

# Lessons from Project LISTEN: What Have We Learned from a Reading Tutor That Listens?

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**Abstract.** For 20+ years, Project LISTEN ([www.cs.cmu.edu/~listen](http://www.cs.cmu.edu/~listen)) has made computers listen to children read aloud, and help them learn to read. Along the way we have learned lessons about children, reading, speech technology, intelligent tutors, educational data mining, and doing AIED research in schools.

## 1 Some of the Research Questions Project LISTEN Has Studied

Nobel laureate Herbert Simon's annual talk on how to do research advised incoming PhD students to pick research questions (not merely topics) both significant (i.e., that people care about) and right-sized (not too hard). Questions we have studied include<sup>1</sup>:

What ought a Reading Tutor do?	<a href="#">AAAI94*</a> , <a href="#">CALICO 99</a> , <a href="#">ICMI02</a> , <a href="#">STLL 08</a>
Do children like a feature?	<a href="#">AIED05</a> , <a href="#">SLaTE11</a>
Which system features matter?	<a href="#">SIGDial11</a>
What should the Reading Tutor listen for, why, and how?	<a href="#">Eurospeech93&amp;03</a> , <a href="#">ESCA99</a> , <a href="#">HMC00</a> , <a href="#">AAAI94*</a> , <a href="#">ICSLP98&amp;02&amp;06</a> , <a href="#">AIED01&amp;05&amp;07</a> , <a href="#">ICAAI03</a> , <a href="#">EDM08</a> , <a href="#">Interspeech09&amp;11</a> , <a href="#">SLaTE09&amp;11</a> , <a href="#">ITS10</a> , <a href="#">TSLP 11</a> , <a href="#">FLAIRS12</a> , <a href="#">Chen 12</a> , <a href="#">ISADEPT12</a> , <a href="#">IJAIED 13</a>
How much is it used, and why?	<a href="#">Kant 04</a> , <a href="#">IERI 07</a>
Do Reading Tutor gains beat...	
classroom instruction?	<a href="#">ETS 02</a> , <a href="#">STLL 08</a>
human tutors?	<a href="#">JECR 03</a>
independent reading?	<a href="#">JECR 07</a>
ELL instruction in ...	<a href="#">Canada?</a> <a href="#">IDEC07&amp;09</a> ; <a href="#">Ghana?</a> <a href="#">ITID 10</a> ; <a href="#">India?</a> <a href="#">Dev10</a>
How to model word meaning?	<a href="#">SSSR09</a> , <a href="#">EAACL12</a>
How to generate... questions?	<a href="#">Aist 01*</a> , <a href="#">AIED03</a> , <a href="#">QG09&amp;11</a> , <a href="#">BEA12</a>
examples?	<a href="#">BEA11</a> , <a href="#">JNLE 12</a>
instruction?	<a href="#">AAAI99</a> , <a href="#">IJAIED 01</a> , <a href="#">ITS04&amp;06</a> , <a href="#">AIED09</a>
How to model students?	<a href="#">ITS02&amp;04&amp;06&amp;08*</a> , <a href="#">UM03&amp;07</a> , <a href="#">TICL 04</a> , <a href="#">AIED05&amp;07</a> , <a href="#">IJAIED 06</a> , <a href="#">EDM07&amp;08&amp;10&amp;11&amp;12*</a> , <a href="#">ICWS09</a> , <a href="#">LSA10</a> , <a href="#">TSLP 11</a>
What practice helps most?	<a href="#">FF 01</a> , <a href="#">FLET 08</a> , <a href="#">ITS08*</a> , <a href="#">SSSR12</a>
Could EEG help?	<a href="#">AIED11*</a> , <a href="#">Tan 12</a> , <a href="#">NAACL12</a>
How to mine student data?	<a href="#">JNLE 06</a> , <a href="#">ITS06</a> , <a href="#">HEDM 10</a> , <a href="#">EDM10&amp;11</a> , <a href="#">FLAIRS12*</a>

<sup>1</sup> [www.cs.cmu.edu/~listen](http://www.cs.cmu.edu/~listen) lists *articles*, **chapters**, *conferences*, theses, and awards\*.

## 2 Some of the Secret Weapons Project LISTEN Has Used

Dr. Simon advised students to find “secret weapons” to attack problems in novel ways. Project LISTEN has used speech recognition to attack illiteracy, as well as:

- **Reframing:** replay of a tutoring session as browsing it [HEDM 10]; tracking a reader’s position as guiding it [SLaTE11, FLAIRS12]; understanding children’s questions as training them to ask predictable ones [SLaTE09]; joint cognitive and student modeling as topic modeling [EDM12]
- **Humans:** Wizard of Oz tests to evaluate and extend a tutor [AAAI94\*, ICMI02]
- **Devices:** EEG to detect students’ mental states [AIED11, IJAIED 13]
- **Randomness:** randomize tutor decisions to test effects [AIED03&13, ITS04&06]
- **Corpora:** adult narrations to score children’s reading prosody [TSLP 11]; Google N-grams to build example contexts [BEA11, JNLE 12]; children’s oral reading to mine [Chen 12, ISADEPT12, FLAIRS12\*]
- **Databases:** WordNet to generate vocabulary factoids and questions [Aist 01\*, IJAIED 01]; dictionary to generate vocabulary questions [QG11]
- **Features:** hasty responses to model disengagement [ITS04]
- **Representations:** DBNs to model scaffolding [EDM06]; SCONE mental states to generate questions [AIED09]; maps from prosody to graphics [SLaTE11]; search space of parameterizations [EDM11]
- **Analysis Methods:** learning decomposition [ITS06&08, AIED07, EDM07]; Bayesian knowledge tracing [ITS08\*]; regularization [TSLP 11]; incorporating logistic regression into DBN to trace multi-skill steps [EDM11&12\*]

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