



STUDYING RECEPTIVE LANGUAGE IN NONSPEAKERS THROUGH BRAIN IMAGING



The MRC Cognition and Brain Sciences Unit, University of Cambridge

Dr. Alex WOOLGAR and Dr. ALYSE Brown are COGNITIVE SCIENCE researchers at the MRC Cognition and Brain Sciences Unit, which is part of the UNIVERSITY OF CAMBRIDGE, UK. This is one of the most famous and world-leading universities for research in science. Woolgar and Brown are interested in how non-speaking autistic people understand spoken language.



Dr. Alex Woolgar



Dr. Alyse Brown

These two scientists are what kind of researchers? COGNITIVE SCIENCE
Tell me one of the researcher's names. DR. ALEX WOLLGAR/DR. ALYSE BROWN
In which University do they work? UNIVERSITY OF CAMBRIDGE
They are interested in how non-speaking people understand _____. SPOKEN
LANGUAGE

Question Type Key

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What are they interested in? HOW NON-SPEAKING AUTISTIC PEOPLE UNDERSTAND SPOKEN LANGUAGE

In which country do Woolgar and Brown study? UK/ENGLAND/GREAT BRITAIN

What is another world leading research university? HARVARD, MIT, OXFORD, STANFORD

What would you say is the reason nonspeaking individuals understand spoken language but are not yet producing spoken language to express themselves?

Woolgar is the leader of the research group. She started this work after a 6-year-old child she volunteered with started to use Rapid Prompting Method, (RPM). The child, we'll call her Lucy (not her real name), didn't speak yet at that time, but through RPM she showed that she was smart, imaginative and thoughtful. The experience changed Woolgar's understanding of how well Lucy understood spoken language and made her question the scientific understanding of what autism is.

Woolgar led the _____. RESEARCH GROUP

What is the nickname for the child Woolgar volunteered with? LUCY

How old was she? 6 YEARS OLD

What is another communication system that uses letterboards, spelling, or typing as a means of communication? S2C, SPELLING TO COMMUNICATE, FC, FACILITATED COMMUNICATION, ETC.

What did Woolgar learn? THAT LUCY UNDERSTOOD MORE THAN HER BODY SHOWED/MORE THAN WOOLGAR THOUGHT

Name one thing that Lucy was able to demonstrate because of RPM: INTELLIGENCE, IMAGINATION, THOUGHTFULNESS.

Lucy helped Woolgar question the scientific understanding of what Autism is.

How would you define Autism?

Woolgar's scientific expertise is studying the brain using NEUROIMAGING ("neuro" refers to the brain, "imaging" refers to visualising, so neuroimaging means visualising the brain). The neuroimaging techniques she uses include functional magnetic RESONANCE imaging (fMRI) which uses large magnetic fields to measure blood flow in different brain regions, and ELECTROENCEPHALOGRAPHY (EEG) which uses electrodes on the scalp to measure the tiny electrical impulses caused by neurons firing. fMRI is very good

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for asking precisely which parts of the brain are active in different circumstances, and EEG is good for measuring how quickly the brain responds to stimulation like hearing words.

What's the general term for the method Woolgar uses to study the brain?

NEUROIMAGING

What is the acronym for functional magnetic resonance imaging? fMRI

What neuroimaging technique uses large magnetic fields? FUNCTIONAL MAGNETIC RESONANCE IMAGING / fMRI

What does EEG stand for? ELECTROENCEPHALOGRAPHY

What does electroencephalography (EEG) measure? ELECTRICAL IMPULSES CAUSED BY NEURONS FIRING / ELECTRICITY AT THE SCALP

One day in a session with Woolgar, Lucy expressed frustration on behalf of other autistic children out there whose parents didn't realise how much they understand. So, Woolgar and Lucy decided to team up and do some science together. Woolgar has spent 3 years developing new neuroimaging experiments, guided by Lucy's insights. The focus of the research is on RECEPTIVE language processing – which means *understanding* spoken language. This is distinct from PRODUCTIVE language ability, which refers to producing language by speaking, signing, typing, etc. The aim of the research is to be able to measure receptive language processing directly from brain activity, without relying on speech or behaviour. They hope that this will enable children who do not speak or spell yet, to show with their brains that they understand.

What emotion did Lucy express in a session with Woolgar one day? FRUSTRATION

Why was Lucy frustrated? ON BEHALF OF OTHER AUTISTIC CHILDREN WHOSE PARENTS DIDN'T KNOW HOW MUCH THEY UNDERSTOOD

What word refers to *understanding* spoken language: RECEPTIVE

When someone speaks it is called _____ language. PRODUCTIVE

Can you think of another term for productive language that is often used? EXPRESSIVE

What is the aim of the research? TO MEASURE RECEPTIVE LANGUAGE PROCESSING DIRECTLY FROM BRAIN ACTIVITY / WITHOUT RELYING ON SPEECH OR BEHAVIOUR

What do you hope this research will discover?

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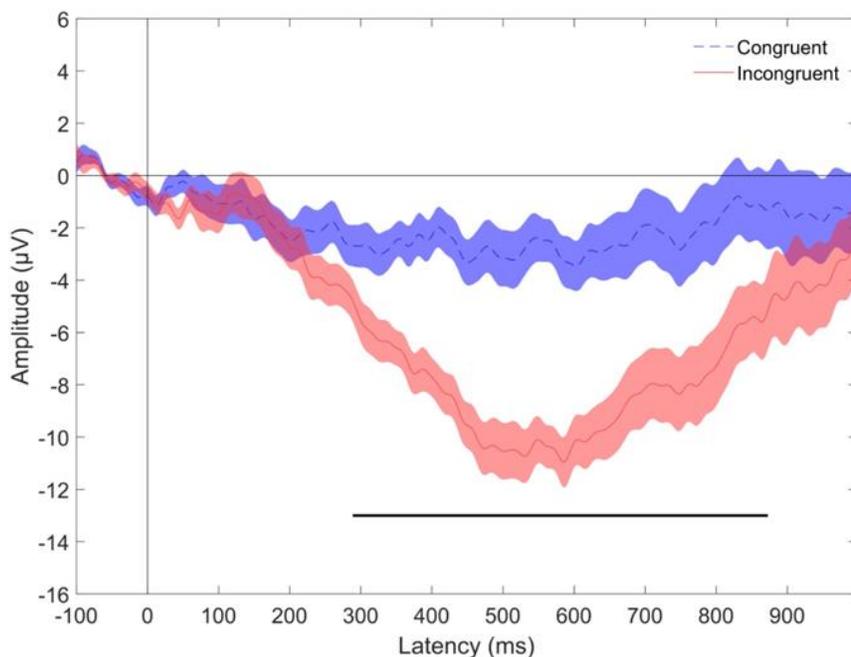


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In their experiments so far, children and adults listened to spoken sentences while the researchers measured their brain activity with EEG. The sentences ended either with a final word that makes sense (e.g. “there were candles on the birthday *cake*” – called a CONGRUENT sentence) or with a final word that is surprising and does not make sense (e.g., “there were candles on the birthday *eye*” – called an INCONGRUENT sentence). When the brain processes the unexpected word, it produces a bigger signal compared to when the correct word is played. The difference between the two signals is called the N400 effect. The N400 signal is shown in the picture below. You can see that the response to the word in the incongruent sentence (the red line) is larger and more negative (the ‘N’ in N400 is for “negative”) than for the word in the congruent sentence (the blue line).



In the experiment, what did people listen to? SPOKEN SENTENCES

Between the two types of sentences discussed, what type of sentence is “the man walked into a banana”? INCONGRUENT

Write your own example of an incongruent sentence.

A sentence with a final word that makes sense is a __ sentence. CONGRUENT

What is the signal called that the researchers are looking for? N400 EFFECT

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Refer to the chart. What do you think the '400' in N400 might stand for?
400ms

What does latency mean? LATENCY (THE SIGNAL HAPPENS AROUND 400ms
AFTER THE WORD IS PLAYED)

In what circumstances does this effect appear in the brain? WHEN PEOPLE HEAR
AN UNEXPECTED WORD / FOR WORDS IN INCONGRUENT SENTENCES

Explain why the N400 signal is important in this context?

We can measure brain responses using an EEG headset, which is a headset with electrodes that connect to the scalp using cotton wool soaked in salty water. If we see an N400 effect, we know that the person understood the sentence. In this way, we hope to demonstrate receptive language processing in nonspeaking individuals, including as children and young people who do not yet have another means of communication.

The brain responses are measured using an EEG _____. HEADSET

What is the cotton wool soaked in? SALTY WATER

Why do you think salty water is used? CONDUCTS ELECTRICITY MORE EFFICIENTLY

What are the researchers hoping to demonstrate? NONSPEAKING PEOPLE
UNDERSTAND SPOKEN LANGUAGE EVEN IF THEY CAN'T DEMONSTRATE IT YET

How do researchers Woolgar and Brown know someone understands a
sentence? SEE A N400

Can you think of any problems with this research method?

If you were designing the research protocol what would your method look like?

The ultimate aim of our research is to provide a chance for all autistic people, regardless of motor ability, to demonstrate how well they understand word meanings. This is really important because at the moment many scientists tend to assume that autistic individuals who do not speak also do not understand when they are spoken to. We hope that our results will change the scientific understanding of autism by showing that in many cases that this is not true.

The research aims to allow all Autistics to demonstrate their understanding of language regardless of their _____. MOTOR ABILITY

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What is the aim of the research? SHOW NONSPEAKING AUTISTICS UNDERSTAND WORDS/WORD MEANINGS

What do some scientists believe about nonspeaking individuals, especially nonspeaking autistics? AUTISTICS WHO DO NOT SPEAK DO NOT UNDERSTAND

What would you like to tell researchers and scientists – that they might not realise - about how your brain and body works?

At the moment, we have had to pause our research because of the COVID-19 PANDEMIC. In the UK, we are trying to “flatten the curve” by working from home and only leaving the house for necessary things like to get food or medicine, or to exercise once a day. This means that brain imaging experiments are on hold, but it gives us time to pause and think about the questions that we address in our science - our RESEARCH QUESTIONS. We are spending the time thinking about what research questions are the most important for us to answer in the future. We would like to write an article about what you, as a nonspeaker, would like researchers to study about your brain.

What do researchers call the questions that they ask in their science? RESEARCH QUESTIONS

The research is currently on hold due to the _____. COVID 19 PANDEMIC

Why is this research being paused at the moment? BECAUSE OF THE COVID-19 PANDEMIC

If you were a cognitive science researcher what question would you want to find the answer to?

Creative Writing

1. What would you like researchers in Cambridge to study, in the future, about the brains of nonspeakers?
2. Describe the ways in which you yourself communicate. What is your preferred method of communication?
3. What makes communication easy or hard for you?

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THE RESEARCHERS WANT TO HEAR FROM YOU! THIS IS YOUR CHANCE TO PROVIDE INPUT. IF YOU WANT TO SHARE YOUR RESPONSES WITH THE RESEARCHERS, FILL OUT THE ATTACHED GOOGLE FORM.

WE WILL EMAIL A CONFIRMATION THAT WE RECEIVED YOUR SURVEY. IF YOU DO NOT HEAR FROM US IN THREE DAYS, PLEASE EMAIL info@i-asc.org.

[GOOGLE FORM](#)



Alexandra Woolgar is a program leader track scientist at the MRC Cognition and Brain Sciences Unit at the University of Cambridge, and an honorary associate professor at Macquarie University. She studies the neural mechanisms that enable humans to think and act flexibly, and to change what we pay attention to from one moment to the next. She uses a range of imaging techniques and aims to advance the methods available to understand how the brain works.

The mission of I-ASC is to advance communication access for nonspeaking individuals globally through [training](#), [education](#), [advocacy](#) and [research](#). I-ASC supports all forms of augmentative and alternative communication (AAC) with a focus on methods of spelling and typing. I-ASC currently offers [Practitioner training in Spelling to Communicate \(S2C\)](#) with the hope that other methods of AAC using spelling or typing will join our association.

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