

**Wayne Hinson Ward**  
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## **EDUCATION**

Ph.D. Quantitative Psychology	University of Colorado, Boulder	1984
<i>Thesis: A Signal Processing Model of Auditory Lateralization</i>		
M.A. Quantitative Psychology	University of Colorado, Boulder	1981
B.A. Mathematical Science / Psychology	Rice University	1973

## **PROFESSIONAL EXPERIENCE**

Boulder Learning, Inc.	Boulder, CO	
Co-Founder and Principal Scientist		2007 -
University of Colorado	Boulder, CO	
Research Professor, Institute of Cognitive Science		2008 -
Director, Center for Spoken Language Research		2007 - 2008
Research Professor, Center for Spoken Language Research		1998 - 2008
Carnegie Mellon University, School of Computer Science	Pittsburgh, PA	
Senior Research Computer Scientist		1996 - 1998
Research Computer Scientist		1990 - 1996
Systems Scientist		1989 - 1990
Research Associate		1986 - 1989
Multicom Research	Pittsburgh, PA	
Co-Founder and President		1994 - 1997
ATT Information Systems Labs, Denver, CO		
Member of Technical Staff		1984 - 1986

## **RESEARCH INTERESTS**

Conversational agents, Intelligent tutoring systems, Automatic speech recognition, Spoken Dialog Systems, Natural language processing, Information extraction, Machine learning

## **ACADEMIC HONORS**

Allen Newell Medal for Research Excellence	Carnegie Mellon University	1992
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## **PUBLICATIONS**

### **Journal Articles and Book Chapters**

Daniel Albright, Arrick Lanfranchi, Anwen Fredriksen, William F. Styler IV, Colin Warner, Jena D. Hwang, Jinho D. Choi, Dmitriy Dligach, Rodney D. Nielsen, James H. Martin, Wayne Ward, Martha Palmer, Guergana K. Savova. **Towards comprehensive syntactic and semantic annotations of the clinical narrative.** JAMIA 20(5): 922-930 (2013)

Wayne Ward, Ron Cole, Daniel Bolaños, C. Buchenroth-Martin, E. Svirsky, Tim Weston. (2013). **My Science Tutor: A Conversational Multimedia Virtual Tutor.** *Journal of Educational Psychology*, 105(4), 1115-1125 doi: 10.1037/a0031589

- Daniel Bolaños, Ron A. Cole, Wayne H. Ward, Gerald A Tindal, Jan Hasbrouck, Paula J. Schwanenflugel. (2013). **Human and Automated Assessment of Oral Reading Fluency**. *Journal of Educational Psychology*. 105(4), 1142-1151 doi: 10.1037/a0031589
- Daniel Bolaños, Ronald A. Cole, Wayne Ward, Gerald A. Tindal, Paula J. Schwanenflugel, Melanie R. Kuhn. (2013). **Automatic assessment of expressive oral reading**. *Speech Communication* 55(2): 221-236 (2013)
- W. Ward, R. Cole, D. Bolanos, C. Buchenroth-Martin, E. Svirsky, S. van Vuuren, T. Weston, J. Zheng. (2011). **My Science Tutor: A Conversational Multi-Media Virtual Tutor for Elementary School Science**. *ACM Transactions on Speech and Language Processing*, vol. 7 Issue 4, August 2011.
- Daniel Bolaños, Ronald A. Cole, Wayne Ward, Eric Borts, Edward Svirsky. (2011). **FLORA: Fluent oral reading assessment of children's speech**. *ACM Transactions on Speech and Language Processing*, vol. 7 Issue 4, August 2011.
- Rodney D. Nielsen, Wayne Ward, James H. Martin. (2009). **Recognizing entailment in intelligent tutoring systems**. In Ido Dagan, Bill Dolan, Bernardo Magnini and Dan Roth (Eds.): *The Journal of Natural Language Engineering, (JNLE)*, 15, pp 479-501. Copyright Cambridge University Press, Cambridge, United Kingdom.
- Rodney D. Nielsen, Wayne Ward, James H. Martin. (2008). **Soft computing in intelligent tutoring systems and educational assessment**. In Bhanu Prasad (Ed.): *Soft Computing Applications in Business*, pp 201-230. Published by Springer-Verlag, Heidelberg, Germany.
- Jiyong Ma, Ronald A. Cole, Bryan L. Pellom, Wayne Ward, Barbara Wise. **Accurate Visible Speech Synthesis Based on Concatenating Variable Length Motion Capture Data**, *IEEE Transactions on Visualization and Computer Graphics*, Volume 12(2): 266-276 (2006)
- Sameer Pradhan, Kadri Hacioglu, Valerie Krugler, Wayne Ward, James Martin, Daniel Jurafsky. (2005). **Support Vector Learning for Semantic Argument Classification**. in *Machine Learning*, vol. 60, no. 1, pp. 11-39, 2005
- S. Su, José A. B. Fortes, T. R. Kasad, M. Patil, Andréa M. Matsunaga, Maurício O. Tsugawa, Violetta Cavalli-Sforza, Jaime G. Carbonell, Peter J. Jansen, Wayne Ward, Ronald A. Cole, Donald F. Towsley, Weifeng Chen, Annie I. Antón, Qingfeng He, C. McSweeney, L. deBrens, J. Ventura, P. Taveras, R. Connolly, C. Ortega, B. Piñeres, O. Brooks, G. A. Murillo, M. Herrera. **Transnational Information Sharing, Event Notification, Rule Enforcement and Process Coordination**. *International Journal of Electronic Government Research*, 1(2): 1-26 (2005)
- Jiyong Ma, Ronald A. Cole, Bryan L. Pellom, Wayne Ward, Barbara Wise. (2004). **Accurate automatic visible speech synthesis of arbitrary 3D models based on concatenation of divisive motion capture data**. *Journal of Visualization and Computer Animation* 15(5): 485-500
- Sheryl Young & Wayne Ward. (1990). **Towards Habitable Systems: Use of World Knowledge to Dynamically Constrain Speech Recognition**. in *Recent Research Towards Advanced Man-Machine Interface through Spoken Language*, Eds. H. Fujisaki, S. Kiritani, K. Shirai & S. Sekimoto, pgs. 385 - 400, 1990.
- Sheryl Young, Alexander Hauptmann, Wayne Ward, Ed Smith, Philip Werner. (1990). **High Level Knowledge Sources in Usable Speech Recognition Systems**. in *Readings in*

*Speech Recognition*, Eds. A. Waibel and K. Lee, Morgan Kaufmann, pgs 538 - 550, 1990.

### **Refereed Conference and Workshop Proceedings**

- Abhijit Suresh, Jennifer Jacobs, Vivian Lai, Chenhao Tan, Wayne Ward, James H. Martin, Tamara Sumner: **Using Transformers to Provide Teachers with Personalized Feedback on their Classroom Discourse: The TalkMoves Application**, AAAI 2021 spring symposium on artificial intelligence for K-12 education, April 2021
- Abhijit Suresh, Tamara Sumner, Jennifer K. Jacobs, Bill Foland, Wayne Ward: **Automating Analysis and Feedback to Improve Mathematics Teachers' Classroom Discourse**, Proceedings of the AAAI Conference on Artificial Intelligence 33:9721-9728, July 2019
- Abhijit Suresh, Tamara Sumner, Isabella Huang, Jennifer K. Jacobs, Bill Foland, Wayne Ward: **Using deep learning to automatically detect talk moves in teachers' mathematics lessons**, 2018 IEEE International Conference on Big Data (Big Data), December 2018
- Ronald A. Cole, Wayne Ward, Daniel Bolaños, Cindy Buchenroth-Martin, Eric Borts: **Spoken Dialogs with Children for Science Learning and Literacy**, In Ivan Habernal, Václav Matousek (Eds.): Text, Speech, and Dialogue - 16th International Conference, TSD 2013, Pilsen, Czech Republic, September 1-5, 2013. Proceedings. Springer 2013 Lecture Notes in Computer Science ISBN 978-3-642-40584-6
- Wayne Ward, Daniel Bolaños, Ronald A. Cole: **Spoken Dialogs With a Virtual Science Tutor**, INTERSPEECH 2012, 13th Annual Conference of the International Speech Communication Association, Portland, Oregon, USA, September 9-13, 2012
- Lee Becker, Martha Palmer, Sarel van Vuuren, Wayne Ward; **Question Ranking and Selection in Tutorial Dialogues**, In the *Proceedings of the 7th Workshop on Building Educational Applications Using NLP, held with ACL-2012*, Jeju Island, South Korea, July, 2012
- Lee Becker, Martha Palmer, Sarel van Vuuren, Wayne Ward; **Learning to Tutor Like a Tutor: Ranking Questions in Context**, In Stefano A. Cerri, William J. Clancey, Giorgos Papadourakis, Kitty Panourgia (Eds.): Intelligent Tutoring Systems - 11th International Conference, ITS 2012, Chania, Crete, Greece, June 14-18, 2012. Proceedings. Springer 2012 Lecture Notes in Computer Science ISBN 978-3-642-30949-6, 368-378
- Lee Becker, Martha Palmer, Sarel van Vuuren, and Wayne Ward; **Evaluating questions in context**, In AAAI 2011 Fall Symposium on Question Generation, Arlington, VA USA, November 2011
- Lee Becker, Wayne Ward, Sarel Van Vuuren and Martha Palmer; **DISCUSS: A dialogue move taxonomy layered over semantic representations**, Poster, In the *Proceedings of the 9th International Conference on Computational Semantics, IWCS 2011*, Oxford, UK, January, 2011
- Rodney D. Nielsen, Richard M. Voyles, Daniel Bolaños, Mohammad H. Mahoor, Wilson D. Pace, Katie A. Siek, Wayne Ward: **A Platform for Human-Robot Dialog Systems Research**, In Dialog with Robots, Papers from the 2010 AAAI Fall Symposium, Arlington, Virginia, USA, November 11-13, 2010.
- Rodney D. Nielsen, James J. Masanz, Philip V. Ogren, Wayne Ward, James H. Martin, Guergana K. Savova, Martha Palmer: **An architecture for complex clinical question answering**, ACM International Health Informatics Symposium, IHI 2010, Arlington,

- VA, USA, November 11 - 12, 2010, Proceedings. ACM 2010 ISBN 978-1-4503-0030-8: 395-399
- Daniel Bolanos, Wayne Ward, and Ron Cole. (2009) **A Reference Verification Framework and its Application to a Children's Speech Reading Tracker**, 2<sup>nd</sup> Workshop on Child, Computer and Interaction, Cambridge, MA, Nov 2009
- Lee Becker, Rodney D. Nielsen, and Wayne Ward. (2009). **What a pilot study says about running a question generation challenge**. In *Proceedings of the Second Workshop on Question Generation, at the 14<sup>th</sup> International Conference on Artificial Intelligence in Education*, Brighton, United Kingdom, July 6-10, 2009. IOS Press.
- Sameer S. Pradhan, Wayne Ward, James H. Martin: **Towards Robust Semantic Role Labeling**. *Computational Linguistics* 34(2): 289-310 (2008)
- Rodney D. Nielsen, Lee Becker, and Wayne Ward. (2008). **TAC 2008 CLEAR RTE system report: Facet-based entailment**. In *Proceedings of the Text Analysis Conference*, Gaithersburg, Maryland, November 17-19, 2008. National Institute of Standards and Technology.
- Daniel Bolanos, Wayne Ward, Barbara Wise and Sarel Van Vuuren, (2008) **Pronunciation Error Detection Techniques for Childrens Speech**. In *Proceedings of Interspeech 2008*, September 22-26. Brisbane, Australia.
- Daniel Bolanos and Wayne Ward (2008) **Implicit State-Tying for Support Vector Machine Based Speech Recognition**. In *Proceedings of Interspeech 2008*, September 22-26. Brisbane, Australia.
- Rodney D. Nielsen, Wayne Ward and James H. Martin. (2008). **Automatic generation of fine-grained representations of learner response semantics**. In Beverly Park Woolf, Esma Aimeur, Roger Nkambou and Susanne P. Lajoie (Eds.): *Proceedings of the Ninth International Conference on Intelligent Tutoring Systems, (ITS 2008)*, pp 173-183, Montreal, Canada, June 23-27, 2008. Published by Springer, Heidelberg, Germany.
- Rodney D. Nielsen, Wayne Ward, James H. Martin and Martha Palmer. (2008). **Extracting a representation from text for semantic analysis**. In *Proceedings of the Forty-Sixth annual meeting of the Association for Computational Linguistics and the Human Language Technologies Conference, (ACL-08:HLT)*, pp 241-244, Columbus, Ohio, June 15-20, 2008. Published by the Association for Computational Linguistics, (ACL), Stroudsburg, Pennsylvania.
- Rodney D. Nielsen, Wayne Ward and James H. Martin. (2008). **Classification errors in a domain-independent assessment system**. In *Proceedings of the Third Workshop on Innovative Use of Natural Language Processing for Building Educational Applications, at the Forty-Sixth annual meeting of the Association for Computational Linguistics, (ACL-08:HLT)*, pp 10-18, Columbus, Ohio, June 15-20, 2008. Published by the Association for Computational Linguistics, (ACL), Stroudsburg, Pennsylvania.
- Rodney D. Nielsen, Wayne Ward, James H. Martin and Martha Palmer. (2008). **Annotating students' understanding of science concepts**. In *Proceedings of the Sixth International Language Resources and Evaluation Conference, (LREC'08)*, Marrakech, Morocco, May 28-30, 2008. Published by the European Language Resources Association, (ELRA), Paris, France.
- Rodney D. Nielsen, Wayne Ward and James H. Martin. (2008). **Learning to assess low-level conceptual understanding**. In *David Wilson and H. Chad Lane (Eds.): Proceedings of the Twenty-First International Artificial Intelligence Researchers Society Conference*,

- (*FLAIRS-08*), pp 427-432, Coconut Grove, Florida, May 15-17, 2008. Published by the Association for the Advancement of Artificial Intelligence, (AAAI Press), Menlo Park, California.
- Daniel Bolanos, Wayne Ward, Sarel Van Vuuren, and Javier Garrido (2008). **SVM Based Posterior Probabilities for Syllable Confidence Annotation**. In Proceedings of the International Conference on Acoustics, Speech, and Signal Processing (ICASSP), Las Vegas, Nevada, Mar 30 –Apr 4, 2008
- Daniel Bolanos, Wayne Ward, Sarel Van Vuuren and Javier Garrido, (2007) **Syllable lattices as a basis for a Children’s Speech Reading Tracker**, Interspeech 2007, Aug 27-31, 2007, Antwerp, Belgium.
- Rodney D. Nielsen and Wayne Ward. (2007). **A corpus of fine-grained entailment relations**. In *Proceedings of the Pattern Analysis, Statistical Modelling and Computational Learning Workshop on Textual Entailment and Paraphrasing, at the Forty-Fifth annual meeting of the Association for Computational Linguistics, (ACL-PASCAL-07)*, pp 28-35, Prague, Czech Republic, June 23-30, 2007. Published by the Association for Computational Linguistics, (ACL), Stroudsburg, Pennsylvania.
- Daniel Bolanos and Wayne Ward, (2007) **Posterior Probability Based Confidence Measures Applied to a Children’s Speech Reading Tracking System**. NODALIDA 2007, Proceedings of the 16th Nordic Conference of Computational Linguistics NODALIDA-2007. Editors: Joakim Nivre, Heiki-Jaan Kaalep, Kadri Muischnek and Mare Koit. University of Tartu, ISBN 978-9985-4-0513-0 (online) ISBN 978-9985-4-0514-7 (CD-ROM) pp. 274-277. Tartu, (Estonia), May 25-26 2007.
- Sameer S. Pradhan, Wayne Ward, James H. Martin: **Towards Robust Semantic Role Labeling**, Human Language Technology Conference of the North American Chapter of the Association of Computational Linguistics, Proceedings, April 22-27, 2007, Rochester, New York, USA, 556-563
- Steven Bethard, Rodney D. Nielsen, James H. Martin, Wayne Ward, and Martha Palmer. (2007). **Semantic integration in learning from text**. In *Proceedings of the Association for the Advancement of Artificial Intelligence Spring Symposium Series on Machine Reading, (AAAI SSS-07)*, Stanford University, Palo Alto, California, March 26-28, 2007. Published by the Association for the Advancement of Artificial Intelligence, (AAAI Press), Menlo Park, California.
- Rodney D. Nielsen, Wayne Ward and James H. Martin. (2006). **Toward dependency path based entailment**. In *Bernardo Magnini and Ido Dagan (Eds.): Proceedings of the Second PASCAL Recognising Textual Entailment Challenge Workshop, (PASCAL RTE 2006)*, pp 44-49, Venice, Italy, April 10, 2006. Published by the Pattern Analysis, Statistical Modelling and Computational Learning Network of Excellence, (PASCAL).
- Sameer Pradhan, Kadri Hacioglu, Wayne Ward, James Martin, and Daniel Jurafsky, (2005), **Semantic Role Chunking Combining Complementary Syntactic Views**. in Proceedings of the Ninth Conference on Computational Natural Language Learning (CoNLL-2005), published by Association for Computational Linguistics, pages 217--220, Ann Arbor, MI, June, 2005
- Sameer Pradhan, Wayne Ward, Kadri Hacioglu, James Martin and Daniel Jurafsky, (2005), **Semantic Role Labeling Using Different Syntactic Views**. in Proceedings of the Association for Computational Linguistics 43rd annual meeting (ACL-2005), Ann Arbor, MI, June, 2005

- Kadri Hacioglu, Sameer Pradhan, Wayne Ward, James Martin and Daniel Jurafsky, (2004) **Semantic Role Labeling by Tagging Syntactic Chunks**, in Proceedings of the Eighth Conference on Natural Language Learning (CONLL-2004), eds. Hwee Tou Ng and Ellen Riloff, Boston, MA, USA, 2004, pages 110—113
- Kadri Hacioglu , Bryan Pellom, Wayne Ward, (2004) **Parsing Speech into Articulatory Events**, in Proceedings of the International Conference on Acoustics, Speech and Signal Processing, Montreal, Quebec, Canada, May 17-21, 2004
- Sameer Pradhan, Honglin Sun, Wayne Ward, James Martin and Daniel Jurafsky (2004) **Parsing Arguments of Nominalizations in English and Chinese**, in Proceedings of the Human Language Technology Conference/North American chapter of the Association for Computational Linguistics, Boston, MA, May, 2004
- Sameer Pradhan, Wayne Ward, Kadri Hacioglu, James Martin, Dan Jurafsky, (2004) **Shallow Semantic Parsing Using Support Vector Machines**, Proceedings of HLT-NAACL, Boston, Mass, May, 2004
- Ayako Ikeno, Bryan Pellom, Dan Cer, Ashley Thornton, Jason Brenier, Dan Jurafsky, Wayne Ward, William Byrne, **Issues in Recognition of Spanish-Accented Spontaneous English**, in ISCA & IEEE ISCA & IEEE Workshop on Spontaneous Speech Processing and Recognition, Tokyo, Japan, April, 2003
- Kadri Hacioglu and Wayne Ward, **Question Classification with Support Vector Machines and Error Correcting Codes**, in Proceedings of HLT-NAACL, pp. 28-30, Edmonton, Canada, May, 2003
- Kadri Hacioglu and Wayne Ward, **Target Word Detection and Semantic Role Chunking Using Support Vector Machines**, in Proceedings of HLT-NAACL, pp. 25-27, Edmonton, Canada, May, 2003
- Pradhan, S., Hacioglu, K., Ward, W., Martin, J., Jurafsky, D., **Semantic Role Parsing: Adding Semantic Structure to Unstructured Text**, in Proceedings of the International Conference on Data Mining (ICDM-2003), Melbourne, FL, Nov, 2003
- Hacioglu Kadri and Wayne Ward, **A Concept Graph Based Confidence Measure**, in International Conference on Acoustics, Speech, and Signal Processing (ICASSP), Orlando, Florida, May, 2002
- Hacioglu, Kadri and Wayne Ward, **Does Confidence Annotation Meet the Dialog Goal?**, in Proceedings of the Human Language Technology Conference, San Diego, Ca, March, 2002
- Jianping Zhang, Wayne Ward and Bryan Pellom, **Phone Based Voice Activity Detection Using Online Bayesian Adaptation with Conjugate Normal Distributions**, in International Conference on Acoustics, Speech and Signal Processing (ICASSP), Orlando, Florida, May, 2002
- K. Hacioglu, W. Ward, **A Figure of Merit for the Analysis of Spoken Dialog Systems**, in International Conference on Spoken Language Processing (ICSLP), pp. 877-880, Denver, Colorado, Sept, 2002
- Pradhan Sameer S. and Wayne Ward, **Estimating Semantic Confidence for Spoken Dialogue Systems**, in International Conference on Acoustic Speech and Signal Processing (ICASSP), Orlando, Florida, May, 2002
- Pradhan, S., Illouz, G., Blair-Goldensohn, S., Schlaikjer, A., Krugler, V., Filatova, E., Duboue, P., Yu, H., Passonneau, R., Bethard, S., Hatzivassiloglou, V., Ward, W., Jurafsky, D., McKeown, K., Martin, J., **Building a Foundation System for Producing Short**

- Answers to Factual Questions**, in Proceedings of Text REtrieval Conference (TREC), Gaithersburg, MD, Nov, 2002
- Pradhan, S., V. Krugler, W. Ward, D. Jurafsky, J. Martin, **Using Semantic Representations in Question Answering**, in International Conference on Natural Language Processing (ICON-2002), Bombay, India, December, 2002
- Wayne Ward, Holly Krech, Xiuyang Yu, Keith Herold, George Figgs, Ayako Ikeno, Dan Jurafsky, and William Byrne, **Lexicon Adaptation for LVCSR: Speaker Idiosyncracies, Non-Native Speakers, and Pronunciation Choice**, in ISCA Workshop on Pronunciation Modeling and Lexicon Adaptation, Estes Park, Colorado, September, 2002
- Kadri Hacioglu and Wayne Ward, **A Word Graph Interface for a Flexible Concept Based Speech Understanding Framework**, Eurospeech 2001, Aalborg Denmark, Sept. 2001.
- Jianping Zhang, Wayne Ward, Bryan Pellom, Xiuyang Yu, Kadri Hacioglu, **Improvements in Audio Processing and Language Modeling in the CU Communicator**, Eurospeech 2001, Aalborg Denmark, Sept. 2001.
- Jurafsky, Dan, Wayne Ward, Zhang Jianping, Keith Herold, Yu Xiuyang, and Zhang Sen. 2001. **What Kind of Pronunciation Variation is Hard for Triphones to Model?** *Proceedings of ICASSP-01*, 1.577-580, Salt Lake City, Utah.
- K. Hacioglu, W. Ward, **Combining Language Models : Oracle Approach**, Human Language Technology Conference (HLT-2001) San Diego, March 2001.
- B. Pellom, W. Ward, J. Hansen, K. Hacioglu, J. Zhang, X. Yu, S. Pradhan, **University of Colorado Dialog Systems for Travel and Navigation**, Human Language Technology Conference (HLT-2001) San Diego, March 2001.
- K. Hacioglu, W. Ward, **Dialog-Context Dependent Language Modeling Using N-Grams and Stochastic Context-Free Grammars**, IEEE International Conference on Acoustics, Speech, and Signal Processing (ICASSP-2001), Salt Lake City, May 2001.
- R. San-Segundo, B. Pellom, K. Hacioglu, W. Ward, J.M. Pardo, **Confidence Measures for Dialogue Systems**, IEEE International Conference on Acoustics, Speech, and Signal Processing (ICASSP-2001), Salt Lake City, May 2001.
- B. Pellom, W. Ward, S. Pradhan, **The CU Communicator: An Architecture for Dialogue Systems**, International Conference on Spoken Language Processing (ICSLP), Beijing China, November 2000.
- R. San-Segundo, B. Pellom, W. Ward, J. M. Pardo, **Confidence Measures for Dialogue Management in the CU Communicator System**, IEEE International Conference on Acoustics, Speech, and Signal Processing (ICASSP-2000), Istanbul Turkey, June 2000.
- Ward, W. and Pellom, B., **The CU Communicator System**, IEEE Automatic Speech Recognition and Understanding Workshop, Keystone Colorado, December 1999
- Yu, X. and Ward, W., **Corrective Training for Speaker Adaptation**, EuroSpeech 99, Budapest
- Krishnan, G. and Ward, W., **Characterizing Speech Rate by Vowel Durations**, ICSLP-98, Sydney
- Gillett, J. and Ward, W., **A Language Model Combining Trigrams and Context-Free Grammars**, ICSLP-98, Sydney
- Markey, K. and Ward, W., **Lexical Tuning Based on Triphone Confidence Estimation**, *Proceedings of Eurospeech 97*, September 1997
- Uhrik, C. and Ward, W., **Confidence Metrics Based on N-Gram Language Model Backoff Behaviors**, *Proceedings of Eurospeech 97*, September 1997

- Bergen, Z. and Ward, W., **A Senone Based Confidence Measure For Speech Recognition**, *Proceedings of Eurospeech 97*, September 1997
- Young, S. R. and Ward, W. H., **The Role of Higher-Level Semantic, Pragmatic and Discourse Knowledge in Recognizing and Understanding New Spoken Words and Phrases**, *ESCA Workshop on Spoken Dialog Systems - Theories and Applications*, Hanstholm, Denmark, June, 1995.
- Mayfield, L., Gavalda, M., Ward, W. H., and Waibel, A., **Concept-Based Speech Translation**, *IEEE Conference on Acoustics, Speech and Signal Processing*, May 1995.
- Ward, W. and Issar, S., **The CMU ATIS System**, *Proceedings of ARPA Workshop on Spoken Language Technology*, Jan 1995
- Issar, S. and Ward, W., **Flexible Parsing: CMU's Approach to Spoken Language Understanding**, *Proceedings of ARPA Workshop on Spoken Language Technology*, March 1994
- Ward, W., **Extracting Information From Spontaneous Speech**, *International Conference on Spoken Language Processing*, September 1994.
- Issar, S. and Ward, W., **CMU's Robust Spoken Language Understanding System**, *IEEE Conference on Acoustics, Speech, and Signal Processing*, April 1994
- Ward, W. and Issar, S., "Integrating Semantic Constraints Into the SPHINX-II Recognition Search", *IEEE Conference on Acoustics, Speech, and Signal Processing*, April 1994
- Ward, W. and Issar, S., "Recent Improvements in the CMU Spoken Language Understanding System", *Proceedings of ARPA Workshop on Human Language Technology*, March 1994
- Issar, S. and Ward, W., "CMU's Robust Spoken Language Understanding System", *Proceedings of EUROSPEECH 93*, September 1993
- Young, S. and Ward, W., "Recognition Confidence Measures for Spontaneous Spoken Dialog", *Proceedings of EUROSPEECH 93*, September 1993.
- Young, S. and Ward, W., "Using Semantics and Pragmatics in Speech Recognition", *Proceedings of EUROSPEECH 93*, September 1993
- Young, S. and Ward, W., "Learning New Words From Spontaneous Speech", *IEEE Conference on Acoustics, Speech, and Signal Processing*, April 1993.
- Ward, W. and Young, S., "Flexible Use of Semantic Constraints in Speech Recognition", *IEEE Conference on Acoustics, Speech, and Signal Processing*, April 1993.
- Young, S. R., Huang, X., Ward, W. H. and Stern, R., "Overview of Recent Research at CMU in Speech Recognition and Spontaneous Spoken Language Understanding", *Proceedings of the Fifth DARPA Workshop on Speech and Natural Language*, Morgan Kaufmann, 1992.
- Ward, W., Issar, S. Huang, X., Hon, H., Hwang, M., Young, S., Matessa, M., Liu, F., Stern, R., "Speech Understanding In Open Tasks", *Proceedings of the Fifth DARPA Workshop on Speech and Natural Language*, Feb 1992
- Kita, K. and Ward, W., "Incorporating LR Parsing Into Sphinx", *IEEE ICASSP*, April 1991
- Ward, W. H., "The Phoenix System: Understanding Spontaneous Speech", *IEEE ICASSP*, April 1991
- Ward, W. H., "Evaluation of the CMU ATIS System", *Proceedings of the Fourth DARPA Speech and Natural Language Workshop*, Feb 1991
- Ward, W. H., "The CMU Air Travel Information Service: Understanding Spontaneous Speech", *Proceedings of the DARPA Speech and Natural Language Workshop*, June 1990
- Ward, W. H., "Modelling Non-verbal Sounds for Speech Recognition", *Proceedings of the DARPA Speech and Natural Language Workshop*, Oct 1989



- Ward, W. H., "Understanding Spontaneous Speech", *Proceedings of the DARPA Spoken Language Workshop*, Feb 1989
- Young, S. R., Hauptmann, A. G., and Ward, W. H. "Using Dialog-Level Knowledge Sources to Improve Speech Recognition", *Communications of the ACM*, 32 (2) 1989.
- Young, S. R., Hauptmann, A. G. and Ward, W. H. "Layering Predictions: Flexible use of Dialog Expectation in Speech Recognition", *IJCAI-89*, Morgan Kaufmann: San Mateo, 1989, 1543 - 1549.
- Young, S.R., Hauptmann, A.G., Ward, W.H., Smith, E.T., and Werner, P., "High Level Knowledge Sources in Usable Speech Recognition Systems", *CACM* 32, 2, Feb 1989, 183-194
- Young, S.R. and Ward, W.H. , "Towards Habitable Systems: Use of World Knowledge to Dynamically Constrain Speech Recognition", *Second Symposium on Advanced Man-Machine Interface through Spoken Language*, 1988
- Young, S.R., Hauptmann, A.G., and Ward, W.H. , "An Integrated Speech and Natural Language Dialog System: Using Dialog Knowledge in Speech Recognition", *AAAI 88*
- Ward, W. H., Hauptmann, A. G., Stern, R. M., and Chanak, T., "Parsing Spoken Phrases Despite Missing Words", *IEEE ICASSP 88*
- Stern, R. M., Ward, W. H., Hauptmann, A. G., and Leon, J., "Sentence Parsing with Weak Grammatical Constraints", *IEEE ICASSP 87*

## **GRANTS AND AWARDS**

- National Science Foundation, **Comprehension Assessment via Spoken Dialog**, Wayne Ward (PI), NSF 1938024, \$150,000, 2018-2020
- Institute of Education Sciences, **ELVA: English Learner Vocabulary Acquisition: Promoting the Vocabulary and Language Proficiency of Spanish Speaking English Learners in Second Grade**, Doris Luft-Baker (PI), Wayne Ward, Ron Cole (Co-PIs), IES R305A110492, \$1,350,000, 2014-2017
- Institute of Education Sciences, **MyST: My Science Tutor Efficacy Study**, Wayne Ward (PI), Ron Cole (Co-PI), IES R305A130206, \$3,499,713, 2013-2017
- National Science Foundation, **MRI Development: Human Avatars: Enabling Research in Natural Communication with Virtual Tutors, Therapists, and Robotic Companions**, Mohammad Mahoor (PI), Wayne Ward and Ron Cole (Co-PIs), \$1,019,528, 2014-2017
- National Science Foundation, **EXP: Collaborative Research: A cyber-ensemble of inversion, immersion, collaborative workspaces, query & media-making in mathematics classrooms**, Wayne Ward (PI), NSF 1321071, \$100,000, 2013-2016
- National Science Foundation, **Collaborative Research: Companionbots for Proactive Therapeutic Dialog on Depression**, Wayne Ward (PI), NSF 1111544, \$282,388, 2011-2015
- National Science Foundation, **Understanding the Transformative Potential of Spoken Assessments of Science for Young Learners**, Wayne Ward (PI), Ron Cole (Co-PI), NSF 1228996, \$249,567, 2012-2014
- National Institutes of Health, R01, **Temporal Relation Discovery for Clinical Text**, Martha Palmer (PI), James Martin (Co-PI), NIH R01 LM010090-01A1, \$1.5M, 2010-2014.
- National Institutes of Health, Health and Human Services Administration, **SHARP Area 4: Secondary Uses of Electronic Health Records**, Martha Palmer (PI), James H. Martin, Wayne Ward (Co-PIs), NIH RC1 LM010608-01, \$1.4M, 2010-2014

National Science Foundation, **Improving Science Learning in Inquiry-Based Programs**, Wayne Ward (PI), Ron Cole (Co-PI), NSF DRL 0733323, \$3,000,000, 2007-2012

Institute of Education Sciences, **Secondary School Pilot Research for Agent and Library Augmented Shared Knowledge Areas**, Eric Hamilton (PI), Wayne Ward (Co-PI), IES R305B07705, \$100,000, 2008-2011

Institute of Education Sciences, **Improving Science Learning through Tutorial Dialogs**, Wayne Ward (PI), Ron Cole (Co-PI), IES R305B070434, \$3,130,043, 2007-2011

National Institutes of Health, RC1, **Multi-source Integrated Platform for Answering Clinical Questions**, James H. Martin (PI), M. Palmer and W. Ward (Co-PIs), RC1 LM010608-01, \$500,000, 2009-2011

Institute of Education Sciences, **Agent and Library Augmented Shared Knowledge Areas**, Eric Hamilton (PI), Wayne Ward (Co-PI), \$270,000, 2008-2011

National Science Foundation, **CRI: Next Generation Learning Tools**, Ron Cole (PI), Wayne Ward (Co-PI), \$500,000, 2006-2008

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National Science Foundation, Knowledge Discovery and Dissemination, Dan Jurafsky (PI), Wayne Ward (Co-PI), \$700,000, 2002-2003

National Science Foundation, Creativity Award, Dan Jurafsky (PI), Wayne Ward (Co-PI), \$180,000, 2002-2003

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National Science Foundation, Universal Access, **Modeling Pronunciation Variation for Universal Access to Speech Understanding**, Dan Jurafsky (PI), Wayne Ward (Co-PI), \$503,000, 1999-2002

Defense Advanced Research Projects Agency, HLT, **Portable, Accessible Natural Dialogue Systems**, Ron Cole (PI), Wayne Ward (Co-PI), \$600,000, 1998-2000

National Institute for Standards and Technology, ATP, **Intelligent, Spoken Multi-Media Electronic Patient Medical Records**, Wayne Ward (PI), \$2,000,000, 1995-1998

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