# Analysis of Spelling Errors: Developmental Patterns and the Need for Continued Instruction

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-- [Amy] And again it is a pleasure to have Dr. Ruth Huntley Bahr joining us today who is going to be presenting on the Analysis of Spelling Errors and this course is being offered in partnership with the American Board of Child Language and Language Disorders. Our guest editor for today is Dr. Trisha Self. She is an associate professor and the Paul M. Cassat Distinguished Chair in Communications Sciences and Disorders department at Wichita State University in Wichita, Kansas. She teaches courses, supervises and conducts research in ASD. She is a board certified child language specialist with over 30 years of experience working with children demonstrating complex communication needs including ASD. She is the coordinator of the Autism Interdisciplinary Diagnostic and Treatment team lab at WSU. So thank you so much for a great webinar today, Trisha, and you can go ahead and turn on your mic.

- [Trisha] All right. Thank you, Amy. As Amy mentioned, this continuing education event is in partnership with the American Board of Child Language and Language Disorders, also known as ABCLLD. I'm on the board of ABCLLD and just want to mention to today's attendees that if you think you have advanced knowledge, skills in leadership in child language and are interested in becoming a certified child language specialist, you'll find resources at our website that describes this process. The web address is www.childlanguagespecialist.org. Those of us who are specialists have found many benefits to being certified as an expert in child language. One being that we're all dedicated to ensuring that children receive high quality services. So I invite you to become a specialist. I'd like to thank all of you for joining us today. We're fortunate to have Dr Ruth Bahr with us who will discuss the Analysis of Spelling Errors, Developmental Patterns, and the Need for Continued Instruction. And now it's my pleasure to introduce our speaker. Dr. Ruth Huntley Bahr is associate Dean for the office of graduate studies and professor of communication sciences and disorders at the university of South Florida in Tampa, Florida. As an ASHA fellow and a board certified specialist in child language and language disorders, her primary research interests include spelling, written language, and the nature of phonological

representations in dialect speakers and second language learners. She has received the Svend Smith award for her work in applied phonetics and is currently serving as the president and treasurer for the International Society of Phonetic Sciences, secretary for the International Association of Forensic Phonetics and Acoustics and treasurer for the American Board of Child Language and Language Disorders. Welcome Dr. Bahr, we're looking forward to your presentation today.

- [Ruth] It's such a pleasure to represent ABCLLD in this endeavor, I really appreciate the invitation. Wanted to start with my financial and nonfinancial disclosures. I do work at a university. I do have a book that's out that receives royalties and I'm on several boards, as we mentioned during the introduction. The learning outcomes today, you are gonna be able to identify the cognitive and linguistic influences that affect spelling accuracy. We're gonna take spelling a little deeper than just correct, incorrect, and give you some insight into what students might be doing as they get attempt to spell new words. We're gonna identify strategies that they use, especially in the context of learning new vocabulary and in writing.

And then we're gonna talk about spelling activities that you can incorporate as you're working in vocabulary planning and teaching writing. So let's start off, what is spelling? Most people think that it's just letter-sound correspondences, this sound matches this letter. Some people just think that it's a transcription process, meaning that all of the language is composed in your head and spelling is just the mechanism by which you put it down on paper. I'm gonna encourage you to see spelling as a word formation process. We're gonna talk today about the strategies that children use and the resources that they draw on to create a word. And it may give us some insights into what they know about words and what they know about phonology, orthography, and morphology as it's used in the production of words. So I like to think of it as a word formation process. And as a consequence, it also helps us build vocabulary. Our spelling is dependent upon the richness of our lexicon, how deep our lexical

representations are. And so we're gonna talk about spelling as a word formation process and how it contributes to vocabulary building. Love this quote, it's from Berninger Garcia and Abbott, where it says, "Although spelling is often regarded as a mechanical skill, "it is to the contrary, a complex linguistic process "without which writers could not generate written language." There's gonna be an emphasis today on looking at spelling within the context of writing. That's not to say that the Friday spelling test is not a bad idea, but it's most appropriate for children in the early grades and as they get older, we want them to focus on writing and getting the spelling right in writing. So spelling as a word formation process, it involves three linguistic processes, phonology, orthography and morphology. And you can see how I have them embedded in this figure.

Phonology, we're gonna be talking about matching the letters and sounds. We have to know the letter-sound correspondences and the sound-letter correspondences. And that's gonna be at the phonological level. As we introduce that into orthography, we already have the letter-sound correspondences, but we also start to use learned letter sequences through reading and just visual things in the environment, written words in the environment. We pick up letter sequences like O-U-G-H for cough, we learn those things and those are patterns that we store. Both phonology and orthography then reside in the whole concept of morphology. That's the generation of a word. and in the early grades involves the base words, but as, and even in the early grades as well, but we develop prefixes and suffixes. They are happening in grades one and two, but especially true as we move into the academic language registers that typify students in the upper grades. In this case grades three, and even all the way up to grade nine, where students are still struggling with spelling as they learn new vocabulary. At the top of that, I've listed etymology. I know that most clinicians and teachers are not that familiar with etymology, just on the top of their heads. I look it up on Google. I just go and find things. It does help to understand where words come from. We have a tendency to think that English spelling is incredibly irregular, but when you can take

word etymology into context and teach students the base words, spelling becomes a lot more regular in English when we approach it from that perspective. So why is etymology important? Think about a lot of our words in math and science in middle school. They have Greek and Latin origins and it helps the student to know that H-E-X is six, in helping them recognize that base form in other words. So morphology is very important in this development of spelling. So this leads us to the fact that we end up with three types of word forms. We have phonological word forms, and these are the words that we hear and we speak. We code them in memory and we storage and process them.

And here's what's different at the whole and the sub-word levels. What we mean is that we put in whole words so that we can divide them into onsets and rhymes. We have syllables, but we also store things at the phoneme level. And you're gonna see those different word levels represented in this misspellings I'm gonna show you today. Next is the orthographic word form. These are the words that we see and we write, okay? And again, the words and their word parts are coded in memory in words and sub-words. And we talked about individual letters and letter groups. And then finally, there's morphological word forms. Regardless of how they come in, either reading, writing, speaking, listening, they have a morphology.

There's a root word with or without affixes, and you can have a root word with a prefix or a suffix. So we're gonna talk about how all three word forms come together. And when they don't come together appropriately, it results in a misspelling. So what we're talking about here is the ability to integrate information across the phonology, orthographic and morphological codes to generate what we're gonna talk about as a word-specific spelling. In other words, a conventional spelling, the word that you want to spell. When those word parts do not come together appropriately, it results in a spelling error. So as you can see on the chart that is before you, if you start at the bottom, you see the phonology. These are again, are real spellings from written

samples from children. These are all from older children. These are kids in middle school, six to grades nine. So you can see palaces, they left out the second A. It's a shwa vowel. But the phonological skeleton, what I mean by that, is that every sound in the word is represented in the spelling. This one's missing a sound. So that's a phonological error. If you go to the top in orthographic error, you see physical, that's a diagraph at the beginning. The child's substituted a P instead of a P-H for that. So you and I would look at it and go they spelled pysical, but it's not unusual for children to drop a part of a diagraph. So that would be an orthographic error. They recognize there was a sound there.

They put a sound there. They just didn't represent the sound correctly, orthographically. So that's a orthographic error. Morphology over on the right hand side, they have condition there. So I like this one because it's kinda weird. They have the C-O-N-D-I there, but they ended the T-I-O-N with D-I-S-E-S. So I'm not quite sure why they did that. That's very unusual. So they kinda knew the root word, but the suffix was inappropriately utilized. What I really wanted to point out is that you can have combinations. So over here on the right hand side, you have a PO error, phonological-orthographic error. And that means that they substituted the vowel inappropriately there. You see the O-W instead of O-A.

Interestingly, if you say it float, flowt, it sounds the same. So they represented the sound and they used an acceptable orthographic pattern, just the wrong orthographic pattern. So there was a mismatch between the phonology and the orthography. They got the phonology right, the orthography was wrong. If you go at the bottom left, you can see the PM that's a phonological morthographic error. Now, these are typically what you call like abbreviated or colloquial form. So probly for probably. Now, not many of us say probably, but you don't typically write probly when you're writing. So they don't understand what the root word is. They're just spelling it the way it sounds. And up at the top a morphological orthographic error that is saying that the word form

was there, but it's not spelled correctly in an orthographic sense. So we have board B-O-R-D, has all the right sounds, but it doesn't convey the meaning that we want it to convey, as the past tense of bore. So those are different types of errors. You could have a POM error, we'll see some of those today as we go along. But our goal in spelling is to integrate this information so that it generates an appropriate word. So we wanna think about spelling errors in a broader context. And so let's start in the middle. I'm gonna talk about scoring systems next. But how we score a spelling error has a lot to do with how we perceive it. Many times if you look at research, it's a correct or incorrect. That's all they're doing. And so that doesn't give us much information. There's different types of scoring systems that will give us different linguistic informations. But what we really wanna focus on are the things that influence it, so this level right here. So we've got working memory, you've gotta be able to hold things in working memory to be able to write them down or to spell them out loud. Longterm memory.

The things that we've stored in our memory so that we can retrieve them. And this is where our lexical representations come in. Metalinguistic sensitivity. Are you good at picking up phonological, orthographic, and morphological patterns? Has a little bit to do with statistical learning, which we won't really get into today. But that's how we get this sensitivity. We pick out patterns from the environment. And then importantly, attention and control. When we're writing, our attention is divided. We have to think about what to say next. What word we're gonna use. Oops, I can't spell that word, can I think of another one I can spell? And those things drive errors even on the most simple words, things that you know that they know and we'll see examples of that. The next level goes out and talks about the actual processing abilities, orthographic, phonological and morphological. And then are those processing skills affect our spelling. And then the outer level looks at the level of our oral language that's gonna affect our vocabulary, that's gonna affect the words that we spell. Reading, it is typical that people that are good readers are also good spellers. That's not universally true.

There is a good reader, poor speller. But reading gives us exposure to orthographic patterns. Our vocabulary knowledge, big influence on how we can spell things. We have to have exposure to lots of different words to recognize the patterns, to be able to generate correct spellings. And then writing. It interferes with the tensional controls. We have to think about what we're gonna write and to construct the sentence while we're trying to spell the word. So all of these things influence our spelling skill, and are involved in spelling errors as we produce them. So let's talk about scoring systems. As I've mentioned, many individuals just do a plus minus. Yes, it's right. No, it's not. Or something very cursory. They're looking for something specific. Oh, they didn't spell the vowel right, or they didn't look at the right consonants. They have this focus on what they're trying to do and that's totally fine. And that works really well in statistics. That can tell you something about the students. But if you really wanna work on vocabulary, help them learn academic language, help them with their spelling, 'cause when they write, for many of our state assessments, now spelling, at least in the state of Florida, is counted against the student. And you can see why.

If a composition is full of lots of misspelled words, it just sends the wrong impression. The content can be great, but it's hard to get there when you have to work so hard to figure out what the words are. We'll see some of those things coming up. But basically, when you really wanna understand spelling errors, you wanna think about a scoring system that looks at phonological plausibility. How close is the orthographic representation to the target word? And you have two different ways of doing this. The first is a constrained approach, and this is the more common approach that's used. What happens here is that you're looking at spelling accuracy in terms of orthographically acceptable letter patterns. So what am I talking about? So when you come down here, see the word reach. This is an acceptable spelling pattern. They've represented all of the sounds in the word, but they didn't represent the vowel correctly, but they still indicated that it's a long vowel by putting the E on the end of the word. So if you saw R-E-C-H-E, you would pronounce it reach, more than likely. What this shows

us, when you use this kind of a system, you are really heavily weighted on structural and positional knowledge. So for instance, C-K can only occur at the end of the word. You don't see that in the initial position. So those kinds of things would be marked wrong in this kind of system. Totally fine. This is what many people use. But you also have the opportunity to use an unconstrained system. And then that system, you're more focused on matching the phonemes and graphemes.

You just wanna know if it's phonetically plausible. So if you look at the bottom reach there, R-E-C-H, it does represent every sound. It's a CVC word. So C-H is a diagraph. It's one sound. You've got your vowel. Now with that spelling, you're not sure if it's a long or a short vowel, but once you can look at it in context, you know that it's a long vowel. So it represented the phonological skeleton. So that's the difference. It doesn't have to be orthographically correct. It just has to represent every element in the phonological skeleton. And that's why I put another one there that you'll like better, I think, is necessity. They didn't double the S and they used an E instead of a Y, because they're spelling the word the way it sounds. So that's the difference between constrained and unconstrained. Now I'm a phenologist, so I like the unconstrained system and here's why, I am so interested in figuring out what the student knows, not what he got wrong. And that's a subtle distinction. What does he know? What information can I garner from the spellings that the child produces about what lexical information he has?

So we came up with a system years ago. This is in a JSLHR article in 2012 and we developed what we call the POMAS, Phonological, Orthographic, Morphological Analysis of Spelling. It was developed within a grounded theory, meaning that I used actual data to generate the rules that I used. So if you wanna use this spelling, honestly and truly, just sit down and look at their spelling and come up with the rules that make sense to you, but you're welcome to use, I'll send you my rules. I'm happy to do that. But you just kinda look and see what this person's doing. It's a bottom up analysis. So

it's more unconstrained. So when I talk about phonological errors, I'm talking about phoneme omissions and substitutions to the phonological skeleton. What would I mean by that? So if something's missing, okay, no joke that makes sense. But what do you mean by a substitution? Why would that be orthographic? Well, if the word is son and they wrote gun, a G, and this infrequently happens, but does happen, that did not represent the phonological skeleton. That sound is not right. If you were trying to do shun and they said son, an S for an S-H, that's That still represented the phonological skeleton, we're missing the diagraph. So phonological errors have to represent the phonological skeleton. If they don't, it's an error. Orthographic errors are letter substitutions and omissions.

So the phonological skeleton is intact and you're making substitutions or omissions. Omissions are usually on the diagraphs, both consonant and vowel diagraphs. Morphological errors are errors looking at word meanings. This is usually the production of a homomyn. So if they write S-I-T-E for S-I-G-H-T, then that would be a morphological error. Everything's correct, the orthography is correct, it's just not the right word. And it also looks at inflections and derivations. So we took the POMAS and then in order to do publications and things I needed to come up with some kind of scoring system 'cause all of this did was give me a list of descriptive features and errors.

And right now I've got about 64 features that I've identified. I've used it in Spanish and it's been very effective there. I just saw an article where they used it in Italian so you can use these features, but you can't do much statistically with it. So I came up with another system to quantify how far the spelling error was from the target. Now Rebecca Trieman, who's also very well known at spelling has a system out and she has something similar but she's looking to strictly at the number of letters and the organization of the letters. I'm going a little farther. I needed to be able to demonstrate cross-code integration. I wanted to know what was happening in phonology,

orthography and morphology when the children developed a word. So I've got an example here. The word is astronaut. This is the current sample I'm working on and they were asked to write about a space, what would astronauts do in space. And what I loved about that is the word astronaut appears all over the place. So I wanted to show you different spellings of the word astronaut. And what this score does, you first have to do the POMAS 'cause you have to have the POMAS codes to actually score how far it is away from the target. If you look at the POMAS codes, P, O and M actually refer to P-phonology, O-orthography, M-morphology. That's always the first letter in the code. And then the rest of it has to do with what I have in parenthesis. So that tells me what types of errors and then I score it individually for P, O and M, to show you how far. And as you can see as you go through this list, you get different scorings. They're further away or closer based on how many errors are in the word. I particularly like astarenots.

So you got this one. There's that real word stare, S-T-A-R-E. How it went from stro to stare, see, this is where they just kind of, they're in a hurry, they pulled out an orthographic pattern, they knew S, T and R were in there, and they put a real word in there. But what I wanted you to see is that this scoring system allows us to show phonological errors and whether they're correct. The higher score means it's much further from the target, zero means you got it right. And so a zero in a category means you're do it fairly well.

I just wanted to explain this, this article that I cited at the top is in reading and writing. It is actually in print as of this week. So it's in reading and writing the current issue and you can see a little bit more about how that system is used. I do want you to say that complexity, it's a play on words, complexity of the air, palm. But you don't have to use that. But what it does help you do is see something's more complex. This is simply a system I'm using to do statistics. And again, the POMAS is just the way that I'm going through and quantifying some linguistic things. Again, love to share it with you if you're

interested in it. Again, you can do this without that information. So what this tells us is we've got to merge our word general knowledge into word-specific knowledge. So what do I mean? So on this chart you can see at the top we have a conventional spelling. And that's our goal. We want the spelling to look like it's how it's supposed to. So how do we do that? Well, we use word general knowledge, and that includes alphabetic knowledge and linguistic feature knowledge. We pick this up through statistical learning, our exposure to words, our experiences with words. And what I'm gonna show you later is some tasks that you can help develop this kind of experience for students.

Help them to play with the words, to learn these things so that they can use this information to generate word-specific spellings. And these are the target spelling. When I say word-specific, we know that N-I-G-H-T, that's how you spell it when you're talking about the nighttime, when it's dark. You don't spell it N-I-T-E, unless we're texting each other. But that's the word-specific spelling. And it's then going to influence the lexicon. This is going to enhance the lexical representation that the student has for the word.

As you can see, word general knowledge is influenced by experience with words, whereas word-specific knowledge has to do with specific experience with specific word forms and their word parts. So Steve Graham and Santangelo in 2014 put out a report talking about that the best way to work with spelling and the best way to assess spelling is within writing. One afternoon, a colleague of mine and myself were looking up some articles and we found an article from 1910, believe it or not it was on the internet, you could read it, and they were saying back in 1910, that the Friday spelling lists, they didn't say it that way, but you give the kids some words at the beginning of the week and have them spell them on Friday, even if it's based on a rule that's great for first and second grade, totally ineffective in the upper grades. And that's what I wanna help you see, is that we've got to do different things. We've gotta give students

experiences with words so that they strengthen their lexical representation. When the time comes to write, they can pull out an accurate spelling. So I brought in this model, this is Hayes & Berninger, and they're looking at spelling within a model of writing. And where we are, is this spelling right here, the transcriber, it's at the process level. What this is talking about is you're thinking about what you're writing, you're evaluating it, you're translating it into your language and into the appropriate letters and then you're writing it down. What I want you to get off of this slide is that writing, i.e. spelling, is influenced by many things. It is affected at the control level. Who's initiating? Are you writing something that somebody told you to write about like our state prompts? Or are you writing for your own pleasure?

Planning, your writing schemas. What kind of knowledge do you have about writing? What's the task like? Are you writing it with people? Are you typing it or handwriting it? There's a whole literature on that. What is the material? Is it academic material, social studies, math? Or is it nonfiction or fiction that you're interested in? And then finally, and this is what I like just to think about a lot, our resource level. We've already talked about this, about our attentional abilities, working memory, longterm memory, and just our experience with reading. All of these things are going to impact the accuracy of our spellings. So now the good part, so I have things in colors to help you out. This is some writing samples.

These were on children from grades one through nine. This is the data from the 2012 article. This is a grade one female, and the prompt is one day student, that's a pseudonym, had the worst day at school. That was the prompt. And she had I think 15 minutes. So this is what she generated in 15 minutes 'cause she did not have a friend, her friends were all sick. She was lonely and her sister was at school. But then one of her friends came it, and then she was done. What I wanted to point out here is look, she spelled friend two different ways in the same sample. So spelling errors are not consistent. It's based on the context. So you could see a lot of interesting things. She's

really struggling with letter order. One, and school, and friends. She has all the letters there, they're just not in the right order. She was trying to write a lot and you can see down here, here's her dog. She likes her dog. When W-H-E-N is what that's supposed to be and this is she pretty. You see that a lot. I also see it as P-R-I-D-E like pride. It took me a minute to catch that spelling word. So that's a first grader. Pretty typical. These are all typically developing kids. Here's a fourth grader. This one's a male, same prompt. But notice he had many fewer errors. Now it could be, because he is only writing the words he knows how to spell. It could be that. If you read a syntax, not so great. some kind of rambles and things, but he doesn't have very many spelling errors. The ones that he did have are down at the bottom. And these are pretty typical. Theres, missing an apostrophe.

Our college students do that too. Alot, this is a error I make, that's actually two words, a lot. But here's another common error with letter doubling. Look at different, only one F. So this is a fourth grader still struggling with some pretty basic words. Different, shouldn't be that hard, but because of the writing context, he probably missed it. So let's see what we found, some developmental patterns. So here are some typical errors for students in grades one through four. Sonorant cluster reduction. This is one that Becky Treiman talks a lot about and what's happening is when you have a liquid sonorant consonant liquid glides nasals it often merges with the vowel next to it, so the students cannot break that apart easily, so they drop it.

So you'll see that a lot in very young students because they're still relying totally on letter-sound matching in how they pronounce the word. You can see that the flap is an error. Then there's the P-R-I-D-E, very common error. And final consonant voicing becus instead of because. See it should've had a Z on that, so it wasn't represented correctly. Letter name, I'm sorry that this one's backwards, the pal on the pale. But anyway, what do I mean by that? Car, C-R, car. The R, says its name. So that represents the phonological skeleton. Doesn't have the A on it, but it does represent

the phonological skeleton. I put pal as a substitution for pale because that's a very common error. Silent E is a difficult one to give a rule to because it doesn't hold true all the time. So you take the word home, the E makes a vowel say its name. But what about words like come and some? The vowel are short. We won't go into, it goes back to old English. There's a reason why that is. So we like to call it a letter name error if the silent E is missing on the end because what we're trying to say is the vowel isn't saying its name, you don't know that it's saying its name. The rest of those are pretty common types of errors. Still getting some letter reversals at the bottom, B and D reversals.

And even I've seen some P and D reversals so it's not just the B and D. And morphological. Yes, they are doing morphology. Look they're doing inflections. There's a whole literature that's talking about morphology doesn't come until later. These children in first grade do know some inflections and even some derived forms. Struggling with contractions and homonyms as well. So what do we see in grades five through nine? They changed a little bit. Now we're struggling with diphthongs. So these are represented by vowel diagraphs, but they also are two sounds and they're not representing them.

And then that nasty schwa. That is the hardest thing in English because it's an unstressed vowel and it can be represented by any vowel. Orthographic errors, again, short vowel diagraphs, consonant doubling, vowel errors, and then they're still struggling with the E, if you will, the silent E. But this time it's usually in the construction of a derived form. So it's increased in complexity. So they still don't know, do I drop the E or not drop the E? I'm not sure. And then morphology. Pretty much the same, if you can notice we're struggling with where that apostrophe goes in our contractions. And then derivations come in at that level in the upper grades. So when you compare them, grades one through four to five to nine, I just takes what's on the previous slides here you can see that the quality of the error changes. The errors

themselves don't necessarily change that much. It's kind of the quality. You see letter name is in both grades one through four, and five through nine. So what am I saying here? I have these charts in here because I don't want you to be overwhelmed by the POMAS or pumplexity. What I want you to do is to really focus on these. I'm telling you right now, you work on these processes or these rules with your students, you're gonna hit just about everybody in some way, shape or form. So I am kind of having you move away from a careful analysis of every student's writing sample and you should breathe a sigh of relief and know, look at the key words. Look at your vocabulary for the week.

What is the spelling rule, if you will, that's going on in that vocabulary? Teach these things within the vocabulary they need that day because I'm gonna show you with more samples that the spelling error changes as they use different information or as the resources vary. So if you sit here and think, oh they don't ever use silent E, they're gonna turn right around and spell the word correctly later. So these are the things that we just need to strengthen and there's probably some more, but I've looked at over, these are 300 samples, I believe. These were pretty generic and things that people struggle with. So this slide right here would be very helpful to know what you'd wanna choose. So errors are principled over time. This is a dataset that uses the Y tool so it's an older data set.

A friend of mine retired and sent me boxes and boxes of data. And so in this one she had data on poor average and superior spellings. All of these students are typically developing. So poor spellers are not just students with learning disabilities or language problems, and I'll come back to that in a slide coming up, but we have poor spellers. You know people that say, I'm not a good speller, but they're fine. Their language skills are good, they're just not a good speller. So that's who these people are. And they spelled these words for five years. So it allowed us to compare their spellings across time. What I think is most telling is if you look at the top one, because this test had

basals and ceilings, so they didn't try some of these other words until later. And these are just the words that I thought were most interesting. Look at average and poor. A is average, P is poor. Look at the difference, and this is in grades three to seven. You could see that this person charge, they did have the phonological skeleton, the C for the C-H, the R for the verb and the G for the /j/ sound. So they got it, but not anywhere close. Up above, it's a little bit closer. And then watch how it changes over time. By year three, the average student has it. But notice here, poor students spelling in year three like the average speller in grade two. And then they both eventually get it by year four. And so what you can see on this slide is that there are differences. Poor spellers have earlier developing spellings, but they're not necessarily deviant. I'm not saying, that they don't ever do anything that's a little bit crazy, but it's using more of a letter sound correspondence.

What we see is that they move through a progression of strict reliance on letter-sound correspondences to starting to use some orthographic patterns to match the phonology but not correct, and then getting to the correct form over time. So there is a progression.

So they are principled. Here's a student, this is a superior speller and they're spelling the word absence. And what's interesting is in grade one, this superior speller, could at least pull out the base word, absent. They were able to spell that correctly. And as you can see in grade two, they go on and absents, so they put an S on the end. Grade three, they're struggling. Is it S or C? They don't know what the derived form, the suffix is. And then by grade four they have it. So this is a more linear, they're gradually, they're still representing all the sounds, but over time it's getting closer and closer to the target. It's important when we're thinking about spelling and looking at the errors to think about the morphological level or the linguistic level that we're looking at. An article by Newman back in 2010 talked about how students can make connections between linguistic features and spoken language. And we have applied this to spelling.

So Newman talked about three levels. One was granularity. And this is the linguistic level at which the phonology is mapped to the orthography. Is it at the sub-word level? Is it at the word level? We're gonna look at that. Stability, the regularity of phonological-orthographic, orthographic-morphological. All of these relationships, how stable are they? Do they fluctuate? Are they able to hold onto that knowledge? And then finally, how accessible is it to get the feature that you need? So let me show you some examples. So let's start with granularity. We looked at our students and these were in grades one through seven and there were 81 different spellings of the word careless. I think it's but I think it's super interesting that only five of those students ever used a different letter than C, to spell careless. And the reason why that surprised me is you know, /k/ can be represented by C or K.

But note, they already knew that it was a C and there were really only four instances of K and then the fifth one was a C-H. And probably how that just sounded to them. So the phonological ambiguity these students do to things in the environment, they figured out that C was probably a better choice for our initial sound than a K. And they knew it in the word careless. More interesting to me is the word conscientious. Yes, yes, I know, first graders can't spell conscientious, But guess what? Some of these first grade spellers tried it.

And over the five years, we had 28 attempts at conscientious, every single time they started it with a C. So these superior spellers, it was average and superior, but mostly superior spellers, they knew con was a prefix and they knew it started with C. This is what I'm talking about, the distributional properties. They know what things go in what word position. This is information they gather from the environment. Here's another one. So here's the word careless again. You've got your poor, average and superior spellers, grades one through five, and you can see how, I think it's very interesting that the average speller is, in my opinion, closer to the word, than the poor and the superior spelling. But she could see that the superior speller jumps in real quickly and gets it

right. So what we're talking about here is recursion, meaning that they go back and forth between incorrect and correct presumptions, or earlier patterns and later patterns. So for the superior speller, left the E out in year four they already showed me they knew how to spell it two times before that and then they came back. What's happening here, the average spellers, they're not too bad, not great, but not too bad. And then look, they go back and do a K and they drop the E and the S, so that's kind of going back in time. Coming back up, this is better. And then it goes more linear. And the same thing here. You look at the poor speller, not too bad. Drifts back, doesn't have as many things matching. It's pretty doggone close. Drifts back again and gets close. Never got it right by grade five but did get it by grade seven. So again, you can see this is what we mean by recursion, is that they go back and forth as they learn new knowledge, and they figure out how to apply it. Stability, this is the thing that amazes me the most is that they can have a spelling and then they lose it. And you can see it here.

Look at grade three, what's going on? They reversed the letters. They have it in grades two, four and five. In grade one, they're just off by a little bit. So this is the same child over time. And this is why spellings don't stay stable. It has things to do with the information you're teaching them. Then they apply it in the wrong ways and they lose it and then they come back. How about the accessibility of specific forms? How easy is it to get to the forms?

Well, the first thing we noted was poor morphological decomposition. Okay, that's big words. So what am I talking about? Well, they didn't recognize the base word. They didn't use their knowledge of prefixes and suffixes and what the root word was. They tended to spell words the way they sound. Why do you think they did that? What does the teacher say? Sound it out. So you see the word dangerous became dangrous. Favorite became favrot. And she'd go on and you can see all of those. So what's happening is that they're working at the syllable level as opposed to a word level. And

so they're using their letter-sound knowledge as opposed to saying, oh, favorite is related to the word favor. No, I'm sure they don't know that. We haven't been teaching as much about that, but now with all of the emphasis on teaching morphology, we're gonna be getting back to that, and that would really help. The next one, and this explains the homonym errors, is that there's just weak integration between form and meeting. Students very routinely spell the word addition, plus, for edition of a book, even when presented in context. Patience and patients. So what they're doing is they're not recognizing the meaning of the word in the sentence. They're just generating a word form that's correctly spelled, but it doesn't have the meaning that they want. And then as I've talked about a little bit before, they are also just pulling orthographic patterns and I'm calling that a real word error. So you can see excitement, E-X-S-I-G-H-T.

They're doing that for excitement. I think that's just super interesting. That's like in a seventh grader. And then trying pharmaceutical, on a good day. That's hard for all of us. But I loved this student's attempt, farmer, there's a real word, suit. So again, going through, sounding it out, and pulling out real words to fit in there, orthographic patterns that they're familiar with. So question of the hour. What about a specific learning disability? Does it result in different misspelling patterns? This is the article that we just printed. So here's some samples. These are students that were involved in a writing program.

They're in grades six through nine. They were given a text and they were supposed to take notes and then write a summary of the text. In this particular section, they were looking at social studies. So this was done within the academic language register. And what I've done here, is I've highlighted all the words in blue that the student has misspelled and then I have this one in green here to show you again they used the real word to spell the word surrounded. You can see there's there for they're. That's a homonym they're, it should have been that. Again, struggling with the letter doubling.

Capitalization, I didn't really count, but that's a big issue. So this is a student with dysgraphia. Meaning that they're having trouble with the written form. Their language is not bad, their perception is good, but they're struggling with getting it down. The big thing is that you can see, they can write more, they have fewer errors. The problem is an orthographic memory. And what happens is because that's impaired, and because of the motor skill issue, they forget some of the letters or make some errors. But their errors are not too bad, but they're very much like the errors that typically developing students are making as well. Now here's a student with dyslexia. She's 14 and what I like about this is I've highlighted in green are the errors and in blue are the times that they spelled it right. So let's go here. So here's space is spelled correctly. Space is spelled correctly.

Oh, guess what space, S-P-O-C-E is spelled wrong there. Oh goodness, the word test is spelled right several other times. Now look there, it's spelled wrong. This is what I'm talking about in terms of struggling with all of the demands on the task, getting it right. But we see here as you would expect, phonological processing is the problem with dyslexia. And if you look at these words out here, actually, operation, achieve, I love that one. They're missing standard knowledge, conditions. They're not absolutely solid in matching the phonology to the orthography. Not too unlike younger students, but you can see those types of errors in this student. This student has an OWL LD, Oral Written Language Learning Disability, kinda like an SLI. And you can see the same thing here. What really amazed me here was the fact that the student only used 41 different words. So he repeated himself a lot. Probably, six times. Astronaut was repeated five times and spelled three different ways. And he really relied on a sounding out strategy. So the words in green of course are the ones that he missed. So those are just to give you some examples, fewer words, 68 words. So really struggling with getting all aspects, getting it written down, and then incorporating the spelling. So what we've found in these students is that with dyslexia, they have pretty high 20% error. Most students are around 10 or 15%. But look at, and you can look at these a little bit

more later, but category, see how many different ways it was spelled, but we're still having trouble with inflections, omissions, schwa vowels, classified. Again, what I'm trying to show you is that there isn't one way to misspell a word. So if you're trying to work at a group level, let's work on the word and how to spell the word and the rules in the word, not worrying about what each student is doing, but let's just teach the word parts. We get over to OWL LD. These students were more impaired but look their spelling errors are less. Why? They're not trying words they can't spell. Their samples are smaller. But if you look, you can see that their spellings are quite similar. Sorry, there's an extra W on vowels.

Quite similar to what the dyslexia students are doing and not too different than what typically developing students would do, who were unfamiliar with these words. So bottom line, yes they do make errors, probably make a few more errors, might be a little more severe, meaning that they would be much more typical of students much younger than they are. But spelling errors are still, they're still spelling them, they're still putting Cs for categorize and not Ks. So what are some suggestions if I wanna get to this? What I want you to really walk away with is that English spelling is patterned. It's not illogical. It shows you there are attempts at spelling the words the way they sounded.

So either the general word knowledge is incomplete or the word-specific knowledge is incomplete. So delicious, you see a spelling there. They're doing their best to use the information that they have. Individual differences are common and we need to look at morphological transparency and syntactic roles. Look for the root words. We wanna focus on the words, not the rule. You want to help them learn how to spell the word. That's gonna help us integrate it with syntactic roles. So how can we do that? So the first thing, you're gonna see I'm gonna give you phonological and orthographic tasks. You wanna emphasize word patterns. Please use words from this week's lessons. That's gonna be more meaningful. But the first one is a task for rhotic R. As you know,

R bark, that is a different sound than fern, girl, surf. My point in this activity is you could make letter cards, you can have B, blank blank K on there and you could have R on the table R, IR, and have students make the words using the right vocalic R. And that's practice. The reason why that's an interesting task is that R is the only one that sounds different. The rest of them all sound the same. So you have to kinda learn which word is E-R versus U-R are. So that would be a sorting task. Again, another sorting task, orthographic constancy. As you might know, I didn't for a long time, I do now, but T-C-H occurs at the end of words with short vowels and C-H occurs at the end of words with long vowels. So you could give them words that have T-C-H and C-H, have them sort them into words with short vowels and words with long vowels. But I love the oddballs, rich, much, short vowels, not a T-C-H.

We don't have to get into the etymology of why that is. But you wanna train students so that they see the regularities, but they also see what Venezky calls an alternation. How is it spelled differently? So that they can identify the ones that don't fit the rule and can focus on learning how to spell those. Here's another one. You can sort groups by vowel patterns to compare and contrast short/long. So here what I have is that I have different ways of spelling long E, E-A, I-E. And you're sorting them with short E.

But also notice I've got E-A in two words over here that are short, so that they can learn the differences. So you wanna sort them by sound. Notice I'm focusing on phonology. And then the one at the bottom you can do it by orthographic pattern. And you could help them sort it by syllable pattern, you could have them sort it by vowel and then have them say them. And what you would see here is cheap and clean match priest and niece. They all match. But you wanna maybe put some alternations in there, things that don't fit that pattern. How do you find these words? I Google them, words with I-E. You'd be shocked at what you're gonna find. You get a whole list and you can figure out which ones match and which ones don't. So how do you improve accuracy? You wanna be a word detective? This is a new article by Amanda Goodwin who does a

lot on morphology and she's talking about strengthening the quality of the student's lexical representation. You wanna focus on vocabulary building. And so if you look carefully, we had a student Jordan, that spelled through, as throw, and that kind of threw me off. So what I did was I went back and I looked at what are the ways to spell O-U-G-H? 'Cause students often do that. They throw a pattern down like that. And you can see here, bow, cough should have an F, rough, there's different ways. But there's dough, O-U-G-H. So he's looking at the word through, thinking through, and he's saying O. So that's where he came up with throw. He knew it was T-H-R, put an O, all right, W. Oh that's a real word. He didn't mean throw, he was trying to write through, but that's how we got there.

You can also go back and look at how they spelled U sound and notice that O-U-G-H is that. So I'm gonna leave this. This is from Goodwin's Article. You wanna identify units of meaning, identify base words, show them how they can use suffixes as syntactic devices. So you have sentences, you'd give them the word demonstrate and they do demonstration. Our students need to understand identifying the root word and how to convert them. You can teach them how to decode complex words and then you can see all of the words relate back to the base word and then you wanna help them know that when they see the word operation, operate will help them define the word.

So you can already see some vocabulary activities. What's happening here is I'm encouraging you to put the spelling in with the vocabulary so that they now can link the spelling to the word in their memory. So what are the conclusions? Spelling is a cognitive linguistic activity that is influenced by availability of cognitive resources, linguistic processes, task control and task environment. It's not simply have they got the word memorized. They're best observed when writing. If you wanna know what the student knows, you wanna use an unconstrained system. If you wanna see what they have wrong, a constrained system is just fine. Spelling errors represent their understanding of features and their organization. Students make similar errors for

different reasons. It's where they are in their learning process, what information they have and are they applying it appropriately. Spelling errors will change. My favorite one is a gymnast who spelled score, S-O-C-O-R, when she talked about bar and beam. And when she got to talking about her floor score, she spelled it S-C-O-O-R. So it is influenced by the context. The focus should be on strengthening word study. That's what Kenn Apel is calling it now and I love that. It's word study, we wanna understand words. And treatments occur within writing. It does not have to be individualized, Have them write after their lessons, look at the spelling, pick the words from there that are vocabulary words and build them up. The individual nature comes when they're misspelling test and those kinds of things. So I've got a lot of references at the end. And now I'm gonna start questions. So give me a minute. Elena, the forensics, I do speaker identification, and I go in and identify voices off of tape. That's pretty cool. Oh, I love that question.

Till what grade? My daughter was a fabulous inventive speller and she was still doing it in fourth and fifth grade and the teachers weren't marking it wrong, and I was like, you gotta start marking it wrong. I think it's great in grades one and two, I would never discourage them, but I would try to show them other patterns early on. Start off early but accept it 'cause you want to get the writing going on. But by grade three and four they need to start really focusing on knowing those words, would be what I would say. Were subjects reading about astronaut or just generating the story? They were just generating the story.

I don't remember the prompt right now, but it was talk about what an astronaut would do in space. It was pretty vague and so the stories were pretty interesting. I love looking at your writing, but it's hard to get a lot of words that are the same and so at least the theme of astronaut in space made sure that those words showed up in there. The rest of the words were all kind of different. So it's hard to compare student spellings in context, but this was just the generation upwards. So this is Rebecca's

question. I use sub-word analysis in auditory processing testing. Let me pull this down so I can see. There we go. Pattern, sequence, and duration. Poor spelling That wouldn't surprise me. I think she's talking about, I guess you guys can't see the questions, but I'll read it. As an audiologist, I use sub-word analysis in auditory processing, diagnostic testing, the tap test, the random gap detection tests, pattern sequence and duration, pattern sequencing. I'm finding that many students with poor spelling and reading... Give me a second. It doesn't always come down with me. Decoding fluency have auditory processing problems at the sub-word level. At the sub-word level? And it would affect the spelling. It would make it very difficult. And that's what I think we're seeing in our dyslexia students as well. So that's a very interesting observation. Thank you for sharing that. So Carolyn is saying in grade three and up, would you encourage teachers to give a content grade and a spelling grade on written compositions in order to encourage writing and give credit for what the student does?

I think that's an excellent idea 'cause we do. Students don't look forward to writing. They get nervous. So we wanna make sure that they feel like they can write and that they're not afraid to try. And as I mentioned earlier, many students are afraid to write words that they don't know how to spell because they don't wanna be wrong. And so yes, I really think that if you can do that, that would be great. It is hard sometimes when you look at a sample with lots of invented spellings to not have that cloud your judgment. And Steve Graham talks about that all the time. But I think that's a really good idea. And it softens the blow because spelling errors are learning opportunities not to be penalized. So Cindy wants to know what's the difference between constrained and unconstrained? That's a great question. Constrained means that you're looking at the misspelling for what the student is not doing correctly. So you have an orthographic layer on it. So they have the phonological structure, but they also have to use a correct orthographic the pattern so that they have to match. So like in the word float, F-L-O-U is an acceptable O sound for O-A. So that would be okay in a

constrained system. An unconstrained system just looks at the phonological skeleton. Is every sound represented? So like in the word charge, C-R-G, that would be considered an appropriate spelling because the C represents the C-H sound, the R represents the vowel and the G is the /j/. That would be unconstrained. There is a letter that matches each element in the phonological skeleton. Jody says, do you feel that the B-D, I just lost it. Where did it go? Confusion can at least sometimes be due to similar acoustic features of the two sound. Both are voice plosives rather than being I think Jenny, that's an excellent point and it very well could be. It's always surprising when students listen to words and sometimes they'll use an affricate or something for things that really aren't an affricate sound.

So I think that's a really good point. It could be that the students are not picking up the vowel format transition, which is really critical in the perception of B's and D's. And so yes, it very well could be a perceptual problem and not just simply a motor issue. That's an excellent comment. Jane said, can dysgraphia be present in students who have typical skills in other reading literacy semantic areas? Yes, it can be. It's motor. If it affects the writing skill it can affect the spelling in orthographic memory. Interestingly, if you remember the social studies slides I was showing you, those students were given the opportunity to hand-write, albeit with your finger on an iPad. So that's a little unnatural and type.

And typing didn't make that much of a difference even for the dysgraphia students. I think what happened is they tried to write more and they made more errors. So the typing is a good solution for clarity, but it didn't really solve the orthographic memory issue. They were still making spelling errors with that. But yes, that's the thing with dysgraphia, their other language skills can be much stronger than the dyslexic and OWL LD students. Andrea, what's an example of an incomplete code integration? Well that was the slide. I don't even know if I can get back that far, in the beginning where I had the examples of incomplete cross code integration. So float F-L-O-W-T would be

an orthographic error. It was incomplete representation. If you had excitement, S-I-G-H-T instead of S-I-T-E, they pulled in an orthographic pattern to use for S-I-T-E. So they had the morphology right, they had a lot of the phonology right, but the orthographic was wrong. So what we're talking about, if you go back to the slide that has the PO and the OM it's a little on hexagons all on top of each other. Those are examples of incomplete cross code integration. All spelling errors represent incomplete cross code integration because if it was able to put the phonology, orthography, and morphology together well, it would result in a correct spelling. So I think it's time to wrap things up. I'd be happy to answer Jane's question in expressive mapping. What I'm talking about is putting down the word, so what I'm focusing on in spelling is word generation. Can you make a word? So expressive mapping would be putting the word down and sometimes they choose different words because they know I can't spell situation so I'm gonna say time. I hope that answered your question. If not, I'd very much love to have you email me. So thank you all for attending. I really appreciate it. It was a pleasure talking with you. And I hope you have a good day.

- [Amy] Thank you so much, Ruth, for joining us today and sharing your knowledge. There is so much to learn and I just think it's a really fascinating area. So thank you so much for joining us, we really do appreciate your time. And thank you to our participants for joining us today. We really appreciate your time as well and some really great followup questions and we look forward to seeing everyone again soon. Have a great rest of the day, everyone.