted in fatigue for her.

Sally's performance on the 12 language tasks used in the study is shown below, alongside the performance of the 16 healthy participants who also took part in the study up to November 2020 (Fig. 4):

Task	**Sally**	**Healthy controls‡ (N=16)**	**Healthy females$^{\Phi}$ (N=10)**
Sam and Fred (immediate recall)¶	57%	66% (42-92%)	68%
Sam and Fred (delayed recall)¶	64%	64% (39-85%)	67%
Cookie theft picture description¶	66%	66% (54-83%)	68%
Sentence generation	100%	87% (66-100%)	89%
Letter fluency (F-A-S)	42	46 (30-67)	47
Category fluency (animals)	15	25 (18-37)	26
Category fluency (vegetables)	18	16 (9-24)	18

Appears in: Cummings, L. (2023) 'Cognitive-linguistic difficulties in COVID-19', in A. Capone and A. Penna (eds.), *Exploring Contextualism and Performativity: The Environment Matters*, Perspectives in Pragmatics, Philosophy & Psychology 30, Cham, Switzerland: Springer, 141-161.

Flowerpot incident narration[¶]	42%	73% (55-100%)	75%
Cinderella narration[¶]	30%	67% (47-90%)	67%
Procedural discourse (sandwich)[¶]	81%	90% (68-100%)	89%
Procedural discourse (letter)[¶]	75%	79% (25-100%)	82%
Confrontation naming	60%	88% (65-100%)	88%

[‡] Figures for healthy controls are means (range). [¶] Figures indicate informativeness as a percentage.
[ϕ] Figures for healthy females are means.

Fig. 4: Sally's performance relative to healthy participants

Sally displayed several cognitive-linguistic strengths. She was able to generate well-formed sentences when presented auditorily with two, three, and four words. Sally was clearly able to hold words in memory while she encoded them into a grammatical utterance. She was also able to plan and sequence instructions for undertaking everyday tasks like making a sandwich. Her planning ability in this task suggests that her executive function skills were relatively intact. This is supported by her letter fluency score of 42 words beginning with F-A-S in 60 seconds. This score is consistent with published normative data for individuals of similar age, gender, and education level to Sally (Fig. 5):

Letter fluency (Tombaugh *et al.,* 1999):

Age (40-49 years): 43.5 words

Gender (female): 37.8 words

Education (9-12 years): 36.7 words

Fig. 5: Normative values for letter fluency

Appears in: Cummings, L. (2023) 'Cognitive-linguistic difficulties in COVID-19', in A. Capone and A. Penna (eds.), *Exploring Contextualism and Performativity: The Environment Matters*, Perspectives in Pragmatics, Philosophy & Psychology 30, Cham, Switzerland: Springer, 141-161.

Sally was also able to produce a reasonably informative description of the single frame Cookie Theft picture. Her performance on this task was comparable to the mean performance of healthy participants in the study. But there were also areas of poor performance in Sally's cognitive-linguistic profile. Her performance on confrontation naming placed her over 2 standard deviations below the mean of healthy participants in the study. Among the stimulus items that Sally was unable to name, an orthographic cue triggered the production of *raccoon* and *grasshopper*, a semantic cue triggered production of *lobster* and *eagle*, and a phonemic cue triggered production of *celery*. Neither an orthographic nor a phonemic cue triggered Sally to produce *French horn*, a word that did not appear to be part of her lexicon. Sally's poor confrontation naming performance confirms her subjective reports of word-finding difficulties in conversation. It is difficult to determine to what extent her naming performance reflects lexical access and retrieval problems related to her COVID illness or is simply typical for her pre-morbid vocabulary.

Sally's lexical generation performance was uneven. She produced 15 animal names and 18 vegetable names in 60 seconds. Her category fluency score for animals placed her over 2 standard deviations below the mean of healthy participants in the study, while her score for vegetables placed her within 1 standard deviation above the mean. However, her ability to generate animal names is not reduced when compared to published normative data for individuals of a similar educational level to Sally. On this basis, it is reasonable to conclude that lexical generation was not an area of impairment for Sally (Fig. 6):

Animal naming (Tombaugh *et al.,* 1999): Age (40-49 years): 20.7 names Gender (female): 16.5 names Education (9-12 years): 16.7 names	*Animal naming* (Acevedo *et al.,* 2000): Age (50-59 years): 18.4 names Gender (female): 16.3 names Education (8-12 years): 15.0 names

Appears in: Cummings, L. (2023) 'Cognitive-linguistic difficulties in COVID-19', in A. Capone and A. Penna (eds.), *Exploring Contextualism and Performativity: The Environment Matters*, Perspectives in Pragmatics, Philosophy & Psychology 30, Cham, Switzerland: Springer, 141-161.

Vegetable naming (Acevedo *et al.,* 2000): Age (50-59 years): 16.0 names Gender (female): 15.0 names Education (8-12 years): 14.2 names	

Fig. 6: Normative values for category fluency

The area where Sally had the most significant difficulties was in the informativeness of her spoken discourse. Her immediate recall of the 100-word Sam and Fred story was very compromised. This task was conducted on three occasions over two consecutive days. On the first reading of the passage, she was only able to recall three essential information units, a performance that placed her over 3 standard deviations below the mean of healthy participants. After the second reading, she recalled six information units and performed over 1 standard deviation below the mean of healthy participants. After the third reading, Sally recalled eight information units, a performance that placed her within 1 standard deviation below the mean. Although her delayed recall of the story was consistent with the mean performance of healthy participants, it should be noted that this result was preceded by considerable rehearsal and learning of the story.

Sally's poor retention of the details of the Sam and Fred story suggest difficulties with verbal memory. But memory alone cannot account for the reduced informativeness of her memorized narrative. This is because Sally's informativeness was lower still during her Cinderella narration and Flowerpot Incident storytelling. Her informativeness score for the Flowerpot Incident story placed her at over 2 standard deviations below the mean for healthy participants. Her performance was worse still on the Cinderella story. Sally produced only 30% of essential information units in this story. This score placed her at over 3 standard deviations below the mean of healthy participants. Neither performance can be attributed to poor verbal memory. Both tasks use visual prompts, with the images for the Flowerpot story on display throughout the task.

Appears in: Cummings, L. (2023) 'Cognitive-linguistic difficulties in COVID-19', in A. Capone and A. Penna (eds.), *Exploring Contextualism and Performativity: The Environment Matters*, Perspectives in Pragmatics, Philosophy & Psychology 30, Cham, Switzerland: Springer, 141-161.

Considered alongside Sally's much better performance on the Cookie Theft picture description task, Sally's performance during the Cinderella and Flowerpot discourse production tasks suggests a pattern in her cognitive-linguistic functioning. Sally's auditory verbal memory is poor and much weaker than her ability to assimilate information that is presented visually in pictures. But even her stronger abilities in processing visual information break down when the cognitive complexity of the task increases. The Flowerpot story requires Sally to integrate information across six images and draw inferences between these images. This high-level processing was a challenge to Sally who had evident struggle in establishing logical connections between the different scenes in the task. In the text demarcated by ↑ Sally can be seen to think aloud about what is happening in the scene. Is the man outside the building and then he goes indoors, or is it the other way round? She also draws the implausible inference that it may be his wife who dropped the flowerpot on his head, implausible if for no other reason that the man would not be banging forcefully on the front door of his own apartment:

> "so, looks like there's a man with a dog and a walking stick and aah hat his hat's fallen off, looks like plant pot is just landed on his head but I couldn't be too sure about that um he looks a bit angry um (2.93) the dog is barking um it's on a floor so a plant pot's fallen on his head it's made him angry, right got that and so he's gone off indoors left the plant pot there ↑ or has he gone out and left the plant pot indoors not sure um ah right yes, I'm getting it now finally, so looks like he is um either in a flat or (1.41) or something like that or his wife might've just dropped something out the upstairs window ↑ either that or his the flat and the person in the flat upstairs has dropped a plant pot out the window and he's gone upstairs to complain um (1.56) the lady has answered the door (1.23) um (1.32) has taken a bit of a shine to the dog and it look as though he's taken rather a shine to the lady upstairs and that (*laughter*) in turn um and an any and that the dog's got a bone and everybody's happy"

Appears in: Cummings, L. (2023) 'Cognitive-linguistic difficulties in COVID-19', in A. Capone and A. Penna (eds.), *Exploring Contextualism and Performativity: The Environment Matters*, Perspectives in Pragmatics, Philosophy & Psychology 30, Cham, Switzerland: Springer, 141-161.

The Cinderella story is even more cognitively challenging for Sally. There is no visual material on display throughout the task. Sally is totally reliant on what she can recall from the pictures presented to her at the beginning of the task, alongside any script she may have in memory of this fictional narrative. The lack of immediate visual support and her forced reliance on memory exceed her cognitive capacity and result in a marked reduction in the informativeness of this narrative.

Sally's cognitive-linguistic performance displays many similarities to Nigel's performance. Both speakers can produce well-formed and meaningful utterances. Although Sally's confrontation naming performance was considerably weaker than that of Nigel, this was less a lexical retrieval deficit consequent to her COVID illness, and more a feature of her pre-morbid vocabulary level. Sally certainly had a lexical repertoire that exceeded the lexical requirements of the discourse production tasks used in the study. So, both speakers have the linguistic structures that are needed to undertake each of the discourse production tasks examined in this study. And yet Sally, like Nigel, cannot harness her linguistic skills to produce informative discourse. Sally's performance breaks down with the changing cognitive demands of each task. Her recall of verbal material is very poor. She can produce informative discourse when there is a single scene to describe, as in the Cookie Theft picture description task. However, as the number of images in the task increases and Sally must draw inferences to connect the images, the informativeness of her discourse decreases. She is least informative when all visual support is removed from her and she is reliant on memory, but she must still interrelate events and actions into a coherent narrative. These are exactly the conditions that obtain during Cinderella narration, Sally's least informative discourse.

4. Implications

Both Nigel and Sally displayed linguistic strengths and weaknesses. Their performance was strong on aspects of language that are typically disrupted in aphasia. They were able to produce well-formed utterances and could comprehend a range of syntactic constructions in the author's utterances. They both reported word-finding difficulty in conversation, although

this was not an evident feature of their expressive language. Nigel's confrontation naming performance was excellent and Sally's performance, while poorer, was certainly adequate for the lexical demands of the discourse production tasks used in the study. Neither speaker produced phonemic or semantic paraphasic errors, and they did not use circumlocutions or produce neologisms. Their expressive language was coherent and meaningful. Despite these linguistic strengths, both speakers displayed a marked reduction in the informativeness of their expressive discourse. This was a consistent feature across the following contexts: immediate and delayed recall of verbal material; picture description; narration based on a sequence of pictures; and narration of a well-known fictional narrative. Procedural discourse was the only form of discourse where their performance was consistent with that of healthy participants. Both speakers were able to identify the key steps needed to perform two everyday activities – making a sandwich and writing a letter – and were able to sequence these steps correctly.

Both Nigel and Sally occupy professional roles – a journalist and assistant psychologist, respectively. In these roles, they may be expected to be relatively adept at assimilating complex information across multiple sources. The reduced informativeness of their discourse is unexpected given their professional training and work experience. In considering the factors that may have contributed to the reduced discourse informativeness of these speakers, it is important to evaluate the potential contribution of gender. Male gender is associated with reduced informativeness of narrative discourse (Wainwright, 2019). However, Nigel's narrative discourses – the Flowerpot Incident and Cinderella – were still markedly less informative than these same discourses produced by male speakers only among the healthy participants, although this was admittedly a small sample of just five participants. Sally also displayed reduced informativeness relative to healthy female participants. Based on these findings, gender did not appear to be a significant factor in the performance of either of these speakers.

Appears in: Cummings, L. (2023) 'Cognitive-linguistic difficulties in COVID-19', in A. Capone and A. Penna (eds.), *Exploring Contextualism and Performativity: The Environment Matters*, Perspectives in Pragmatics, Philosophy & Psychology 30, Cham, Switzerland: Springer, 141-161.

A more convincing explanation appears to be the cognitive demands associated with the different types of discourse production task used in the study. The discourse production tasks that appeared to be most challenging for Nigel and Sally were immediate and delayed recall of a 100-word story, picture description (for Nigel), and Cinderella and Flowerpot narration (for both). The immediate and delayed recall tasks drew on a single cognitive resource, namely, the retention of information in verbal memory. This appeared to be an area of weakness for both speakers, but particularly for Sally. She needed three attempts at immediate recall, and even then, she did not approximate the mean performance of healthy participants in the study.

The Cookie Theft picture description task requires the processing of visual information in a single scene. While Nigel appeared unable to extract all relevant information from this scene to produce an informative description, the visual content of this task appeared to work well for Sally and was much better than her very weak verbal memory for information. For Nigel, the processing of information according to *either* an auditory *or* a visual cognitive modality appeared to be insufficient for him to extract the maximal amount of information needed for later discourse production. It is noteworthy that as other cognitive resources were pressed into use by a task, the informativeness of Nigel's discourses improved, even though they were still below the mean scores obtained by healthy participants. As well as providing a narrator with visual information, the Flowerpot Incident story provided additional narrative structure through the sequence of six frames used in the task. The Cinderella story task provided visual information prior to narration which primed an already well-established story script. These additional cognitive resources appeared to assist Nigel in maximizing information extraction from the input stimuli used in these tasks, with a consequent increase in the informativeness of his narrative discourse. The opposite was true for Sally, whose discourse informativeness decreased with the additional cognitive demands of these tasks.

Reduced discourse informativeness is a feature of the participants in these case studies and other individuals with COVID-19 infection examined by the author (Cummings, 2021a, 2021b,

Appears in: Cummings, L. (2023) 'Cognitive-linguistic difficulties in COVID-19', in A. Capone and A. Penna (eds.), *Exploring Contextualism and Performativity: The Environment Matters*, Perspectives in Pragmatics, Philosophy & Psychology 30, Cham, Switzerland: Springer, 141-161.

2023). But as any speech-language pathologist will tell you, reduced informativeness is also a prominent characteristic of language produced by adults with neurodegeneration, even in the absence of dementia (Cummings, 2020). Reduced informativeness has been reported in adults with Alzheimer's dementia (Cummings, 2019a; Pistono *et al.,* 2019), primary progressive aphasia (Cummings, 2019b), Parkinson's disease spectrum disorders (Ash *et al.,* 2017; Roberts and Post, 2018), and multiple sclerosis (Arnott *et al.,* 1997). Adults who sustain traumatic brain injury (TBI) and right-hemisphere damage (RHD) have also been reported to exhibit reduced informativeness in discourse (Marini, 2012; Power *et al.,* 2020).

Neurodegeneration, TBI, and RHD are conditions in which affected adults can exhibit cognitive-communication disorders. These disorders present the converse type of linguistic impairments to that normally seen in aphasia in that phonology, syntax, and semantics are generally intact or are only mildly impaired. Yet, individuals with cognitive-communication disorders can still communicate inadequately because of impairments in pragmatics and discourse that are often related to cognitive dysfunction. These impairments can make it difficult to construct an informative narrative or provide an adequate description of a depicted scene, even while a speaker has an adequate linguistic repertoire to perform each of these communicative functions. The adults with COVID-19 in these case studies produced considerably less informative discourse than their strong structural language skills would have predicted. Their COVID-19 infections had not caused aphasic language impairments but had resulted in subtle changes to high-level discourse skills needed to produce informative discourse (notwithstanding, of course, that no assessment of these participants' pre-morbid language skills was possible). Speech-language pathologists are used to assessing and treating cognitive-communication disorders in adults with stroke- and trauma-induced brain injury, and brain damage related to neurodegeneration. These cases of cognitive-communication difficulties in adults with COVID-19 indicate that these same difficulties may also be a sequela of this new infectious disease.

Appears in: Cummings, L. (2023) 'Cognitive-linguistic difficulties in COVID-19', in A. Capone and A. Penna (eds.), *Exploring Contextualism and Performativity: The Environment Matters*, Perspectives in Pragmatics, Philosophy & Psychology 30, Cham, Switzerland: Springer, 141-161.

Further research is required to determine if the reduced informativeness observed in speakers with Long COVID in this study resolves over time as part of a protracted recovery or is a permanent feature of this condition. Although this is speculation at this early stage in our understanding of Long COVID, it is possible that the severe fatigue that is a consistent feature of the condition is a significant performance limitation on the use of language. It is for this reason that a group of individuals with chronic fatigue syndrome are included as a control group in the study reported in Cummings (2023). Fatigue may interact with subtle neurocognitive impairments in Long COVID to compromise the use of language. Alternatively, fatigue may make an independent contribution to the reduced informativeness of speakers with Long COVID. Whatever factors are ultimately linked to the linguistic performance of speakers with Long COVID, clinical pragmatists would do well to consider the explanatory potential of this new illness in cognitive models of pragmatic disorders.

Appears in: Cummings, L. (2023) 'Cognitive-linguistic difficulties in COVID-19', in A. Capone and A. Penna (eds.), *Exploring Contextualism and Performativity: The Environment Matters*, Perspectives in Pragmatics, Philosophy & Psychology 30, Cham, Switzerland: Springer, 141-161.

APPENDIX

Study group	N	Age (mean)	Age (range)	Gender (M/F)	Education (years)
COVID experimental participants	69	49.1 years	24.0-64.3 years	5 M/ 64 F	29 under 17 years 40 over 17 years
COVID control participants	11	46.5 years	30.9-60.6 years	3 M/ 8 F	4 under 17 years 7 over 17 years
ME/CFS participants	11	49.2 years	29.3-64.8 years	1 M/ 10 F	5 under 17 years 6 over 17 years
Healthy participants	26	48.2 years	18.1-64.6 years	10 M/ 16 F	7 under 17 years 19 over 17 years
L2 English COVID participants[1]	12	43.2 years	31.2-62.8 years	0 M/ 12 F	2 under 17 years 10 over 17 years
L2 English control participants[2]	13	38.3 years	18.3-60.8 years	3 M/ 10 F	1 under 17 years 12 over 17 years
TOTAL	142	47.3 years	18.1-64.8 years	22 M/ 120 F	48 under 17 years 94 over 17 years

[1] First languages of participants: Mandarin Chinese; Dutch; Romanian; Polish; Portuguese; Italian; Shona (Zimbabwe)

[2] First languages of participants: Mandarin Chinese; Cantonese Chinese; French; Spanish; Dutch

Table 1: Participant characteristics

Appears in: Cummings, L. (2023) 'Cognitive-linguistic difficulties in COVID-19', in A. Capone and A. Penna (eds.), *Exploring Contextualism and Performativity: The Environment Matters*, Perspectives in Pragmatics, Philosophy & Psychology 30, Cham, Switzerland: Springer, 141-161.

Task	Nigel[§]	Sally[§]	Healthy participants Mean (standard deviation)
Sam and Fred (immediate recall)	7/14	8/14	9.4 (±1.9)
Sam and Fred (delayed recall)	6/14	9/14	9.0 (±1.9)
Cookie theft picture description	6/12	8/12	7.9 (±0.9)
Sentence generation	5/6	6/6	5.2 (±0.9)
Letter fluency (F-A-S)	39	42	46 (±10.1)
Category fluency (animals)	22	15	25.6 (±4.8)
Category fluency (vegetables)	14	18	15.9 (±4.2)
Flowerpot incident narration	11/20	8.5/20	14.75 (±2.3)
Cinderella narration	31/50	15/50	33.5 (±5.7)
Procedural discourse (sandwich)	6/8	6.5/8	6.7 (±1.0)
Procedural discourse (letter)	8/8	6/8	6.3 (±1.6)
Confrontation naming	20/20	12/20	17.6 (±2.1)

[§] Figures are raw scores

Table 2: Means and standard deviations for healthy participants

Appears in: Cummings, L. (2023) 'Cognitive-linguistic difficulties in COVID-19', in A. Capone and A. Penna (eds.), *Exploring Contextualism and Performativity: The Environment Matters*, Perspectives in Pragmatics, Philosophy & Psychology 30, Cham, Switzerland: Springer, 141-161.

Task	Nigel	Sally
Sam and Fred (immediate recall)	➢ 1 SD below mean	within 1 SD below mean
Sam and Fred (delayed recall)	➢ 1 SD below mean	on mean
Cookie theft picture description	➢ 2 SD below mean	within 1 SD above mean
Sentence generation	within 1 SD below mean	within 1 SD above mean
Letter fluency (F-A-S)	within 1 SD below mean	within 1 SD below mean
Category fluency (animals)	within 1 SD below mean	➢ 2 SD below mean
Category fluency (vegetables)	within 1 SD below mean	within 1 SD above mean
Flowerpot incident narration	➢ 1 SD below mean	➢ 2 SD below mean
Cinderella narration	within 1 SD below mean	➢ 3 SD below mean
Procedural discourse (sandwich)	within 1 SD below mean	within 1 SD below mean
Procedural discourse (letter)	➢ 1 SD above mean	within 1 SD below mean
Confrontation naming	➢ 1 SD above mean	➢ 2 SD below mean

Table 3: Nigel's and Sally's performance relative to mean scores of healthy participants

Appears in: Cummings, L. (2023) 'Cognitive-linguistic difficulties in COVID-19', in A. Capone and A. Penna (eds.), *Exploring Contextualism and Performativity: The Environment Matters*, Perspectives in Pragmatics, Philosophy & Psychology 30, Cham, Switzerland: Springer, 141-161.

BIBLIOGRAPHY

Acevedo, A., Loewenstein, D.A., Barker, W.W., Harwood, D.G., Luis, C., Bravo, M., Hurwitz, D.A., Aguero, H., Greenfield, L. and Duara, R. (2000) 'Category fluency test: Normative data for English- and Spanish-speaking elderly', *Journal of the International Neuropsychological Society,* 6 (7): 760-769.

Arnott, W.L., Jordan, F.M., Murdoch, B.E. and Lethlean, J.B. (1997) 'Narrative discourse in multiple sclerosis: An investigation of conceptual structure', *Aphasiology,* 11 (10): 969-991.

Ash, S., Jester, C., York, C., Kofman, O.L., Langey, R., Halpin, A., Firn, K., Perez, S.D., Chahine, L., Spindler, M., Dahodwala, N., Irwin, D.J., McMillan, C., Weintraub, D. and Grossman, M. (2017) 'Longitudinal decline in speech production in Parkinson's disease spectrum disorders', *Brain and Language,* 171, 42-51.

Clark, D.G., McLaughlin, P.M., Woo, E., Hwang, K., Hurtz, S., Ramirez, L., Eastman, J., Dukes, R.-M., Kapur, P., DeRamus, T.P. and Apostolova, L.G. (2016) 'Novel verbal fluency scores and structural brain imaging for prediction of cognitive outcome in mild cognitive impairment', *Alzheimer's & Dementia: Diagnosis, Assessment & Disease Monitoring,* 2: 113-122.

Cummings, L. (2009) *Clinical Pragmatics*. Cambridge: Cambridge University Press.

Cummings, L. (2019a) 'Describing the cookie theft picture: Sources of breakdown in Alzheimer's dementia', *Pragmatics and Society,* 10 (2): 151-174.

Cummings, L. (2019b) 'Narrating the Cinderella story in adults with primary progressive aphasia', in A. Capone, M. Carapezza and F. Lo Piparo (Eds.), *Further Advances in Pragmatics and Philosophy. Part 2: Theories and Applications*. Cham, Switzerland: Springer International Publishing AG, 301-329.

Appears in: Cummings, L. (2023) 'Cognitive-linguistic difficulties in COVID-19', in A. Capone and A. Penna (eds.), *Exploring Contextualism and Performativity: The Environment Matters*, Perspectives in Pragmatics, Philosophy & Psychology 30, Cham, Switzerland: Springer, 141-161.

Cummings, L. (2020) *Language in Dementia*. Cambridge: Cambridge University Press.

Cummings, L. (2021a) 'COVID-19 and language: A case study', *International Journal of Language Studies*, 15 (3): 1-24.

Cummings, L. (2021b) *Language Case Files in Neurological Disorders*. New York: Routledge.

Cummings, L. (2023) 'Cognitive-communication difficulties in adults with long Covid', in L. Cummings (Ed.), *Covid-19 and Speech-Language Pathology*. New York: Routledge, 72-95.

Fotuhi, M., Mian, A., Meysami, S. and Raji, C.A. (2020) 'Neurobiology of COVID-19', *Journal of Alzheimer's Disease,* 76 (1): 3-19.

Goodglass, H., Kaplan, E. and Barresi, B. (2001) *Boston Diagnostic Aphasia Examination*. Third Edition. Baltimore, MD: Lippincott Williams & Wilkins.

Harari, D. and Keep, M. (2021) *Coronavirus: Economic Impact*. Briefing Paper. Number 8866. House of Commons Library.

Huang, C., Wang, Y., Li, X., Ren, L., Zhao, J., Hu, Y., Zhang, L., Fan, G., Xu, J., Gu, X., Cheng, Z., Yu, T., Xia, J., Wei, Y., Wu, W., Xie, X., Yin, W., Li, H., Liu, M., Xiao, Y., Gao, H., Guo, L., Xie, J., Wang, G., Jiang, R., Gao, Z., Jin, Q., Wang, J. and Cao, B. (2020) 'Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China', *Lancet*, 395: 497-506.

Marini, A. (2012) 'Characteristics of narrative discourse processing after damage to the right hemisphere', *Seminars in Speech and Language,* 33 (1): 68-78.

Appears in: Cummings, L. (2023) 'Cognitive-linguistic difficulties in COVID-19', in A. Capone and A. Penna (eds.), *Exploring Contextualism and Performativity: The Environment Matters*, Perspectives in Pragmatics, Philosophy & Psychology 30, Cham, Switzerland: Springer, 141-161.

Pistono, A., Jucla, M., Bézy, C., Lemesle, B., Le Men, J. and Pariente, J. (2019) 'Discourse macrolinguistic impairment as a marker of linguistic and extralinguistic functions decline in early Alzheimer's disease', *International Journal of Language & Communication Disorders,* 54 (3): 390-400.

Power, E., Weir, S., Richardson, J., Fromm, D., Forbes, M., MacWhinney, B. and Togher, L. (2020) 'Patterns of narrative discourse in early recovery following severe traumatic brain injury', *Brain Injury,* 34 (1): 98-109.

Priftis, K., Algeri, L., Villella, S. and Spada, M.S. (2020) 'COVID-19 presenting with agraphia and conduction aphasia in a patient with left-hemisphere ischemic stroke', *Neurological Sciences,* 41 (12): 3381-3384.

Priftis, K., Prior, M., Meneghetti, L., Mercogliano, T., Bendini, M. (2021) 'Alexia without agraphia in a post COVID-19 patient with left-hemisphere ischemic stroke', *Neurological Sciences*, to appear.

Roberts, A. and Post, D. (2018) 'Information content and efficiency in the spoken discourse of individuals with Parkinson's disease', *Journal of Speech, Language, and Hearing Research,* 61 (9): 2259-2274.

Tombaugh, T.N., Kozakb, J. and Reesc, L. (1999) 'Normative data stratified by age and education for two measures of verbal fluency: FAS and animal naming', *Archives of Clinical Neuropsychology*, 14 (2): 167-177.

Wainwright, A.B. (2019) 'Gender differences in the narrative productions of African American adults', *American Journal of Speech-Language Pathology,* 28 (2): 623-638.

World Bank Group (2021) *Global Economic Prospects*. Washington, DC: The World Bank.

Appears in: Cummings, L. (2023) 'Cognitive-linguistic difficulties in COVID-19', in A. Capone and A. Penna (eds.), *Exploring Contextualism and Performativity: The Environment Matters*, Perspectives in Pragmatics, Philosophy & Psychology 30, Cham, Switzerland: Springer, 141-161.

Appears in: Cummings, L. (2023) 'Cognitive-linguistic difficulties in COVID-19', in A. Capone and A. Penna (eds.), *Exploring Contextualism and Performativity: The Environment Matters*, Perspectives in Pragmatics, Philosophy & Psychology 30, Cham, Switzerland: Springer, 141-161.