

# Science AMA Series: I'm Stephanie Huetter and I study mechanisms of language and visual processing. AMA!

StephanieHuetter<sup>1</sup>and r/ScienceAMAs<sup>1</sup>

<sup>1</sup>Affiliation not available

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## Abstract

Hi everyone, I am an Assistant Professor of Psychology at the University of Memphis and an affiliate with the Institute for Intelligent Systems which is a center for interdisciplinary research <https://sites.google.com/site/stephaniehuetter/> . I study language processing as it unfolds using eye tracking and motion tracking technologies. Words have a profound impact on behavior, changing everything from perception, to judgements and decisions we make every day, all the way up to political viewpoints (e.g. <http://news.sciencemag.org/2010/10/politicians-watch-your-grammar> for discussion of a colleague's work along these lines). I specifically study negation and usage of modal verbs "should" and "must" and how these words are used, affect learning, and activation dynamics in the lexicon (your mental dictionary). While many people are aware Cognitive Science has made many advances in Natural Language Processing in machine learning areas and are being used actively on projects like IBM's jeopardy playing Watson, less well known are the advances we've made in the understanding of how people develop and process linguistic information at both a millisecond, hourly, and yearly timescale. I will be back at 1 pm ET (10 am PT, 5 pm UTC) to answer questions, Ask me anything about how you process language (fleeting milliseconds that make differences in how we understand cognition in general), or how negation hyperbolizes the perception of truth of a statement (a recent finding in my lab!)

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STEPHANIE\_HUETTE [R/SCIENCE](#)

### ABSTRACT

Hi everyone, I am an Assistant Professor of Psychology at the University of Memphis and an affiliate with the Institute for Intelligent Systems which is a center for interdisciplinary research <https://sites.google.com/site/stephaniehuette/>. I study language processing as it unfolds using eye tracking and motion tracking technologies. Words have a profound impact on behavior, changing everything from perception, to judgements and decisions we make every day, all the way up to political viewpoints (e.g.

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**how negation hyperbolizes the perception of truth of a statement (a recent finding in my lab!)**

**I am wondering if you could expand on what you mean by this and how discovered the significance of it.**

[ruck\\_it3](#)

I sure can! We gave people sentences that ranged in how true they were, from very true statements like "People live on Earth" to ambiguous statements like "Murder is sometimes justifiable" to very untrue statements like "1000 is more than one million". Versions were also constructed that contained a negation, inverting their truth value (i.e. "1000 is not more than one million"). To summarize the findings briefly, we observed that the computer mouse path was more curved toward their final response when the sentence was negated. What this implies is very false statements become even more false when negated and true statements become more true. Intuitively, if I tell you "Air is not blue" you might be insulted that I think you believe air to be blue. If I say "Air is colorless", which is also true, this is less likely to be insultingly true. The implication is that the context in which you use negation is critically important, and in these very true and very false contexts, negation actually changes the perceived truth.

**What in your opinion are the major ways human language processing is evolving? How does this contrast with advancements of previous ages?**

[cyborgTemplar](#)

medium, provided that the original author and source are credited.



It's difficult to say what will happen in the future. Language evolution happens much faster than biological evolution. With the invention of the printing press, telephone, radio, television, and finally now the internet, language transmission happens over longer distances and we are exposed to a greater variety of language. Thus it's likely language is more fluid and rapidly changing than it was before we had these channels for communication. We have some of this ubiquity for words that have been made up in recent years, for example, the word "computer" and the word "internet" are the same in most languages.

**Hey Stephanie Huette, is human communication more efficient now than it was, say, 2000 years ago? And can our methods of communication become more efficient and universal as a species?**

**i probably only notice how repetitive and inefficient language is (spoken and unspoken) due to my job as a taxi driver, i understand if it may not feel like that to everybody else.**

#### [whatshisuserface](#)

One of the biggest challenges we face is what language use looked like more than a couple hundred years ago. Until a couple hundred years ago when the printing press was invented, books were rare and there were no recording devices for spoken language. In spite of this, we can get at this by looking broadly at languages today and how they are structured.

Two of my colleagues published a paper on what they call the "linguistic niche" hypothesis (<http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0008559>). They found that languages with more complexity are spoken by fewer people than simpler languages. This supports the theory that culture exerts an influence on the spread of different languages. It's hard right now to predict in what direction this will go in the future, because cultures are so fluid and change in hard to predict ways over time.

For the second part the answer is yes, language is a very "impoverished" signal. What this means is it lacks the richness in information that a given environment might have. For example, you likely have a very detailed representation of the city you drive in. If I were to ask you to describe it in detail, you could likely talk for hours about the different routes you take, the things you see along the way, etc. If you've ever called tech support or IT for help you have experienced this: it takes a very long time to communicate exactly what error you have. But if you have an IT person looking at the computer with you in person, it suddenly becomes much easier. There is a vast literature on how people communicate in different contexts like this and how prevalent ambiguity and misunderstandings can be.

**Based on your own specialty, what single insight do you think could be used to benefit those learning a second language?**

#### [hamsterish](#)

Thanks for the great question! We're currently actively looking at how adults learn new words in the lab. One of the things that we've observed informally so far is how well people learn new vocabulary with repetitions in different contexts. Thus it's not just how well you can memorize new words or explicitly learn grammatical rules. There is a "sweet spot" for getting just the right amount of variability in contexts, accents, etc. The right amount is what's called the "Zone of Proximal development", which basically says new material should be challenging, but not so challenging that you are not able to learn it. With language, your skills at learning, even in adulthood, are much better than you might think since much of this learning occurs outside of your conscious awareness.

I highly recommend a book just published by one of my colleagues here at University of Memphis and a former student of his. It goes into great detail on what we know and how you can apply what we know

from Cognitive Science to learning a second language: <https://mitpress.mit.edu/becoming-fluent>

**Language is absolutely fascinating. What about Freudian Slips? I know that they are part psychology, but there must also be a cognitive language aspect to it. What makes the person choose the wrong or inappropriate word? Is it in any way related to the mechanism or pathology that is involved in Tourette's Syndrome?**

[Farscape29](#)

Freudian slips are one kind of spoken language error we make, but more generally these are called spoonerisms: <http://www.fun-with-words.com/spoonerisms.html>

We make them because we are continually planning ahead of what we are currently saying. What's interesting is these errors more often are words than non-words. Thus it's more likely you'll say something like "a (l)ack of (p)ies" when you intended to say "a pack of lies", and less likely you'd say "ltop slight" instead of "stop light". Thus the words you intend to say actually interact with the sounds.

There isn't much evidence for Freud's interpretation of language errors being influenced by hidden or repressed desires. We make all kinds of spoken language errors regularly, some of which you can induce in a laboratory setting and do systematic research on!

[https://en.wikipedia.org/wiki/Speech\\_error](https://en.wikipedia.org/wiki/Speech_error)

As for Tourette's the short answer is I'm not sure as I'm not as familiar with the literature in this area. However, at first glance Tourette Syndrome shows deficits in language processing areas of the brain. It very likely is similar in terms of it being a difference in how language processing, and production, unfolds over time.

**Why do you think certain quotes from characters in films resonate well with people so that they remember it for years and years? Is there a science in writing language such as that?**

[thesaifking](#)

On behalf of Keith Shubeck:

Hi [/u/thesaifking](#)[1] , Good question! I'm Keith, a PhD student who works with Dr. Huette. The short answer is there is some evidence that certain features of language lead to people remember and retransmitting quotes. In a recent study, Stephanie and I were able to determine which linguistic features of memes were contributing most to success. Not surprisingly, shorter memes are more likely to be successful. Also, template memes (e.g., Socially Awkward Penguin) are more likely to be successful, while memes with curse words or taboo words are less likely to be successful.

I think you'll find the area that is getting closest at answering your question is the area of memetics! Memetics is the study of meme behavior (e.g., how certain cultural units are transmitted socially, why some memes are successful and others aren't, etc.). There's been a recent resurgence in the memetics area, particularly in computer science, computational linguistics and psycholinguistics.

Stephanie and I recently presented our work, "Predicting Meme Success with Linguistic Features in a Multilayer Backpropagation Network" (<https://mindmodeling.org/cogsci2015/papers/0376/paper0376.pdf>) at the annual Cognitive Science Society conference. Basically what we did is took a bunch of text-based memes from knowyourmeme.com and broke them down into 15-string binary vectors, where each vector represented a specific linguistic feature of that meme (e.g., # of words, # of syllables, presence of emotional content, concreteness/abstractness). We trained a backprop network on these features to see if the network could successfully predict meme success, and it turns out that it can, to some degree, predict meme success by simply looking at the meme content.

tl;dr: we don't know exactly why some movie quotes, or memes, are more viral than others. There's certainly a social component to meme success, but we think there's linguistic features that lend to meme success.

**Mechanisms of language and visual processing, very interesting! Wow we are living in exciting times.**

**Just a few questions as I understand as this is such a big subject - the amount of possible information to study and research into this must come with many many questions but I will do my best not to go overboard...**

**1) How exactly do you get to see how language affects visual processing?**

**2) What kind of interesting results happen when we use words such as "should must"?**

**3) Is it true that all our thoughts are rooted in visual images/processes subconsciously/unconsciously? If so, are even emotions rooted on visual processes and images?**

**4) New technologies are up and coming – one of them is the "brain decoder" with the ability to read minds and dreams by Prof Jack Gallant from the university of California. Do you have access to this or similar technologies. And are there any technologies in the works that get you bubbling in excitement?**

**5) And finally, do you have links to extra research material/literature to look into on how the usage of words affects behavior in more depth? A list of your favourite publishers/books would be so greatly appreciated <3!**

**[biffro](#)**

Hi biffro! All great questions. Here is a start on answering your first two questions, answered by one of my graduate students:

Hi there! My name is Jeff Viaud and I am a Ph.D student conducting psycholinguistic research with Dr. Huette. I can answer your 1st question about language and visual processing as this is my current area of research. Previous research has found that language can direct viewing behaviors, even on a unconscious level. Certain language mechanisms, such as negation, have been found to reallocate attention during the viewing of an image, even if you not looking for anything in particular within the image.

In regards to your request to gather some more info on phenomena such as these, I suggest taking a look at some of Dr. Huette's published articles on this very subject:

<http://faculty1.ucmerced.edu/tmatlock/papers/paper0468-2.pdf>

(2) I am familiar with Dr. Huette's work investigating "should vs must" and that particular research yielded some interesting findings. Participants were eye tracked while listening to statements such as "You should brush your teeth" or "You must brush your teeth". Participants were asked if they agreed or disagreed with statements that they heard (either framed as a "should" or a must "statement") and it was found that participants fixated more on the competitor (meaning they fixated more on the opposite response of what they eventually chose) when the statement was framed as a "should" statement. Overall, "should" statements appear to prime people to consider alternate responses. For example, if someone were to say "You should come to my party tonight", people are more likely to think what else they may do instead since they only "should" go to this party. What other alternatives might they have?

**I'm in my first year of studying psychology. I don't know what I will be majoring in. I'm sure the**

**scope of your work involves many things. Can you give me a little more of a description or explanation on what you studied in school? Is the research you have done throughout your career from a nomothetic or idiographic approach (i hope that's worded correctly)? What are your general thoughts when it comes to language and discussing diversity in our social world (for example, Does our choice of words change when talking about minorities or a person's sexual orientation?)**

[breezyboo49](#)

I got a Bachelor of Science in Psychology and got my PhD in Cognitive and Information Sciences. I started working in a lab my Junior year of college - whatever field you go into if the University supports research you can ask professors you like if you can work in their lab in exchange for course credit. This kind of experience is crucial if you plan on going to graduate school in any scientific field.

Many studies in psychology are phenomenon based, for example you'll likely learn about the Stroop effect which speaks to how automatically and unconsciously we process language ([https://en.wikipedia.org/wiki/Stroop\\_effect](https://en.wikipedia.org/wiki/Stroop_effect)). But why is that? What kind of mechanism would lead to a system that processes language even when we are explicitly told to ignore it? I approach it from this angle, where we attempt to characterize general principles and mechanisms of learning and processing, which is crucial to refining theories.

For your last question, there is a wealth of evidence on how language distorts our concepts and categories of information. For example, Russian speakers regularly distinguish between light blue and dark blue with two different words. Russian speakers are also faster at discriminating between light blue and dark blue compared to English speakers who only use "blue" at the basic level. So yes, labels affect the way we think about, interact with, and respond to our environments. For example, people have adopted "cisgender" in place of "normal" because normal would imply transgender individuals were abnormal in some way. This may lead to worse discrimination and negative views of this population. Thus it's not a waste of time to be politically correct, and in fact, I would argue we need to have more focus and spend more time and attention on the vocabulary we use when we speak about people at a societal level, especially underrepresented groups.

**I study language processing as it unfolds using eye tracking and motion tracking technologies.**

**What kinds of unique challenges do you face when it comes to data collection and subsequent analyses? Are there any unique (or what you have found to be interesting) statistical models to explain the processes you are studying? What about underlying assumptions for those models that you struggle with?**

[Namemedickles](#)

There are many challenges to this, and nobody knows this better than my students who are in the process of learning them (your first question answered here by Jeff Viaud):

If you are an aspiring researcher who likes to open up an Excel file and likes to find thousands and thousands of rows of data then eye tracking research is for you! One of the unique challenges that eye tracking presents is that for a single participant, you are left with thousands of rows of fixation data that is up to you to transform into a coherent representation of your research question. Out of 100,000 rows of data, you may only want to particularly isolate and examine about 20,000 rows and it is up to you as a researcher to deduce what needs to be isolated and how to do so.

Here is a list to give you an idea of just some of the measures that can be extracted directly from those thousands of wonderful rows of data:

a) Fixation Duration b) Saccade Direction c) Pupil Dilation d) Saccade Velocity e) Time to First Fixation and more!

**What is your opinion of Noam Chomsky's work? When I studied linguistics ( not as a major ) he was a God. Now I keep on reading on reddit that he is mostly irrelevant to linguistics today. I find that hard to believe, but I'm not up to date.**

**Do you consider your work as being research into Universal Grammar, which is what it sounds like to me, or do you not find that a useful framework?**

[jjhgfjhgf](#)

Chomsky is one of the most important people in the history of language research and Cognitive Science. He was one of the speakers at the conference that led to the formation of that field. He created the theories that led to the wealth of evidence we have now (albeit, most of that evidence disproving or at least not supporting many of his hypotheses). Science is a process of proving people wrong, but the questions he posed and attempted to answer were the right ones, and that is a big part of the battle. I typically don't discuss him much because we have a great deal of evidence now that digs deeper than his linguistic analyses ever did. For example, when positing that language is innate, the followup question is where that information is encoded? Is it in a gene? The answer to that is no, there is not one single gene or combination that lets us process language. He also posited a language module (the Language Acquisition Device) - a part of the brain that is only for language. We know language is interactive with perception, and perception is interactive with language, and there is no one part of the brain only for language use. If it weren't for Chomsky, we may not have pursued issues in this way, and in that way he is relevant. But most of the tenants such as Universal Grammar, modularity, and innateness have less support than notions of cultural relativity, complex dynamic interactions, and mechanisms of learning.