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Pragmatic impairment and COVID-19

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Abstract: The COVID-19 pandemic is the greatest global health threat in over 100 years. Its impact is seen in large numbers of premature deaths and the loss of economic stability for many millions of people. A significant number of people who contract the SARS-CoV-2 virus – the virus that causes COVID disease – experience symptoms many months after their acute illness. So-called Long COVID is now a recognized condition, with many affected individuals unable to return to work and engage in other daily activities. Among the complex symptoms of this condition is "brain fog", a constellation of cognitive-linguistic problems that manifest as forgetfulness, word-finding difficulty, a lack of attention and concentration, and problems engaging in conversation. In this paper, I examine two women who had moderate COVID-19 infection during the first wave of the pandemic in Belgium and the UK. Both participants reported cognitive-linguistic difficulties several months after first becoming unwell. The UK participant is a native English speaker while the participant in Belgium speaks English as a second language. Case studies are used to examine their pre-morbid functioning and lifestyle, the onset and course of their COVID illness, and its impact on their language skills. It is argued that Long COVID has the potential to disrupt pragmatic and discourse skills even as structural language skills are intact. As such, this condition requires further systematic study by clinical linguists and speech-language pathologists.

Keywords: cognitive-linguistic difficulties; COVID-19 pandemic; discourse production; informativeness; long COVID; narrative; pragmatics; SARS-CoV-2

1 Introduction

The SARS-CoV-2 virus is a novel coronavirus that first came to global prominence in December 2019, following an outbreak of severe respiratory illness in people in the central Chinese city of Wuhan. Although the origin of the virus is unknown, its

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genetic similarity to a bat SARS-like coronavirus BatCovRaTG13 (identity 96%) suggests that it is zoonotic in origin. It is unclear whether the seafood or wet market in Wuhan to which early cases were linked was the context for animal-to-human transmission or an amplifier event for a virus that was already transmitting from person to person. It was apparent to the Chinese doctors who treated the early cases of COVID-19 that the SARS-CoV-2 virus affects many organs and systems in the body beyond the lungs and respiration (Li et al. 2020). The nervous system is no exception. In a systematic review and meta-analysis, neurological symptoms (e.g., headache) and complications (e.g., cerebral hemorrhage) were clinical features of patients with COVID-19 infection (Collantes et al. 2021). Against this backdrop, it is not surprising that there should be a growing number of reports of cognitive and language disorder in adults with severe COVID disease (Priftis et al. 2020, 2021). What is probably more surprising, however, is that adults with no manifest neurological complications and with milder forms of illness that did not require hospitalization should also display cognitive-linguistic difficulties. It is these individuals who are the focus of this paper.

The first wave of the pandemic in Europe and the UK began to subside by the middle of 2020. At that time, people who had had COVID infection during the lockdown in the UK were beginning to organize themselves online and share accounts of their illness. There was a recurring theme to their narratives. Many people were expressing concerns that their symptoms were not improving, or at least not as rapidly as might be expected based on other viral illnesses they had experienced. For some people, symptoms improved only to be replaced by new symptoms. People who had had COVID were reporting being too unwell to return to work. Many others had to reduce their working hours because of debilitating fatigue. The expression 'brain fog' began to be used to capture a group of symptoms that related to difficulties with cognition and language. Here are some of the ways these symptoms were expressed:

> ***60-year-old woman*** (reading and writing):
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> Reading isn't too bad but in small doses – newspaper articles, papers relating to Covid, Facebook posts. I've started three books but haven't finished one. The first birthday card I wrote after becoming ill was a disaster – my hand would not do what I wanted it to. I ruined it and had to find another one. I now practice what I'm going to write in a card and take lots of time over it. Rushing is impossible.
>
> ***51-year-old woman*** (word-finding difficulty):
>
> I take more time to find words or can't find them. Then suspect after the event I've got the wrong word. I meant to say 'beach' but ended up saying *bench* and instead of 'yogurt', I said *olive*.

37-year-old man (concentration):

I would lose concentration easily. So would rewind things or stop them and come back to them.

62-year-old man (word-finding difficulty):

I realize I often have gaps in conversation and frustratingly I have to fill in with some description of the word or name I'm trying to find or describe: "so-and-so who did that" "that thing I was looking for yesterday" etc. I had a good one the other day when trying to describe a repair needed on my tractor mower: The cutting deck needs sand-blasting and then powder-coating, but the two pairs of hyphenated words I couldn't get out. Fortunately the engineer knew what I was trying to describe.

As a clinical linguist and speech-language pathologist, I was interested in the difficulties that these individuals were reporting and decided to investigate further. I initiated interviews and data collection in October 2020. At the time of writing, I have recorded and analyzed the language of over 90 adults with Long COVID. The two case studies in this paper feature two of these adults. The wider investigation of which these studies are a part is reported in Cummings (2022).

2 Methodology

To put these case studies in context, it is helpful to provide some information about the methodology of the larger study from which they are extracted. A total of 142 participants were admitted to the study. Each participant was assigned to one of six study categories: adults with COVID who report cognitive-linguistic difficulties; adults with COVID who do not report cognitive-linguistic difficulties; healthy adults (no COVID); speakers of English as a second language with COVID who report cognitive-linguistic difficulties; healthy speakers of English as a second language (no COVID); and adults with chronic fatigue syndrome (CFS). Four of these six study groups served as control participants. This included the two healthy (no COVID) groups, the adults with COVID and no self-reported cognitive-linguistic difficulties, and the adults with CFS. Fatigue was a universal symptom in the COVID participants in the study (see Table 1). To control for the impact of fatigue on cognition and language, adults with CFS – another condition in which there is chronic, debilitating fatigue – were included in the study. The characteristics of all participants can be found in Table 2.

Participants were recruited to the study through posts placed on Long COVID and CFS Facebook groups. Many individuals who participated went on to recommend the study to others who then also took part. Recruitment effectively

Table 1: Overall symptoms in 92 COVID participants in the study.

Symptom	Frequency	Symptom	Frequency
Fatigue	100%	Ear infections	10.87%
Muscle aches and pains	98.91%	Swelling (hands, feet, tongue, glands)	7.61%
Headache	93.48%	Depression and anxiety	6.52%
Breathing difficulties	89.13%	Joint pain	6.52%
Chest pain or pressure	85.87%	Nasal symptoms	6.52%
Coughing	80.43%	Urinary problems	6.52%
Unusual sensations	77.17%	Hallucinations	5.43%
Gastrointestinal symptoms	76.09%	Hormonal problems	5.43%
Fever	71.74%	Laryngitis and voice problems	5.43%
Sore throat	69.57%	Shivers and chills	5.43%
Loss of taste and smell	67.39%	Skin sensitivity	5.43%
Cognitive issues	54.35%	Dental problems	5.43%
Skin rash	51.09%	Localised pain	5.43%
Conjunctivitis	30.43%	Bruising	4.35%
Other symptoms	29.35%	Sinus problems	4.35%
Speech and language problems	25.00%	Noise and light sensitivity	4.35%
Heart palpitations	20.65%	Anorexia (weight loss)	3.26%
Dizziness	19.57%	Hearing loss	3.26%
Insomnia	14.13%	Mouth ulcers	2.17%
Vision problems	14.13%	Post-exertional malaise	2.17%
Tinnitus	13.04%	Swallowing problems	2.17%
Hair loss and scalp sensitivity	11.96%	Postural orthostatic tachycardia syndrome	2.17%
		Thyroid problems	1.09%

proceeded by means of snowball sampling. Seven countries were represented among the 142 participants in the study: UK; Ireland; USA; Canada; Brazil; Belgium; and Australia. The SARS-CoV-2 virus has had an equally devastating impact on people from all cultural and language backgrounds. It was, therefore, considered important to examine if cognitive-linguistic difficulties reported by native speakers of English who had had COVID might also be replicated in speakers of English as a second language who had contracted the virus. For this reason, the author sought to include participants who spoke English as a second language. The first languages of the L2 English speakers with COVID in the study included Mandarin Chinese, Dutch, Romanian, Polish, Portuguese, Italian, and Shona (Zimbabwe).

Table 2: Characteristics of study participants.

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[a]	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[b]	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

[a]First languages of participants: Mandarin Chinese; Dutch; Romanian; Polish; Portuguese; Italian; Shona (Zimbabwe). [b]First languages of participants: Mandarin Chinese; Cantonese Chinese; French; Spanish; Dutch.

Only one COVID participant in the study received intensive medical support in ICU. All other participants remained at home during their illness, with many attending accident and emergency departments or receiving home visits from paramedics for management of their symptoms (e.g., breathing difficulties). Lack of hospitalization was not a sign that these infections were mild in severity – many were not – but reflected the parlous condition that hospitals were in at the start of the COVID pandemic. As cases of infection surged, and medical facilities came under increasing pressure, only the most seriously ill patients were admitted to hospital. Some 21 different symptoms were reported at COVID onset by the 92 COVID participants in the study (see Table 3). As participants with COVID moved beyond the acute phase of their illness into chronic or Long COVID, the number of symptoms increased, eventually totaling some 44 different symptoms (see Table 1). Among the 92 adults with COVID in the study, 52 received a clinical diagnosis of COVID infection by a physician, 16 had a positive PCR test, 20 had a positive antibody test, and 4 had a positive PCR *and* antibody test. All adults in the study enjoyed good health prior to their COVID infections.

Table 3: Symptoms at onset in the 92 participants with COVID in the study.

Symptom	Frequency	Symptom	Frequency
Coughing	46.74%	Dizziness	6.52%
Fever	39.13%	Nasal symptoms	6.52%
Breathing difficulties	31.52%	Shivers and chills	6.52%
Fatigue	29.35%	Cognitive issues	4.35%
Muscle aches and pains	27.17%	Hallucinations	4.35%
Sore throat	26.09%	Heart palpitations	4.35%
Headache	26.09%	Conjunctivitis	3.26%
Loss of taste and smell	19.57%	Joint pain	3.26%
Gastrointestinal problems	13.04%	Insomnia	3.26%
Chest pain or pressure	13.04%	Other symptoms	3.26%
Skin rash	6.52%	Laryngitis & voice problems	2.17%

All interviews were conducted online, using a platform (Zoom, Skype, etc.) chosen by the participants. Interviews were scheduled at a time of day that minimized stress and fatigue for the participants. With permission, all interviews were audio- and video-recorded using the record function on Skype or Zoom and two digital voice recorders (Sony ICD-UX560F). In all but one case, recordings were completed in a single session. For this one participant, the recording was conducted over two consecutive days because she became distressed at her difficulty in completing some of the tasks. The 12 tasks in the study were presented in the same order and with the same set of instructions to all participants (see Table 4). An orthographic transcription was undertaken of all recordings. The author conducted all interviews and scored and analyzed all transcriptions. Participants signed a consent form and received an information sheet in advance of the interview. The study was approved by the Human Subjects Ethics Sub-Committee of The Hong Kong Polytechnic University.

The tasks in the study were used to examine language skills across several language levels. This includes morphology and syntax (sentence generation), lexical access and retrieval (confrontation naming), and pragmatics and discourse (conversation, picture description and narration). Receptive language skills were assessed using the ability to follow complex task instructions and understand questions in conversation and appeared in the normal range for all COVID participants in the study. To ascertain cognitive functioning, several tasks were included that examined immediate and delayed verbal recall and verbal fluency (letter and category fluency). Letter fluency tasks, in which participants are

Table 4: Description of the 12 tasks in the study.

Task	Description
Sam and Fred (immediate recall)	Participant is asked to recall 100-word story immediately. The ability to recall a maximum of 14 propositions is scored.
Sam and Fred (delayed recall)	Participant is asked to recall 100-word story at the end of the test session. The ability to recall a maximum of 14 propositions is scored.
Cookie theft picture description	Participant is asked to describe the Cookie Theft picture from the *Boston Diagnostic Aphasia Examination* (Goodglass et al. 2001). The ability to convey a maximum of 12 propositions is scored.
Sentence generation	Participant is asked to generate a brief sentence containing two, three, or four target words in any order. Sentences are given a maximum score of six points.
Letter fluency (F-A-S)	Participant is asked to produce words beginning with F, A, S in 60 s while avoiding proper names (e.g., *Fred*) and combinations such as *find, finds, finding*. There is no maximum score.
Category fluency (animals)	Participant is asked to produce the names of animals in 60 s. There is no maximum score.
Category fluency (vegetables)	Participant is asked to produce the names of vegetables in 60 s. There is no maximum score.
Flowerpot incident narration	Participant is asked to tell a story based on a sequence of six black-and-white line drawings which are kept on display during the narration. The ability to convey a maximum of 20 propositions is scored.
Cinderella narration	Participant views images in a wordless picture book of the Cinderella story and is then asked to tell the story with the pictures removed from view. The ability to convey a maximum of 50 propositions is scored.
Procedural discourse (sandwich)	Participant describes the stages needed to make a cheese and ham sandwich. The ability to convey a maximum of 8 propositions in the correct order is scored.
Procedural discourse (letter)	Participant describes the stages needed to write a letter to someone. The ability to convey a maximum of 8 propositions in the correct order is scored.
Confrontation naming	Participant is asked to name 20 black-and-white line drawings of objects and living things (animals and plants). Responses are given a maximum score out of 20.

required to conduct a lexical search and produce words in accordance with certain criteria, are a widely used measure of executive function. The combination of these tasks was intended to reveal deficits in lexical-grammatical aspects of language that are typical of aphasia, and deficits in pragmatic and discourse aspects of language that are more typical of a cognitive-communication disorder.

3 Case study 1: 37-year-old researcher

3.1 Background

Mandy (a pseudonym) is 37 years old. She is married and has a 9-year-old son. Mandy has 18 years of formal education. Since January 2020, she has been enrolled for a PhD in Biomedical Sciences. This is a significant departure from her earlier work and studies. Mandy obtained a Master of Science degree in Child Studies in 2009 and is specialized in child behavioral problems. Between 2009 and 2015, she was employed in child protective services. Mandy worked with children up to 18 years of age, some of whom lived in residential settings while others lived at home. She also counselled parents and taught them parenting skills. The families in her care received support on a voluntary basis or were referred to her through the juvenile court. Between 2015 and 2019, Mandy was a project manager in primary healthcare. She worked in a center that coordinates the healthcare provided by general practitioners, physical therapists, pharmacists, psychologists, and social workers for 250,000 people. Mandy trained primary healthcare workers and developed care pathways for specific disorders (e.g., mental health issues). She also encouraged these professionals to coordinate their work and was involved in primary healthcare reform. From 1 January 2019, Mandy has served in a remunerated role in the city council.

Mandy has a diverse language background. She is Chinese and moved with her parents to Belgium when she was almost 4 years old. She reports that her Chinese "isn't that good". She has forgotten many Chinese words since moving out of her parents' house. Her father can only speak Chinese. Mandy reports that her strongest language is Dutch followed by English. She learned English by listening to her mother talk to her friends and co-workers and by watching TV. About 16 years ago, she started reading books written in English because she found the English translations better than Dutch translations (e.g., Murakami's books). She also knows English is vital for the writing of her PhD thesis and that she will need to publish her work in English. She has sometimes noticed that when she forgets a certain word, she can more easily remember it in English than in Dutch. She thinks her Chinese is on the same level as her German which she studied for a year in Austria. Mandy studied French in school but can only understand basic French when people speak slowly.

Prior to contracting COVID-19, Mandy reported that she developed colds quite easily but that otherwise she was healthy. Her only significant health problem has been chronic abdominal pain in the last three years related to adhesions. Her adhesions may have been caused by a caesarean nine years ago when she had her

son. In 2019 and 2020, Mandy had a laparoscopy of the abdomen. She describes herself as slightly overweight for her age, gender, and height. On 6 August 2020, she was tested for diabetes and was found to be pre-diabetic. She is shortsighted but her hearing is normal. Mandy does not have allergies to food or medication. She takes prescribed medications (see *Medication*). Mandy does not consume alcohol and she does not smoke or vape. She takes regular exercise, cycling everywhere she needs to go. She only uses the car to buy groceries. Mandy has a well-balanced diet. She takes magnesium (450 mg) and turmeric complex daily and Vitamin D (25,000 IU) every month. Mandy started taking magnesium and turmeric for the first time following her infection with COVID. She tries to meet with her friends once or twice a week. This is sometimes in real life and sometimes online. She uses Facebook, Slack and Discord to keep in touch with people. Mandy enjoys reading, gardening, tending to her houseplants, cycling, and walking.

On 25 March 2020, Mandy experienced a cough, sore throat, headache, and fever. These symptoms alerted her to the fact that she may have COVID-19. Although she was not tested for the virus, she had a positive antibody test on 8 June 2020. She does not know when or how she was exposed to the virus. Mandy knows many other people who contracted the virus. Her husband was ill, and her husband's grandmother died of COVID-19 infection. One of Mandy's friends and her friend's father also developed COVID-19 as did several of her husband's former colleagues and four people in her local political party. This large number of cases among Mandy's relatives, friends, and other contacts is consistent with the high prevalence of COVID-19 infection that was present in Belgium in the early part of 2020 (Karadag 2020).

Mandy experienced a wide range of mostly severe symptoms during acute infection with COVID-19 (see *Clinical symptoms*). She was not hospitalized during her illness but had contact with her general practitioner by telephone. Mandy has had several investigations and tests related to her illness. On 22 June 2020, she had a chest X-ray and nothing abnormal was detected. On 7 October 2020, she underwent an MRI scan and nothing abnormal was detected. On 9 October 2020, Mandy had neuropsychological testing. Apart from a reduced attention span, her performance was in the normal range. Mandy started brain training for her attention span on 5 November 2020. On 28 October 2020, she had an appointment with a neurologist. The neurologist recorded no significant findings. She does not believe that COVID-19 infection has affected her mental health.

3.2 Clinical symptoms

During acute COVID-19, Mandy experienced a mild fever, altered taste, and chest pain/pressure. She had moderate breathing difficulties, conjunctivitis, and

unusual sensations. However, most of Mandy's symptoms were severe. This included coughing, gastrointestinal problems, fatigue, aches and pains, sore throat, headache, and cognitive problems.

After her acute illness, Mandy noticed a metallic taste in her mouth. Although her temperature is stable, she can experience moments where she suddenly feels cold. She can sometimes get a sensation of heat in one part of her body (e.g., a part of her foot or a spot on her arm). It does not last very long, and it does not happen very often. Mandy has experienced excessive mucus in her eyes since contracting COVID-19. The muscles in her thighs and pelvic floor are often tense. Sometimes her thighs also hurt. At the beginning of her illness, all her muscles were quite tense. Even her jaw felt stiff. Mandy can sometimes experience twitching of the muscles in her arms, legs, and left eyelid. She reports that it feels like small spasms and that it is worse in her legs than in her arms. Sometimes in the middle of the night, the muscles in her legs can suddenly tighten but it does not hurt like a cramp does. In June 2020, this symptom was especially bad, and she started taking magnesium. It began to improve within two weeks of starting magnesium. When Mandy forgets to take magnesium, she can feel more tension in her muscles.

When Mandy wakes up in the morning, her fingers can sometimes tingle. The same fingers on each hand are affected: her little finger, her ring finger, and her middle finger. Electromyography (EMG) was performed on 25 September 2020. She was told that there were signs that some nerves were "blocked". The tingling sensation in her fingers started with the feeling that her wrists were swollen. Turmeric has helped this problem. When Mandy takes it every day, her wrists and fingers are normal. As soon as she stops taking it, the problem returns. Her feet can also be swollen in the morning.

Mandy's cognitive difficulties have persisted long after some of her other symptoms of acute illness have improved. She describes them as leaving her in a "haze". Her ability to remember things is "horrible". She must write everything down in her calendar or otherwise she will forget what she must do. Mandy can only watch programs that are easy to follow because of her cognitive problems. In July and August 2020, she had a period where she could not remember the plot of a film or a story but could only remember "the feeling" that it gave her. Although she feels this has improved somewhat, she often does not watch a whole movie at one time. Alongside cognitive problems, Mandy has also experienced severe fatigue in the post-acute phase of her illness. This has compromised her ability to work, to engage in social and leisure activities, and to communicate with others.

3.3 Daily activities

Mandy describes her recovery from COVID-19 to date as tiresome, frustrating, and extremely slow. All aspects of her daily life have been compromised by her symptoms. She registered for PhD research in January 2020 and has been too unwell to undertake her studies. Since contracting COVID-19, Mandy is engaging in fewer social and leisure activities because she does not have the energy to go out. Household chores are difficult for her and gardening is "too much".

Mandy's ability to engage in exercise has also been compromised by her COVID-19 infection. After her acute illness, she tried taking exercise. By the end of May 2020, she was exercising for about 1 h a day. However, by the end of June 2020, she felt exhausted and decided to discontinue exercise. In August and September, she was able to undertake some cycling although her muscles were sore when cycling. The feeling is one of acute pain and is quite unlike the normal muscular discomfort associated with excessive exercise. In the last couple of weeks, Mandy has stopped exercising altogether because of the pain in her muscles: "my muscles couldn't take it anymore". With any amount of walking or cycling, her muscles felt sore. Sometimes, her muscles twitched for a couple of hours after taking exercise. The twitching does not hurt but it does scare Mandy as she does not know what is happening. She states: "I don't want to relapse, so I avoid these situations".

3.4 Medication

Mandy takes 4 puffs a day of an allergy medication Staloral 10 IR/ml. Occasionally, she also uses Bellozal 20 mg. For the treatment of COVID-19 symptoms, Mandy took Paracetamol 1 g (max 4 times/day) and tramadol 100 mg (prolonged release).

3.5 Communication

Mandy reports several language issues that affect her. She often forgets words she wants to use. This was particularly problematic between June and August 2020, although recently it is slightly better. A couple of times every day, she struggles to finish her sentences. Sometimes, she does not know what the other person has just said even though she wanted to listen. She struggles to follow what others are saying in conversation, especially when there is background noise. Mandy can still read but not as fast as she did before her illness. She sometimes reads words that are not on the page and misses parts of sentences. She can also get easily distracted

while reading. She reports that she is sometimes unable to remember what a book is about. Writing is also difficult. She makes more grammatical mistakes than usual and writes words she did not intend to write. She wrote to a friend that she would visit her "after eating my child" instead of "giving him his dinner".

Mandy's COVID-19 illness has also affected her desire to communicate with others. This is mostly because of fatigue. She describes herself as a very sociable person who likes to participate in conversation. However, sometimes when several people are talking at the same time, she does not talk anymore because it is too tiring. She deactivated her Facebook account for half a year because she did not have the energy to spend on social media. She only switched it back on again to establish a patients' rights group in Belgium. COVID-19 has also affected the frequency of Mandy's communication with friends. For the first couple of months of her illness, she was so tired that she only communicated with one or two friends. Although she is still not communicating with people as often as she did before her illness, it is slowly beginning to improve.

The author spoke to Mandy online for approximately 1 h on 16 October 2020. The time was 10 am in Belgium. She spoke at ease about how difficult the last few months had been for her, especially caring for her son while she and her husband were both ill with COVID-19. Mandy's mood was normal, and she cooperated with all tasks and instructions throughout the session. Her speech was fully intelligible, and she spoke with normal fluency, rate, volume, and pitch. There was no evidence of dysarthria or apraxia of speech. Mandy did not have a phonological impairment. She contributed relevant, meaningful, well-formed utterances to conversation. Mandy's auditory verbal comprehension was intact for conversation. She followed all verbal instructions and understood the author's utterances, many of which contained complex syntax.

Mandy completed the 12 language tasks in the study. Her performance on these tasks is shown in Figure 1 below, along with the results for healthy speakers of English as a second language. These speakers did not have COVID-19 infection.

Mandy's scores exceeded the mean performance of healthy L2 English speakers on eight of 12 tasks in the study. On two of these eight tasks – Cookie Theft picture description and category fluency for vegetables – her performance was between 1 and 2 standard deviations above the mean of healthy L2 English speakers (see Table 5). It was clear that Mandy retained strong lexical generation skills (category fluency) and executive function (letter fluency) following her COVID illness. She also had above average lexical retrieval skills (confrontation naming) for a L2 English speaker and could relate the steps needed to perform everyday tasks like making a sandwich and writing a letter (procedural discourse). Mandy was also able to generate well-formed, meaningful utterances (sentence generation) and could recall the events in a short story (Sam and Fred) both

Task	Mandy Raw scores	Healthy L2 English speakers Mean (standard deviation)
Sam and Fred (immediate recall)	8/14	8.6 (±1.9)
Sam and Fred (delayed recall)	9/14	8.4 (±1.8)
Cookie theft picture description	8/12	6.6 (±1.1)
Sentence generation	4/6	4.6 (±1.1)
Letter fluency (F-A-S)	43	37.0 (±10.3)
Category fluency (animals)	19	18.6 (±4.6)
Category fluency (vegetables)	16	10.4 (±3.2)
Flowerpot incident narration	11/20	12.4 (±1.7)
Cinderella narration	22/50	34.2 (±5.9)
Procedural discourse (sandwich)	5/8	4.6 (±0.9)
Procedural discourse (letter)	7/8	6.1 (±1.4)
Confrontation naming	15/20	13.1 (±4.0)

Figure 1: Mandy's performance relative to healthy L2 English speakers.

Table 5: The performances of Mandy and Julie relative to control participants.

Task	Mandy-Healthy L2 English speakers	Julie-Healthy L1 English speakers	Julie-COVID control participants
Sam and Fred (immediate recall)	Within −1SD	Within −1SD	Between −1 and −2SD
Sam and Fred (delayed recall)	Within +1SD	Within −1SD	Within −1SD
Cookie theft picture description	Between +1 and +2SD	Between −1 and −2SD	Between −2 and −3SD
Sentence generation	Within −1SD	Exactly +1SD	Within +1SD
Letter fluency (F-A-S)	Within +1SD	Within −1SD	Within −1SD
Category fluency (animals)	Within +1SD	Within +1SD	Within +1SD
Category fluency (vegetables)	Between +1 and +2SD	Between +1 and +2SD	Between +1 and +2SD
Flowerpot incident narration	Within −1SD	Within −1SD	Within −1SD
Cinderella narration	Between −2 and −3SD	Between −1 and −2SD	Between −1 and −2SD
Procedural discourse (sandwich)	Within +1SD	Over +1SD	Between +1 and +2SD
Procedural discourse (letter)	Within +1SD	Over +1SD	Within +1SD
Confrontation naming	Within +1SD	Between −1 and −2SD	Between −2 to −3SD

immediately and with a delay, although her performances in sentence generation and immediate recall fell slightly below the healthy mean performance.

What was particularly striking about Mandy's performance was the marked reduction in the informativeness of her Cinderella narration, notwithstanding her strengths in these other cognitive-linguistic areas. Mandy's score on Cinderella narration was between 2 and 3 standard deviations below the mean of healthy L2 English speakers. It was her weakest performance overall and was significantly weaker than her performances in Cookie Theft picture description and narration of the Flowerpot Incident. Evidently, Mandy could produce informative discourse when the cognitive demands of the task were low, namely, when she was able to view a picture of a single scene as in the Cookie Theft picture description task. As the cognitive demands of the task increased, and she was required to integrate information across several pictures in sequence (the Flowerpot Incident), her performance began to deteriorate (Mandy's score on Flowerpot narration was within 1 standard deviation below the mean performance of healthy participants). When the cognitive demands of the task were greatest, namely, when Mandy was not able to view pictures during narration and had to integrate a much larger amount of information from memory (i.e., the conditions in the Cinderella story), her informativeness decreased yet further to between 2 and 3 standard deviations below the mean score of healthy participants. Mandy's COVID illness appeared to compromise her ability to produce informative discourse when the cognitive demands of the task were high, even as she retained lexical and grammatical abilities that were commensurate with these same skills in healthy L2 English speakers and could produce informative discourse under less cognitively challenging conditions.

4 Case study 2: 53-year-old NLP trainer

4.1 Background

Julie (a pseudonym) is 53;3 years old. She is single and has no children. Julie is a self-employed trainer in neuro-linguistic programming (NLP). She passed 7 Ordinary Level ("O Level") examinations in 1983 and achieved a National Vocational Qualification (NVQ) in Social Care in 2002. She also has a diploma in youth work and a qualification in basic counselling skills. Julie is a qualified Integral Eye Movement Therapy practitioner. Her employment history is very diverse. Julie has worked as a kitchen assistant, DJ, gardener, greengrocer, and taxi driver. She has been a care assistant, support worker, and a youth worker. As a specialist youth worker, she has supported individuals who are leaving care. Julie has also run a

café. She is known for her ability to work hard: "I'm known for my capacity to work hard and keep going".

Julie characterizes her overall state of health prior to contracting COVID-19 as "pretty good", although she was aware that she needed to lose weight. She is 5 feet 5 inches in height and weighs 165lbs, giving her a BMI of 27.5. This places her in the overweight category. Julie had a BMI of 30 before developing COVID but has lost 20lbs due to her illness. She has never undergone surgery. Julie takes no prescribed medication and only takes an "off the shelf" medication for allergies (see *Medication*). She has no chronic health conditions. Julie is allergic to Penicillin and is gluten and lactose intolerant. She reports that since becoming ill with COVID, she has developed a slight allergy to nuts and cannot tolerate sugar or caffeine. She has also become much more allergic to cats, histamine, and pollen, requiring her to use antihistamine medication every day where before she used it intermittently. She has a "slight" noise-induced hearing loss related to her earlier work as a DJ. Julie struggles with her hearing if there is a lot of background noise, however she has never sought an audiological assessment. She reports that her vision was good pre-COVID but has deteriorated since becoming unwell. Julie does not wear glasses but thinks she needs an eye test.

Julie stopped drinking alcohol at 40 years of age. She stopped smoking when she was 45 years old. Before developing COVID-19, Julie had a gluten- and lactose-free diet. She has made several dietary changes since her COVID illness. She has reduced her consumption of sugar and eats few processed foods. She is also following a low histamine diet. Julie has started to take a wide range of vitamin and mineral supplements since her illness. She takes daily vitamin B6, C, D and K2, and the minerals magnesium, zinc, copper, and iron (the latter every other day). Julie also takes Curcumin, Q10 (a coenzyme), Quercetin (a flavonol), and the enzymes Diamine oxidase, Nattokinase and Serrapeptase. She takes B12 once or twice a week. Pre-COVID, Julie only took high-dose vitamin D in the winter months plus iron tablets 3 or 4 days a week. Before her illness, Julie was very physically active. She cycled 4 or 5 miles several times per week and undertook at least 6 h of cleaning each week at a local cat rescue. She also did other volunteer activities, ran her own business, and managed an allotment. Pre-COVID, Julie's interests included gardening and working on her allotment, cycling, walking with her friends, cat rescue work and DIY. She used social media before her COVID illness but is using it even more now to keep in touch with people.

Julie first experienced symptoms of COVID-19 on 15 March 2020. She woke up feeling "groggy" and had a slightly sore throat. Over the next few hours, her throat got worse, and she developed a mild fever. By early evening, Julie had a serious headache which was not relieved with paracetamol. She started to feel short of breath and she had a fast heart rate. Julie was breathless on exertion (e.g., climbing

stairs) for several days before her sore throat developed. She put this down to needing to lose weight. With hindsight, she now thinks this was the first signs of COVID-19.

Julie believes she contracted the virus through her cat rescue work, as two other people in her team developed symptoms at the same time as her. She attended an open evening at the cattery. It was a 3-h event during which 25 people visited in small family groups. No-one stayed longer than 40 m. The cattery is a large wooden shed, which is drafty and hard to heat. It is, therefore, quite well ventilated. However, 2-meter social distancing was not possible given the number of people in attendance. Julie believes aerosol transmission accounted for her infection as she spent the entire evening talking to others. She unknowingly passed the virus to another member of the cattery team before she displayed symptoms. Community testing for COVID-19 was not available at the start of the pandemic in the UK, so Julie was not tested for the virus. Her GP made a clinical diagnosis of COVID-19 infection at approximately week 9 of her illness. Six months after the onset of her illness, Julie had an antibody test, which produced a negative result.

Julie followed the advice of NHS 111, the UK's non-emergency medical telephone service, and remained at home during the acute phase of her COVID illness. She attended Accident & Emergency with shortness of breath on 21 July 2020 but was discharged without treatment because her O2 saturation levels, ECG and pulse were normal. In week 9 of her illness, Julie contacted her GP and has had regular appointments from then onwards. In May 2020, her doctor prescribed the antibiotic Clarithromycin for the treatment of a suspected chest infection. After she coughed up a small blood clot, Julie decided to take low-dose aspirin for 5 days out of 7 for about two months. She was later advised by her doctor to stop taking it. She did so only to find the pressure and tight feeling in her lungs returning. She then resumed her taking of aspirin and the pressure and tightness in her chest improved. However, she subsequently reduced her dose of aspirin and then stopped it altogether after she cut her arm and it bled more than she would have expected.

On 16 June 2020, Julie had a chest X-ray and nothing abnormal was detected. On 30 June and 11 August 2020, she had a wide range of blood tests (e.g., liver and kidney function) and all were within the normal range. A diabetes urine test performed on 11 August was clear. Basic coordination and reflex tests were conducted on 2 July 2020 and all were passed. Julie had to be very persistent to receive these different tests. No further medical treatment or monitoring has been offered to her. On 19 August 2020, Julie commenced a 12-week course of acupuncture. This has alleviated some of her COVID symptoms including her increased heart rate and

breathing difficulties. It has also helped her to process outstanding emotions from the difficulties she has experienced during the year.

In early June 2020, Julie bought an oxygen concentrator for use at home. She used this device without medical advice and support. Although she recognized this was a risky course of action, she felt she had no choice as she was fed up feeling "oxygen hungry". Julie described this device as a "godsend". She used it for around 90 min a day on a 90% oxygen setting. The benefits were immediate. Her thinking improved and she was able to walk more easily without struggling to breathe. After a week of daily use, she was able to mow her lawn, which was something she had not previously been able to do.

Julie describes her recovery from COVID-19 as extremely slow with lots of relapses. She reports that she now has more energy and can do more but that she still finds it hard to believe that she is making a recovery. She has got used to thinking of herself as ill. She finds it "harsh" when people ask her how she is doing, and she responds that she is getting better slowly, and they only hear the "getting better" part of what she is saying. She thinks friends have stayed away from her because they are bored with her being ill or could not adjust to seeing her unwell as she is normally very resilient. In the early days of her illness, Julie felt stigmatized by having an infectious disease and now she feels stigmatized as always being "moany" and unwell. She thinks other people do not want to hear about her illness and that other people do not understand it. She says she is also struggling to comprehend what she has been through. Julie is facing considerable uncertainty. She does not know if she will get 100% better. She wonders if she will be able to exercise in the future, get her memory and concentration back, and resume work.

4.2 Clinical symptoms

Julie has had a wide range of symptoms related to COVID-19 infection. Her severe symptoms included gastrointestinal problems, fatigue, headache, and migraine. Julie had very persistent gastrointestinal problems until 5 months into her illness. She is still experiencing fatigue although it is now moderate. Julie has also had severe disturbances of sensation. She had facial neuralgia, which she found very painful. She has experienced muscle twitches, feelings of crawling skin and the sensation that her skull is being prodded. She still gets electrical pains. Julie's moderate symptoms included breathing difficulties, a sore throat, and chest pain and pressure. Her breathing difficulties felt severe at times, but she managed to stay out of hospital. She experiences chest pain and pressure when she has overdone things.

Julie had a mild fever (subjective, not based on temperature) and mild coughing. She had altered taste and an occasional loss of smell. She also imagined smells. Julie still sometimes experiences these disturbances of taste and smell. She has had mild aches and pains, conjunctivitis, and a skin rash. Although she received no diagnosis of an ear infection, Julie has had pain in her ears and itchy ears. Additional symptoms include visual hallucinations, sore teeth and struggling to coordinate walking. Julie still has gastric reflux, swelling of her throat, and can be lightheaded. She also still experiences vibrations in her body, tinnitus, a sore neck, unquenchable thirst, a loss of appetite, histamine intolerance, mucus in her throat and small clots of blood when she blows her nose.

Julie has experienced cognitive difficulties following her illness. She reports that she used to have an excellent memory, much better than average. However, now she cannot remember the six characters in her car registration (she must write them down) or what she was doing 5 m ago. She also struggles to plan and organize her day. Before her illness, everyone remarked that Julie was highly organized. She does make a simple plan, but she forgets things and rarely gets to the end of her list.

Julie's COVID illness has had a direct and an indirect impact on her mental health. She has had COVID-related anxiety where her mind would start racing and she could feel her eyes darting around. This seemed to be triggered by movement and the only way it would resolve was by lying down. Julie's COVID symptoms have left her unable to pursue many of the work activities and interests that she enjoyed before becoming ill. She has also become socially isolated due to a loss of work and friendships. She had a serious argument with the management team – all formerly her friends – at the cat rescue where she worked, an incident she attributes to the irritability caused by her illness and frustration at being ill for so long: "I was very unpredictable at the time, my emotions were all over the place". This resulted in her saying she would leave this role even though this was not something she wanted to do. Julie experienced this as a severe trauma: "It was a terrible trauma to me at the time. My nerves have been shot and anxiety has been difficult to manage since it happened". Because Julie does not have other friends in the area, this episode has resulted in considerable loneliness for her. She reports not going out socially since the national lockdown came into force in the UK in March 2020. She has made new friends online, all fellow COVID sufferers, but she acknowledges that this is not the same as the face-to-face friendships she previously enjoyed. The true impact of COVID-19 on Julie's mental health is most clearly conveyed in her own words:

> I've been depressed and miserable, struggling to find a reason to get out of bed. I've cried and cried over the loss of my friends (that's been the worst thing) and the loss of my health and my business and my volunteer role and my ability to work or do things I enjoy. I've struggled

> because I can't exercise, which I would normally do to relieve stress. Even though I'm missing human company, sometimes I can't be bothered to ring a friend, or I just don't have the energy or don't have anything to say. At the start of the pandemic before I got ill, I noticed myself getting a bit OCD about cleaning everything. And even after I had COVID so presumably have some immunity, I still catch myself backing away from people in a bit of an OTT way. And at the same time, I crave a hug from friends because I feel so alone. COVID has also knocked my confidence in many ways.

4.3 Daily activities

All of Julie's daily activities have been adversely affected by her illness. She is working at most 1 h a day. This is because she struggles to focus and concentrate and when she does, it wears her out. Julie has hardly worked since June 2020. Between March and June, she managed to do more work, some days a few hours. Julie's social activities have diminished significantly. This is related in large part to a loss of friendships following a serious argument she had with her former colleagues, most of whom were also her friends. Since restrictions have been eased, Julie has had one offer to go out for a meal. However, she declined because of her dietary restrictions and she did not know the person very well.

Julie is now well enough to get out of the house for 1 or 2 h most days. She visits her allotment. She has also started some of her own cat rescue activities, which has increased her social contact with other people: "this has been quite cheery because it involves contact with people (generally nice people who do community work)". However, she admits that this is not the same as the friendships she once had.

COVID has had a serious impact on Julie's level of physical activity. Before her illness, she was physically very active. Although she tries to do as much light activity as possible such as walking, gardening, or light DIY, she must avoid any activity that raises her heartbeat as it causes fatigue and a recurrence of her COVID symptoms. Although she can do household chores, she has had to let many of them slip because of her limited energy. She would rather get out of the house each day but then comes home too tired to undertake chores.

4.4 Medication

Julie takes Benadryl, a non-prescription antihistamine, for the treatment of allergies. She has experienced increased allergies since contracting COVID and is now using this medication every day.

4.5 Communication

Julie reports some impact of COVID-19 on her language and communication skills. Although she has not had many conversations with other people, she reports that when she does, she struggles to keep up with the pace of them: "it's like my thinking is slower than the other person's thinking". She cannot recall names of people and things during conversation, such as the name of her cat that she has had for four years. Julie struggles to remember what others have just said in conversation: "it's like my attention wanders". She can remember the topic of a conversation. In the earlier part of her illness, she could not follow the plot in a story or film. It reminded her of when she would watch TV with her 94-year-old grandmother, and her grandmother would ask her to explain what was happening.

Julie reports that she used to be very good at spelling but that her spelling is "terrible" now. She cannot read a body of text. Anything more than a few sentences is difficult for her as she loses concentration. Among the changes in communication, Julie reports reduced desire to participate in conversation. Sometimes, she does not have the energy to engage in conversation. On other occasions, she is not motivated to communicate or feels like she has got nothing to say. There has also been a reduction in the frequency with which she communicates with others. She describes her days as sliding into each other and that she does not get much done. She forgets to get back to people or does not have the energy or motivation to get back to them.

The author spoke to Julie online on 3 November 2020. The meeting took place at 11 am UK time. The conversation lasted 1 h and 15 m during which time Julie talked about her illness, and the impact of her recent loss of friendships on her, among other topics. Julie was eager to communicate with the author and did not appear to fatigue during the session. Her mood was normal, and she was cooperative during all tasks. Her speech was fully intelligible, and she spoke with normal rate, fluency, volume, and pitch. There was no dysarthria or apraxia of speech, and Julie did not have a phonological impairment. Julie's contributions to conversation were relevant, well-formed, and meaningful. She displayed intact auditory verbal comprehension as evidenced by her appropriate responses to all task instructions and questions posed to her by the author.

Julie completed all 12 language tasks used in the study. Her scores are shown in Figure 2, along with the results for healthy participants and COVID control participants.

Julie's performance was strong relative to healthy participants in three areas: category fluency; procedural discourse; and sentence generation. Her generation of animal and vegetable names exceeded the mean performance of healthy

Task	Julie Raw score	Healthy Participants Mean (SD)	COVID control participants Mean (SD)
Sam and Fred (immediate recall)	8.5/14	9.7 (±1.9)	10.4 (±1.5)
Sam and Fred (delayed recall)	8.5/14	9.3 (±2.0)	9.7 (±1.9)
Cookie theft picture description	5.5/12	7.7 (±1.2)	7.7 (±0.9)
Sentence generation	6/6	5.2 (±0.8)	5.4 (±0.8)
Letter fluency (F-A-S)	41	48.0 (±10.8)	53.2 (±14.4)
Category fluency (animals)	29	25.8 (±4.7)	23.4 (±6.6)
Category fluency (vegetables)	22	15.3 (±3.7)	17.1 (±3.4)
Flowerpot incident narration	11/20	13.8 (±2.9)	12.8 (±2.9)
Cinderella narration	22.5/50	32.0 (±5.7)	31.8 (±5.1)
Procedural discourse (sandwich)	8/8	6.6 (±0.9)	6.8 (±0.9)
Procedural discourse (letter)	8/8	6.5 (±1.4)	7.2 (±1.4)
Confrontation naming	15/20	17.6 (±2.0)	18.2 (±1.3)

Figure 2: Julie's performance relative to healthy and COVID control participants.

participants in the study as well as healthy participants in various published studies (Acevedo et al. 2000; Clark et al. 2016) (see Figure 3). Although her letter fluency performance was below the mean of healthy participants in the study, it was comparable to the letter fluency performance of subjects of similar age,

Animal naming (Tombaugh et al. 1999): Age (50-59 years): 20.1 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
Animal and vegetable naming (Clark et al. 2016): 51 cognitively normal adults (mean: 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 (female): 15.0 names Education (8-12 years): 14.2 names
Letter fluency (Tombaugh et al. 1999): Age (50-59 years): 42.1 words Gender (female): 37.8 words Education (9-12 years): 36.7 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; A=15.6; S=16.9 words

Figure 3: Normative data for category and letter fluency tasks.

gender, and education level as Julie in normative studies (Tombaugh et al. 1999). Julie's performance on sentence generation was 1 standard deviation above the mean for healthy participants, while her procedural discourses for sandwich-making and letter writing were greater than 1 standard deviation above the mean. Although Julie's confrontation naming performance was over 1 standard deviation below the mean of healthy participants, this appeared to be related to a lack of familiarity with some of the stimulus items used in the task (e.g., French horn).

Julie's immediate and delayed verbal recall were both within 1 standard deviation below the mean of healthy participants. But by far Julie's greatest difficulty was the reduced informativeness of her spoken discourse. This was evident during Cookie Theft picture description, the Flowerpot Incident narration, and the Cinderella story. Julie's informativeness was within 1 standard deviation below the mean of healthy participants during the Flowerpot Incident story. It was lower still, between 1 and 2 standard deviations below the mean of healthy participants, during Cookie Theft picture description and the Cinderella story. A similar pattern of reduced informativeness emerged when Julie's discourse performance was compared to that of COVID control participants in the study. The informativeness of her Flowerpot Incident story fell within one standard deviation below the mean of COVID controls. For both her Cookie Theft picture description and Cinderella story, the reduction in her informativeness was much more marked. The informativeness of Julie's Cinderella story fell between 1 and 2 standard deviations below the mean of COVID controls, while the informativeness of her picture description was between 2 and 3 standard deviations below the COVID control mean. In summary, the informativeness of Julie's expressive discourse was markedly reduced in the context of relatively intact skills in other cognitive-linguistic areas.

5 Analysis and implications

A key purpose in using language is to convey information. The requirement to be informative in our communicative interactions with others is the essence of Grice's cooperative principle and quantity maxim (Grice 1989). This maxim contains a directive to produce just the right amount of information – not to convey too much information (be over-informative) and not to convey too little information (be under-informative). We have seen in this article how two adults who contracted SARS-CoV-2 at the beginning of the COVID-19 pandemic in Belgium and the UK have problems in satisfying the requirement to be informative in discourse. Specifically, these adults produced markedly under-informative discourse. This occurred across a range of discourse contexts, including picture description and

narration, as well as across speakers of English as a first and second language. Moreover, reduced informativeness was a feature of the expressive language of these adults, even as their structural language skills were intact and their performance in other cognitive-linguistic domains (e.g., letter and category fluency) was in the normal range. This finding prompts us to ask two questions. First, what feature(s) of language contribute to the reduced informativeness of these speakers' expressive discourse? Second, is this discourse deficit a feature of other clinical conditions, or is it a unique cognitive-linguistic sequela of COVID infection?

Discourse can exhibit reduced informativeness on account of several factors (Cummings 2019a, 2019b). The most obvious factor is the simple omission of information – the speaker omits one or more propositions that are essential for conveying the content of a picture or story. Discourse may also display reduced informativeness because a speaker engages in repetition of information. The repetition of information adds nothing new to discourse and, therefore, cannot convey the content of a depicted scene or expand upon the events in a narrative. Discourse is also under-informative when misleading or contradictory information is presented by the speaker or when information is presented in the wrong order. The presence of incorrect and poorly sequenced information does not allow the hearer to construct an accurate and complete mental representation of the events in a story or the content of a pictured scene. To examine which of these factors explains the reduced informativeness of the adult speakers in this study, let us turn to the Cinderella narration that Julie produced. Julie's Cinderella story contained 501 words. Despite its considerable length, Julie's informativeness score on this discourse production task placed her between 1 and 2 standard deviations below the mean of healthy participants in the study. Its reduced informativeness can be explained by the omission, repetition, and incorrect sequencing of information. Julie omitted key propositions throughout her narrative. During Cinderella's encounter with the fairy godmother, Julie does not mention that a pumpkin was transformed into a carriage, that the mice became white horses to pull the carriage, and that Cinderella received a pair of glass slippers as part of the magic spell. These are essential propositions that must be in place to achieve the integration of later events in the story, such as Cinderella losing one of her glass slippers on the steps of the palace.

> *Omission*: "the fairy godmother appeared to Cinderella and said you shall go to the ball and she waved her magic wand and she made a carriage appear and the robes that Cinderella needed to go to the ball"

Julie also presented information in the wrong sequence or order. She introduces the ball into her narrative with no contextualization of why the ball was taking

place – to help the king's son find a wife. This information is provided later in the narrative (in bold). The late presentation of this information forces the hearer to revise his or her mental representation of the story so far.

> *Incorrect sequence*: "there was news (.) of a (.) local ball and they were very excited they were gonna get very dressed up et cetera et cetera (.) uhm and when she mentioned to them that she would like to go they said oh no you stay behind and clean everything and do all the (.) scullery work that you normally do (.) er you're not coming to the ball with us (.) uhm (0.2) and (0.2) **the ball uhm I think it was thrown in the honour of uhm some prince who uhm (.) was looking for a wife.**"

Not only did Julie introduce this information late into her narrative, but she then also went on to repeat it (see below in bold). Her repetition appeared designed to state *who* wanted the prince to get married. But to the extent that Julie could not say if it was the king, or the prince's uncle, or even if the king *was* the prince's uncle, it was a repetition without any gain for the hearer in terms of improving his or her mental representation of the story.

> *Repetition*: "it whisked her off (.) to the ball and she (.) danced with the prince and he was very taken with her and **I think it was his uncle or maybe the king maybe it was his you know his king was the uncle wanted him to get married.**"

These examples are illustrative of the informational difficulties that Julie experienced during her production of narrative discourse. What is clear, however, is that none of these problems arise on account of any structural language deficits on her part. Julie has an extensive lexical repertoire at her disposal, including specific words for all the main characters in the story (e.g., *fairy godmother* as opposed to *woman*) as well as use of low-frequency nouns (e.g., he made a *declaration*) and verbs (e.g., it *whisked* her off). Julie is also able to use a wide array of grammatical structures, including relative clauses (e.g., some prince *who was looking for a wife*), infinitive clauses (e.g., she wouldn't be able *to go to the ball*) and passive voice constructions (e.g., the ball *was thrown* in the honour of some prince). Notwithstanding these grammatical and lexical resources, Julie was unable to harness these linguistic structures to produce *informative* discourse. Mandy, a speaker of English as a second language, displays similar problems in managing information, notwithstanding her evident lexical and grammatical strengths. During Mandy's Cinderella narrative, she did not undertake the informational work required to introduce characters into the story. This resulted in her use of pronouns such as *they* in the extract below for which no referent could be identified in the preceding discourse context. Also, Mandy often used the definite article to introduce characters like the prince for the first time into her story. On hearing this definite noun phrase, the listener is left to pose the question *What prince?* These pragmatic

anomalies in Mandy's narration served to reduce the informativeness of her spoken discourse.

> *Pronominal reference and definite noun phrase*: "one day um **they** announced that there would be a prom with the, **the prince** and the stepmom thought it would be an ideal opportunity let her daughters be seen and maybe one of them could marry the prince."

The informational difficulties of both these speakers represent the converse type of case to that seen in adults with a primary language disorder such as aphasia. In aphasia, impairments of lexical retrieval and grammatical encoding limit a speaker's ability to produce expressive language. Neither Julie nor Mandy exhibited the impairments of linguistic structure that might limit their ability to convey informative discourse. Rather, their pragmatic difficulties in conveying informative discourse appear to be secondary to their self-reported cognitive problems following the onset of their COVID illness. To this extent, they are more akin to the cognitive-communication disorders that arise in adults with traumatic brain injury (TBI), neurodegeneration, and right-hemisphere damage (RHD). It should be noted that problems with the production of informative discourse have also been documented in individuals with these conditions (see Power et al. (2020) for TBI; Ash et al. (2017) for neurodegeneration; Marini (2012) for RHD). Given these striking parallels, and findings reported in Cummings (2022), there is preliminary evidence that speakers with self-reported cognitive problems (brain fog) as part of the Long COVID syndrome experience a more subtle form of the type of cognitive-communication disorder that is assessed and treated by speech-language pathologists in relation to conditions such as TBI and RHD. Further studies should be conducted to corroborate these results.

In summary, the SARS-CoV-2 virus is a novel pathogen with a high burden of death and disability. For individuals who develop the Long COVID syndrome with accompanying brain fog, the impact of this disease is most evident in disruption of the cognitive-linguistic processes that allow speakers to produce informative discourse. Meanwhile, linguistic structures appear relatively well preserved, with speakers able to employ an extensive lexical repertoire (reports of word-finding difficulty notwithstanding) and use and understand a wide range of grammatical constructions. This pattern of linguistic impairment and strength suggests that Long COVID should sit alongside conditions like TBI, neurodegenerative disorders, and RHD – all of which are associated with cognitive-communication disorder – in a nosology of language disorder. It also suggests that clinical pragmatists will have a key role to play in explaining this most persistent and troubling symptom of the Long COVID syndrome in years to come.

References

Acevedo, Amarilis, David A. Loewenstein, Warren W. Barker, Dylan G. Harwood, Cheryl Luis, Marina Bravo, Deborah A. Hurwitz, Hilda Aguero, Lynda Greenfield & Ranjan Duara. 2000. Category fluency test: Normative data for English- and Spanish-speaking elderly. *Journal of the International Neuropsychological Society* 6(7). 760–769.

Ash, Sharon, Charles Jester, Collin York, Olga L. Kofman, Rachel Langey, Halpin Amy, Firn Kim, Sophia Dominguez Perez, Lama Chahine, Meredith Spindler, Nabila Dahodwala, David J. Irwin, Corey McMillan, Daniel Weintraub & Murray Grossman. 2017. Longitudinal decline in speech production in Parkinson's disease spectrum disorders. *Brain and Language* 171. 42–51.

Clark, David Glenn, Paula M. McLaughlin, Ellen Woo, Kristy Hwang, Sona Hurtz, Leslie Ramirez, Jennifer Eastman, Reshil-Marie Dukes, Puneet Kapur, Thomas P. DeRamus & Liana G. Apostolova. 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.

Collantes, Maria Epifania V., Adrian I. Espiritu, C. Sy Marie Charmaine, Veeda Michelle M. Anlacan & Roland Dominic G. Jamora. 2021. Neurological manifestations in COVID-19 infection: A systematic review and meta-analysis. *Canadian Journal of Neurological Sciences* 48(1). 66–76.

Cummings, Louise. 2019a. Narrating the Cinderella story in adults with primary progressive aphasia. In Alessandro Capone, Marco Carapezza & Franco Lo Piparo (eds.), *Further advances in pragmatics and philosophy. Part 2: Theories and applications*, 301–329. Cham, Switzerland: Springer International Publishing AG.

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

Cummings, Louise (ed.). 2022. *COVID-19 and speech-language pathology*. New York: Routledge.

Goodglass, Harold, Edith Kaplan & Barbara Barresi. 2001. *Boston diagnostic aphasia examination*, 3rd edn. Baltimore, MD: Lippincott Williams & Wilkins.

Grice, Herbert Paul. 1989. *Studies in the way of words*. Cambridge, MA: Harvard University Press.

Karadag, Engin. 2020. Increase in COVID-19 cases and case-fatality and case-recovery rates in Europe: A cross-temporal meta-analysis. *Journal of Medical Virology*. https://doi.org/10.1002/jmv.26035.

Li, Xun, Luwen Wang, Shaonan Yan, Yang Fan, Longkui Xiang, Jiling Zhu, Bo Shen & Zuojiong Gong. 2020. Clinical characteristics of 25 death cases with COVID-19: A retrospective review of medical records in a single medical center, Wuhan, China. *International Journal of Infectious Diseases* 94. 128–132.

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

Power, Emma, Stephanie Weir, Jessica Richardson, Davida Fromm, Margaret Forbes, Brian MacWhinney & Leanne Togher. 2020. Patterns of narrative discourse in early recovery following severe traumatic brain injury. *Brain Injury* 34(1). 98–109.

Priftis, Konstantinos, Lorella Algeri, Stella Villella & Maria Simonetta Spada. 2020. COVID-19 presenting with agraphia and conduction aphasia in a patient with left-hemisphere ischemic stroke. *Neurological Sciences* 41(12). 3381–3384.

Priftis, Konstantinos, Massimo Prior, Leonardo Meneghetti, Teresa Mercogliano & Matteo Bendini. 2021. Alexia without agraphia in a post COVID-19 patient with left-hemisphere ischemic stroke. *Neurological Sciences* 42(6). 2179–2181.
Tombaugh, Tom N., Jean Kozak & Laura Rees. 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.

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