



California State University, Sacramento

Department of Communication Sciences and Disorders

UNDERGRADUATE SYLLABUS & COURSE OUTLINE

Semester/Year: Spring 2024	Course: CSAD 110 Physics of Sound and Phonetics.	Section: 50
Meeting Days: Tuesday/Thursday	Meeting Times: 9:30 AM-11:20 AM	Location: Folsom Hall 2204
Instructor: Lisa D'Angelo, Ph.D., CCC-SLP	Email: dangelo@csus.edu	Phone: (530)400-1970 text only
Office Location: FLS 2316 (2404A)	Office Hours/Appointments: schedule with me—tell me best times for you; also 3-4 Mondays and 11:30-12:30 Tuesdays	

Catalogue Course Description

CSAD 110. Physics of Sound and Phonetics.4 Units

Prerequisite(s): [CHDV 30](#), [DEAF 51](#), [PSYC 2](#), and [STAT 1](#)

Corequisite(s): [CSAD 111](#)

Term Typically Offered: Fall only

Physical production, acoustic characteristics of sounds of speech. International Phonetic Alphabet as applied to speech sounds; practice in phonetic transcription of dialects and deviant speech; applications in speech education, speech and hearing therapy. Introduction to physiological acoustics, psychoacoustics, and acoustic phonetics. Perception of speech including voice, resonance, individual speech segments; instrumentation for acoustic and perceptual analysis of speech.

Place of Course in Program

This is an undergraduate course generally taken by Junior level students in the Fall. It is a requirement for the bachelor's degree in CSAD and for acceptance into the graduate program.

<u>Sacramento State Baccalaureate Learning Goals for the 21st Century (BLG)</u>	Addressed by this course (Y/N)
Competence in the Disciplines: <i>The ability to demonstrate the competencies and values listed below in at least one major field of study and to demonstrate informed understandings of other fields, drawing on the knowledge and skills of disciplines outside the major.</i>	Y
Knowledge of Human Cultures and the Physical and Natural World <i>through study in the sciences and mathematics, social sciences, humanities, histories, languages, and the arts. Focused by engagement with big questions, contemporary and enduring.</i>	Y
Intellectual and Practical Skills, Including: <i>inquiry and analysis, critical, philosophical, and creative thinking, written and oral communication, quantitative literacy, information literacy, teamwork and problem solving, practiced extensively, across the curriculum, in the context of progressively more challenging problems, projects, and standards for performance.</i>	Y
Personal and Social Responsibility, Including: <i>civic knowledge and engagement—local and global, intercultural knowledge and competence*, ethical reasoning and action, foundations and skills for lifelong learning anchored through active involvement with diverse communities and real-world challenges</i>	Y
Integrative Learning**, Including: <i>synthesis and advanced accomplishment across general and specialized studies</i>	Y

CSAD-110 COURSE LEARNING OBJECTIVES:

1. Identify speech and acoustic analysis materials used to assess certain types of disorders.
2. Explain the interconnectedness of language, phonetics, and speech production.
3. Effectively explain the relationship between the articulatory features and acoustic features of specific speech sounds.
4. Analyze spectrograms of vowels & consonants within words & phrases.
5. Transcribe typical speech sounds using the International Phonetics Alphabet (IPA).
6. Describe the features of articulatory phonetics along with clinical and research methods in evaluating and treating articulation disorders
7. Transcribe both typical and atypical productions of the sounds of American English during live transcription exercises using IPA notation.

CSAD-110 SPECIFIC STUDENT LEARNING OUTCOMES/MODULE OBJECTIVES:

1. Students will be able to identify the physical and perceptual properties of the production of specific sounds.
2. Students will be able to both accurately identify and describe both the articulatory and acoustic properties of speech sounds (vowels, consonants, diphthongs) using verbal descriptions and graphic representations of these properties.
3. Students will be able to critically evaluate how research in speech science is applied to clinical treatment in speech pathology and audiology.
4. Students will be able to use computer resources to improve learning process.
5. Students will be able to describe the psychoacoustic correlates of sound namely pitch, loudness and timbre.
6. Students will be able to identify the role played by the critical band in the understanding of auditory information.
7. Students will demonstrate competence in transcribing normal and abnormal speech into the International Phonetic Alphabet.
8. Students will identify and transcribe phonemic versus phonetic contrasts as well as the nature of sound variation in speech production.
9. Students will label basic anatomy and physiology of the speech mechanism.
10. Students will describe the basic process of early articulation and phonology development.
11. Students will explain the difference between an articulation approach and a phonological approach evaluating and treating speech disorders.
12. Students will discern between speech differences and a disorders based on an understanding of cultural pronunciation differences.
13. The student will be able to accurately describe the theory and practice of physiologic, psychoacoustic, acoustic and perceptual phonetics.

Mastery of each student-learning outcome listed below is indicated by a grade of C or better on each component of the corresponding measures listed in the table. Students are required to track their progress towards meeting each learning outcome and must make an appointment with the instructor for any grade equal to or less than a C. The instructor will suggest strategies to help you establish competence and knowledge in these areas.

Students should track their progress towards meeting each learning outcome by listing their grades on the table below over the course of the semester.

Course Module Objective:	Components Indicating Competence:	Grades Received
1	Discussion posts: Quiz 1,2, & 3; Lab 1; Exam 1	
2	Quiz 3; Exam 1; Spectrogram	
3	Exam 1	

Course Module Objective:	Components Indicating Competence:	Grades Received
4	Lab 2	
5	Quiz 1, 2, & 3; Exam 1	
6	Lab 2, Exam 1	
7-8	Exams 3 & 4	
9	Exam 2	
10-11	Exams 3 & 4	
12	Exams 3 & 4	
13	Exam 4	

Textbooks and Materials:

NO TEXTBOOKS ARE REQUIRED FOR THIS COURSE. ALL TEXTBOOK CHAPTERS ARE PROVIDED IN PDF FORMAT WITHIN THE CANVAS MODULES.

Small, Larry. (2020). *Fundamentals of Phonetics: A Practical Guide for Students*, Fifth Edition. Boston: Pearson.

Raphael, L.J. Borden, G.J., Harris, K.S., (2011). *Speech Science Primer: Physiology, Acoustics, and Perception of Speech*. Sixth Edition. MA: Lippincott, Williams & Wilkins.

Online Resources:

Canvas

Most of the handouts and materials for this class will be available on Canvas.

Course Requirements/Components:

Canvas: This course is embedded into a Web Course format. You **must** have an active csus.edu account and use CSUS's Canvas to access lectures, course assignments, class discussions and class email. See participation note below.

Assessment:

Student learning outcomes will be assessed with the following assessment strategies:

Discussions: (50 points total; 25 points each): Initial discussion posts, introduction to information. No fault as below.

Assignments (5 points each to total 65 points): Thirteen assignments are scheduled throughout the semester. These are no-fault assignments that will receive full points so long as they are submitted on time within Canvas. These assignments may be discussed in class, but individual feedback is limited unless you sign up/schedule an office visit with the instructor. The answers will be released to you after the homework submission date has passed. I encourage you to organize study groups and go over these assignments together to prepare for the exams.

Late Assignments: I will not accept **ANY** late assignments. It is your responsibility to get them submitted on time. This is to prepare you for the many reports, letters, and IEPs that you as a clinician will be writing in the future.

Quizzes (10 points each to total 30 points)

There will be three short quizzes at the beginning of the semester. These quizzes will be taken through the Canvas platform.

Exams (100 points each to total 400 points): There will be four exams (including the final). All exams are cumulative. Exam dates are tentative except final exam. All exams will be taken **in-person** and include a combination of multiple choice, short answer, fill-in, essay and transcription. All exams will be cumulative covering all material from the course up to the date of the exam. This is necessary since the material requires a build-up of knowledge throughout the semester. During the transcription sections of the course, the exams come up quickly after each other. Please pay close attention to the syllabus/schedule so you are well prepared for all exams.

Labs (50 points each to total 100 points): There will be two lab exercises. Each lab day students will complete and turn in completed lab write-ups. Lab write-ups include written responses to questions. ***Labs may be completed in pairs/groups but the write-up of the lab should be done individually.*** Complete instructions will be available in the assignment box on Canvas.

Spectrogram (55 points): Students will be given one spectrogram of a sentence at the beginning of the semester and will be asked to interpret what the sentence says over the course of the semester. Results will be graded according to how well the student identifies the sentence. This will be judged in terms of acoustically definable distinctive features and feasible linguistic entities.

Late Labs & Spectrograms: These may be turned in late; however, 10 points will be deducted for every day late (including weekend days) up to 50% of total points.

Grading Policy:

The instructor will not reply to emailed requests to “bump up” a grade. *Note:* For more information about grading at Sac State, visit the academic policies and grading section of the university catalog. There will be no additional opportunities for “extra credit” work. There are bonus questions added to some of the exams. Additionally, full credit will be awarded for completion of the chapter assignments (see above).

Your final Grade will be computed as follows:

Assessment	Points	Percentage of Total Points (approx.)
Assignments	65	9%
Discussions	50	7%
3 Quizzes	30	4%
4 Exams	400	57%
2 Lab Reports	100	14%
Spectrogram	55	7%
TOTAL POINTS	700 points	100%

Letter grades will be computed as a % of points earned out of a total of 650 points are assigned according to the following scores:

<u>%</u>	<u>Letter</u>	<u>%</u>	<u>Letter</u>
94.5-100	A	73.5 – 76.4	C
89.5 – 94.4	A-	69.5 – 73.4	C-
86.5 – 89.4	B+	66.5 – 69.4	D+
83.5 – 86.4	B	63.5 – 66.4	D
79.5 – 83.4	B-	59.5 – 63.4	D-
76.5 – 79.4	C+	below 59.5	F

Course Policies/Procedures:

Policy on making up exams: No make-up exams are given unless there is a documented medical emergency with written proof. **Any make up exams are scheduled during dead week and are in essay format.**

Being late for an exam will not automatically entitle you to extra time. Please make sure you arrange your schedules to be here on time for the exams. If you miss a short quiz because you are late for class, or absent you will not be able to make it up, so try not to miss any quizzes.

Policy on attendance: *Students are expected to attend class on a regular basis.* If you are unable to attend a class I need to be informed by you before class begins. If you arrive to the class late, please enter quietly. This is a very lecture heavy class with difficult concepts and needed practice. I have found that students who have three or more absences typically receive a final course grade below C. I offer time at the beginning of each lecture to answer questions regarding previously covered material. Following each class period, I expect you to be reading and studying the lecture material so this will allow you time for confirmation of ideas or clarification. Please communicate with fellow students to get notes, explanations, etc. as needed.

Drop/Add: Students may drop classes according to University/Department Policy. You should speak to me if you would like to add the course before attempting to do so. Students must fill out appropriate forms and meet University deadlines to drop or add classes. CCE has additional rules/policies.

Professional Conduct and Expectations: It is expected students will attend all classes and be ready to begin instruction on time. Please silence cell phones and electronic devices, and hold personal conversations outside of class, including texting.

Notify the professor in **advance** via e-mail if you cannot attend an EXAM or IN-CLASS ACTIVITY. Students may make up one exam or activity with advance notification and a **valid** excuse (illness, family emergency, etc.). If you will miss a class when a homework assignment is due, you may: (a) e-mail it on day of class, (b) or turn it in **prior** to due date. No late assignments will be accepted unless prior approval has been granted.

Additional Information

Health & Safety Information:

If you are sick, stay home and do not attend class. Notify your instructor. Please self-diagnose if you are experiencing any COVID- like symptoms (fever, cough, sore throat, muscle aches, loss of smell or taste, nausea, diarrhea, or headache) or have had exposure to someone who has tested positive for COVID contact Student Health & Counseling Services (SHCS) at 916-278-6461 to receive guidance and/or medical care. You are asked to report any possible COVID related illnesses/exposures to SHCS via this link COVID-19 Illness/Exposure Report Form: <https://sacstateshcs.wufoo.com/forms/covid19-illnessexposure-report/> Expect a call from SHCS within 24 hours. The CDC provides a good source of information regarding COVID-19 and a way to self-check symptoms: <https://www.cdc.gov/coronavirus/2019-ncov/index.html>.

Commitment to Integrity:

As a student in this course (and at this university) you are expected to maintain high degrees of professionalism, commitment to active learning and participation in this class and also integrity in your behavior in and out of the classroom.

Sac State's Academic Honesty Policy & Procedures:

"The principles of truth and honesty are recognized as fundamental to a community of scholars and teachers. California State University, Sacramento expects that both faculty and students will honor these principles, and in so doing, will protect the integrity of academic work and student grades." Read more about Sac State's Academic Honesty Policy & Procedures at the following website: <http://www.csus.edu/umannual/student/stu-0100.htm>

Definitions: At Sac State, "cheating is the act of obtaining or attempting to obtain credit for academic work through the use of any dishonest, deceptive, or fraudulent means." **Plagiarism** is a form of cheating. At Sac State, "plagiarism is the use of distinctive ideas or works belonging to another person without providing adequate acknowledgement of that person's contribution." Source: Sacramento State University Library Note: Any form of academic dishonesty, including cheating and plagiarism, may be reported to the office of student affairs.

Understand When You May Drop This Course:

It is the student's responsibility to understand when he/she need to consider disenrolling from a course. Refer to the Sac State Course Schedule for dates and deadlines for registration. After this period, a serious and compelling reason is required to drop from the course. Serious and compelling reasons include: (a) documented and significant change in work hours, leaving student unable to attend class, or (b) documented and severe physical/mental illness/injury to the student or student's family. Under emergency/special circumstances, students may petition for an incomplete grade. An incomplete will only be assigned if there is a compelling extenuating circumstance. All incomplete course assignments must be completed by the department's policy.

Equal Access:

California State University-Sacramento, Department of Communication Sciences and Disorders, seeks to provide equal access to its programs, services, and activities for people with disabilities. If you have a documented disability and verification from the Disability Access Center (DAC), and wish to discuss academic accommodations, please contact your instructor as soon as possible. It is the student's responsibility to provide documentation of disability to DAC and meet with a DAC counselor to request special accommodation before classes start. Sacramento State Disability Access Center offers a wide range of support services and accommodations for students in order to ensure students with disabilities have equal access and opportunity to pursue their educational goals. Working collaboratively with students, faculty, staff and administrators, DAC provides consultation and serves as the information resource on disability related issues to the campus community. DAC is located in Lassen Hall 1008 and can be contacted by phone at (916) 278-6955(Voice) or (916) 278-7239 (TDD only) or via email at dac@csus.edu

Accessibility/Equity: The goal for all of our students is for access to all information and remove as many barriers as possible to learning. If you feel that you have difficulty accessing the information for WHATEVER reason, please talk to me. We have ways of lending technology (through IRT), helping with disabilities and gaining accommodations (SSWD), and emergency needs for housing, food, etc. If it doesn't fall into those categories, please talk to me anyways: we can figure it out.

Inclusivity:

Students in this class are encouraged to speak up and participate through in-person, online, or discussion posts. Each of us must show respect for each other because our class represents a diversity of beliefs, backgrounds, and lived experiences. I believe that this is what will enrich all of our experiences together. I recognize that our individual differences can deepen our understanding of one another and the world around us, rather than divide us. In this class, people of all ethnicities, genders and gender identities, religions, ages, sexual orientations, disabilities, socioeconomic backgrounds, regions, and nationalities are strongly encouraged to share their rich array of perspectives and experiences. If you feel your differences may in some way isolate you from our classroom community or if you have a specific need, please contact me early in the semester so that we can work together to help you become an active and engaged member of our class and community. We also have a bias reporting system.

https://cm.maxient.com/reportingform.php?CSUSacramento&layout_id=6

This text was adapted from CSU Chico and Winona State University's posts.

Basic Needs Support

If you are experiencing challenges with food, housing, financial, or other unique circumstances that are impacting your education, help is just a phone call or email away! The CARES office provides case management support for any enrolled student. Email the CARES office at cares@csus.edu to speak with a case manager about the resources available to you. Check out the [CARES web page](#)

Student Health and Counseling Services

Your physical and mental health are important to your success as a college student. Student Health and Counseling Services (SHCS) in The WELL offers medical, counseling, and wellness services to help you get and stay healthy during your time at Sac State. SHCS offers: Primary Care medical services, including sexual and reproductive healthcare, transgender care, and immunizations; urgent care for acute illness, injuries, and urgent counseling needs; pharmacy for prescriptions and over-the-counter products; mental health counseling, including individual sessions, group counseling, support groups, mindfulness training, and peer counseling; athletic training for sports injury rehabilitation; wellness services, including nutrition counseling, peer led health education and wellness workshops, and free safer sex supplies; violence and sexual assault support services. Most services are covered by the Health Services fee and available at no additional cost.

Title IX

Students and faculty each have responsibility for maintaining a safe and respectful space to express their reasoned opinions. Professional courtesy and consideration for our classroom community are especially important with respect to topics dealing with differences in race, color, gender and gender identity/expression, sexual orientation, national origin, religion, disability, and age.

While making personal connections with the topics studied in any course can be a meaningful and important endeavor, please be aware of the following policy regarding confidentiality and disclosures of incidents of sexual misconduct/sexual violence. As your instructor, one of my responsibilities is to help maintain a safe learning environment on our campus. In the event that you choose to write, speak or otherwise disclose information about having experienced sexual misconduct/sexual violence, including rape, sexual assault, sexual battery, dating violence, domestic violence, or stalking and specify that this violence occurred while you or the perpetrator were a Sac State student, federal and state laws require that I, in my capacity as a “responsible employee,” must notify Sac State’s Title IX Coordinator. The Title IX Coordinator will contact you to inform you of your rights and options and connect you with support resources, including possibilities for holding accountable the person who harmed you. Please be advised that you will not be forced to share information and your level of involvement will be your choice.

Sac State's Title IX Coordinator: Skip Bishop Director of Equal Opportunity Del Norte Hall 2005
william.bishop@csus.edu 916-278-5770

If you do not want the Title IX Coordinator notified, instead of disclosing the experience to me, you can speak confidentially by contacting the following confidential resources:

* Campus Confidential Advocate – Laura Swartzen Email: weave@csus.edu or phone Number: 916-278-5850
(during business hours) WEAVE 24/7 Hotline: 916-920-2952

Other Resources

Testing Center: <https://www.csus.edu/student-affairs/centers-programs/testing-center/>

Library: <https://library.csus.edu/>

Services to Students with Disabilities: <https://www.csus.edu/student-affairs/centers-programs/services-students-disabilities/>

Student Health and Counseling Services at The WELL: <https://www.csus.edu/student-life/health-counseling/>

Peer & Academic Resource Center: <https://www.csus.edu/student-affairs/centers-programs/peer-academic-resource/>

Student Academic Success and Education Equity Programs: <https://www.csus.edu/student-affairs/retention-academic-success/>

Crisis Assistance and Resource Education Support (CARES): <https://www.csus.edu/student-affairs/crisis-assistance-resource-education-support/>

TENTATIVE Course Schedule/Outline:

<u>Week</u>	<u>Date</u>	<u>Topic</u>	<u>Readings/Practice</u>
1	Jan 23	Introduction: Course Overview	Assignment 1: Log on to Canvas and see instructions for Assignment 1 (Due Jan 26)
	Jan 25	Language, Phonetics and Speech Production	Reading: Raphael, Ch. 1, graded discussion post
2	Jan 30	Acoustics 1 and 2: Simple Harmonic Motion, Complex Waves, etc.	Reading: Raphael, Chapter 2: pp. 17-29
	Feb 1	Acoustics 2 & 3: Physical and Perceptual Properties Quiz #1 (online on Canvas)	Reading: Raphael, Chapter 2: pp. 29-37 Asynchronous recorded lecture Assignment 1 Due
3	Feb 6	Acoustics 3: Physical and Perceptual Properties Acoustic Analysis/Measurement Techniques	Reading: Raphael, Chapter 13: pp. 276-285 Raphael, Chapter 14: pp. 287-297
	Feb 8	Quiz #2 Resonance & Source Filter Theory	Reading: Raphael, Chapter 2: pp. 37-39 Raphael, Chapter 5: pp 96-98
4	Feb 13	Lab 1 (Class and Home project) Resonance & Source Filter Theory	
	Feb 15	Quiz #3 Acoustics of Vowel Production	Reading: Raphael, Chapter 5: pp. 93-104
5	Feb 20	Front Vowels, Back Vowels, Diphthongs and Formant Transitions.	Reading: Raphael, Chapter 5: pp 104-112 Lab 1 Due
	Feb 22	Phonetic Sciences (<i><u>Not on exam 1</u></i>)	Reading: Small, Chapter 1
6	Feb 27	Lab 2: Acoustics Lab Folsom Hall 1029	Bring ALL course materials to Class
	Feb 29	Linguistic Phonetics: Speech vs. Language and Spelling vs. Sound Review for Exam 1	Reading: Small, Chapter 2: pp 9-18
7	Mar 5	Lab 2: Acoustics Lab Folsom Hall 1029	Bring ALL course materials to Class
	Mar 7	Exam 1	Reading: Small, Chapter 2: pp 9-18
8	Mar 12	Linguistic Phonetics (cont.): Language Systems, Morphology, Phonology Phonemes vs. Allophones/Min Pair	Reading: Small, Chapter 2: pp 19-20 Small, Chapter 2: pp 30-31 Assignment 2-1 (due Oct 23) Assignment 2-2 items #1 & #2 (due Oct 23)
	Mar 14	CSHA Phonology Phonotactics: Syllables, Lexical Stress, Exercises in Stress	Reading: Small, Chapter 2 pp 20-25 Small, Chapter 2 pp 25-34 Assignment 2-2 Items #3 <u>through</u> #8 (due Oct. 23) Lab 2 Due

Week	Date	Topic	Readings/Practice
9	Mar 19	Spring Break!	Sleep, eat, chill, chocolate, hike!!!
	Mar 21	Spring Break !	
10	Mar 26	Speech Production Systems Vowels Front Vowels	Reading: Small, Chapter 3, 4 Assignment 4-1
	Mar 28	Exam 2 Back and Central Vowels r-Colored Vowels & Diphthongs	Assignments 2-1 & 2-2 Due March 28 Assignment 4-2 (due April 11) Assignment 4-3 (due April 11) Assignment 4-4 (due April 11)
11	Apr 2	Classification Systems of Consonants Place, Manner, Voicing Distinctive Features	Reading: Small, Chapter 5 pp 109-143 Assignment 5-1 and 5-2 (due April 30)
	April 4	(Con't) Classification Systems Place, Manner, Voicing Distinctive Features	
12	Apr 9	Stops, Nasals, Fricatives and Affricates	Reading: Small, Chapter 5 pp 143-154 Assignment 5-3, 5-4, and 5-5 (due Dec 4)
	Apr 11	Approximant Consonants: Glides and Liquids <i>Review for Exam 3</i>	Assignments 4-1 through 4-4 Due
13	Apr 16	Exam 3	
	Apr 18	Resonant Consonants	Work on Spectrograms ©
14	Apr 23	Non-Resonant Consonants	Reading: Raphael: Ch. 6, pp. 114-123
	Apr 25	Non-Resonant Consonants Practice real patient transcription	Reading: Raphael: Ch. 6, pp. 123-135
15	Apr 30	Diacritical Markers; phonological processes	Assignment 5-1 through 5-5 Due
	May 2	Finish Lecture Spectrogram Review	
TBA		Final Exam	Spectrograms Due

Knowledge and Skills Acquisition (KASA) For Certification in Speech-Language Pathology

CSAD 110 Physics of Sound and Phonetics.

This course has been designed to be in direct support of the following American Speech-Language Hearing Association (ASHA) 2017 Knowledge and Skills Acquisition for certification in Speech-Language Pathology:

Standard IV-A

- The student will demonstrate prerequisite knowledge of the physical sciences.

Standard IV-C: Speech, Language, Hearing, Communication, and Swallowing Disorders and Differences

- The student will demonstrate the ability to analyze, synthesize and evaluate knowledge re: phonology, articulation disorders (including the etiologies, characteristics, and anatomical physiological, acoustic, psychological, developmental, linguistic, and cultural correlates.)
- The student will demonstrate the ability to analyze, synthesize and evaluate knowledge re: voice and resonance disorders (including the etiologies, characteristics, and anatomical physiological, acoustic, psychological, developmental, linguistic, and cultural correlates.)
- The student will demonstrate the ability to analyze, synthesize and evaluate knowledge re: receptive and expressive language disorders (phonology, morphology, syntax, semantics, pragmatics, prelinguistic communication, and paralinguistic communication) in speaking, listening, reading, writing, and manual modalities (including the etiologies, characteristics, and anatomical physiological, acoustic, psychological, developmental, linguistic, and cultural correlates.)

Standard IV-B: Basic Human Communication Processes

- The student will demonstrate the ability to analyze, synthesize and evaluate knowledge re: acoustic bases of human communication.
- The student will demonstrate the ability to analyze, synthesize and evaluate knowledge re: linguistic bases of human communication.