

HILT Activities: High Impact on Student Learning, Little Time in Class to Implement

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Outline

- Introduction to the Project
- Featured Words: Parameter and Statistic
- Becoming a HILT Instructor

Introduction to the Project

Language in the Classroom

- Unless students and teachers are using words in the same way, “there is a vast amount of room for misunderstanding that may never be detected.” (p. 166)¹
- Language can pose as a barrier for students with entry into disciplines including those in the STEM field.^{1,2,3,4}
 - Students perception that a subject is difficult solely based on the lack of understanding of the vocabulary.^{2,5}
- It is “common knowledge in science education that terms used to describe scientific concepts in terms of everyday phenomena often pose a problem for students.” (p. 866)⁶
 - perhaps because people connect what they hear to what they have heard and experienced in the past.^{3,6}

Lexical Ambiguity & the Typical Introductory Statistics Curriculum

• Lexical Ambiguity...

- Domain-specific words that are similar to commonly used English words but have different meanings within a discipline.⁷
- Statistics: *average, normal, parameter, random, ...*
- Shown to create problems for students in many STEM disciplines:
 - Science^{8,3}, Mathematics^{9,10}, Statistics^{11, 12,13,14,15}
- Instructors should address the differences in meaning explicitly in the classroom.^{16,17,18}
- One suggestion is to exploit the differences between the uses.¹⁹

• Typical introductory statistics course...

- Widely viewed as having a fixed, overfilled curriculum.
- Perceived lack of class time to try new approaches.²⁰

Words with Potential Lexical Ambiguity

Center	Minimum	Parameter	Response
Control	Mode	Population	Sample
Correlation	Association	Bias	Scatter
Distribution	Average	Error	Simple
Event	Confidence	Independent	Skew
Experiment	Random	Normal	Standard
Margin	Spread	Significant	Statistic
Mean	Nominal	Range	Statistics
Median	Null	Residual	Variance

Activity Development: Desirable Characteristics

- Help students understand the language of statistics
- Easily incorporated into class with a minimal investment of time
- Have the **HILT** attribute
 - **H**igh **I**mpact on student learning
 - Require **L**ittle **T**ime for an instructor to enact

NSF Project: Specific Project Aims

- Create and implement exemplary HILT activities for addressing issues in student learning in statistics associated with language use
- Research and document differences in student learning outcomes associated with the classroom use of the HILT activities

Activity Effectiveness

- Primarily measured through two forms of student-level data collected at the end of the semester:
 - Written responses to a prompt asking for the statistical definition of a word (Lexical Ambiguity Instrument-Post or LAI-Post)
 - Answer to a multiple-choice or short answer question posed on a final examination (application-based understanding of word)
- Data were collected from students who were exposed to the HILT activities (taught by HILT Instructors) and from students who were not exposed to the HILT activities (taught by a subset of Comparison Instructors)

Featured Words

- **Parameter-Statistic**

Coding Rubric: LAI Prompt - *parameter*

Category	Description
PERIMETER	Total outside length or area
VARIABLE	Any measureable quantity
COLLOQUIAL	Boundary, conditions, intervals, guidelines, rules
POPULATION, SAMPLE, OR DATA	Correct definition of one of the terms
STATISTIC	Correct definition of statistic
INCOMPLETE STATISTICAL	Characteristic of the population
SPECIFIC PARAMETER	Ex: Population mean or proportion
CORRECT STATISTICAL	A numerical summary of the population

Sample Written Responses - *parameter*

Correct Statistical

- A numerical value summarizing the population data is a parameter.
- A numerical characteristic of a population as distinct from a statistic or sample

Specific Parameter

- A parameter can be population mean, population proportion, and population standard deviation.
- A population mean would be a parameter.

Incomplete Statistical

- A parameter is the information that is recorded about a population and shows things about the population.
- Parameter is a value that does not change.

Statistic

- Parameter is a numerical measurement of one set of data.
- A synonym is a statistic which measures the sample.

Sample Written Responses - *parameter*

Population, Sample, or Data

- Parameter is the total population of people in a study.
- Sample of the population
- A parameter is data collected from a study.

Variable

- A parameter is a numerical value.
- Something measurable
- A numerical summary

Perimeter

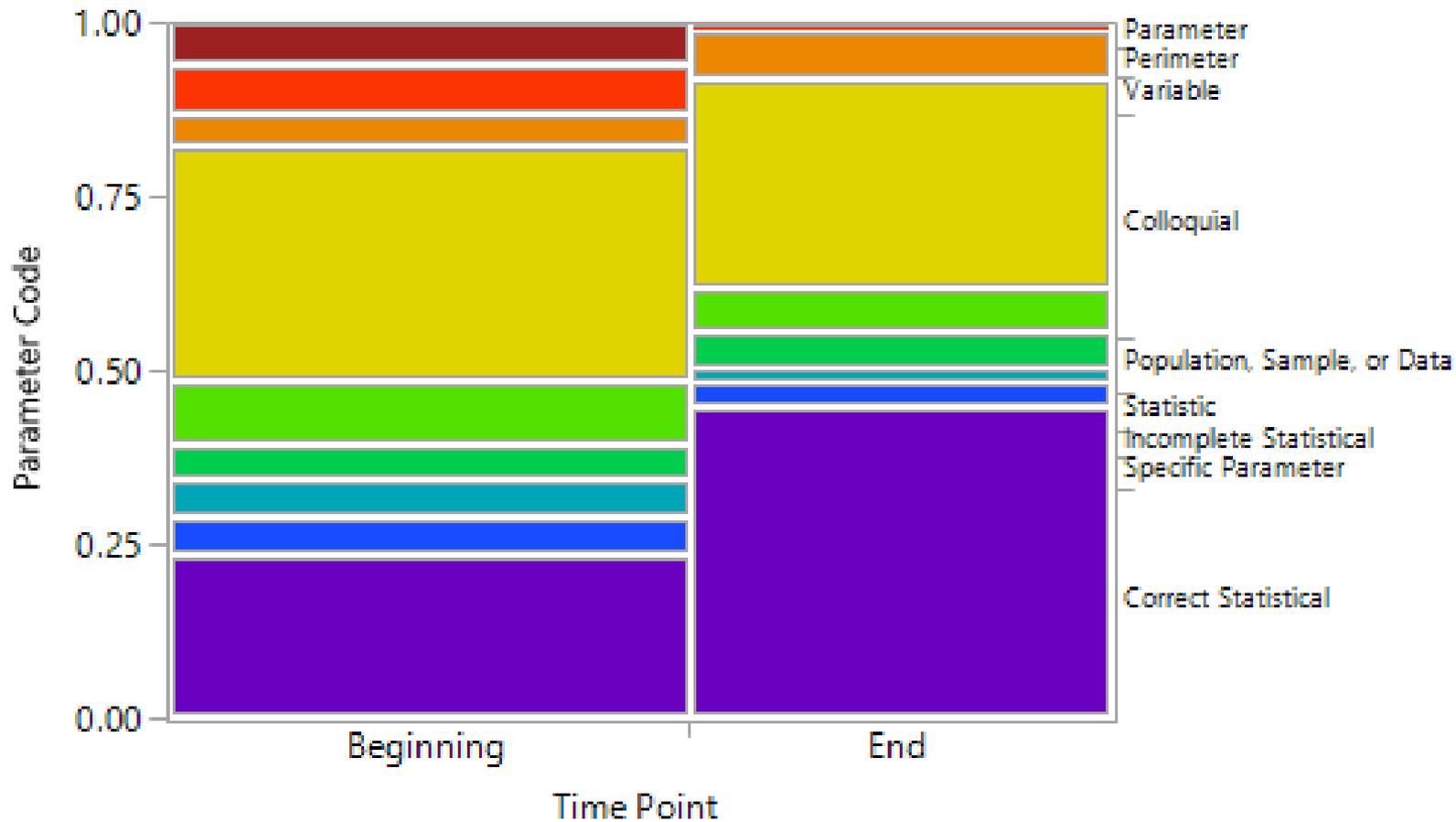
- Parameter is the circumference of a region.
- A parameter is the outside length of an object.

Sample Written Responses - *parameter*

Colloquial

- A parameter, in its common meaning, is a characteristic, feature, or measurable factor that can help in defining a particular system.
- Parameters are criteria, or requirements.
- A parameter is a way in which a statistician chooses who is going to be in his sample group. It may include or exclude certain people/things in the sample.
- A parameter is what specifies where you can obtain data for an experiment.
- The parameter that we are taking data from is the students that are **ONLY** on meal plan.
- A defined set of possible numbers or outcomes.
- parameter is the low and high of something, like it needs to be in that interval.

Student Definitions of *Parameter* (no HILT activity)



$n = 1070$

Coding Rubric: LAI Prompt - *statistic*

Category	Description
PARAMETER	A numerical description of the population.
NAMED STATISTIC	Michael Jordan's shooting percentage is 67%
INFERENCE	Data used to make inferences or using the information from the sample to make comparisons
OBSERVATION, SAMPLE, OR DATA	A statistic is one value from the sample. Statistics are a set of numerical data.
INFORMATION	Refers to quantitative information derived from data with no mention of a sample or inference
DISCIPLINE	Statistic is a type of math class.
SPECIFIC STATISTIC	A percentage calculated from a sample
CORRECT STATISTICAL	A numerical value summarizing the sample data is a parameter.

Sample Written Responses - *statistic*

Correct Statistical

- Statistic means a numerical value summarizing the sample data.
- a quantitative variable that describes a sample

Specific Statistic

- Average of the sample
- A statistic is a percentage or proportion that represents the quantity of a characteristic within a sample.

Discipline

- Statistics is a branch of study that uses data to make informed conclusions.
- The definition of statistics is a fun class that you learn a lot in.

Parameter

- Statistic is a numerical value summarizing the population.
- A statistic is a piece of information about the whole population.

Sample Written Responses - *statistic*

Observation, Sample, or Data

- Statistic in this context means the results recorded from the researcher's sample of people.
- A statistic could also be called a sample.

Named Statistic

- Michael Jordan's shooting average is .04%.
- This statistic represented the percentage of girls who are in STAT 2000.

Inference

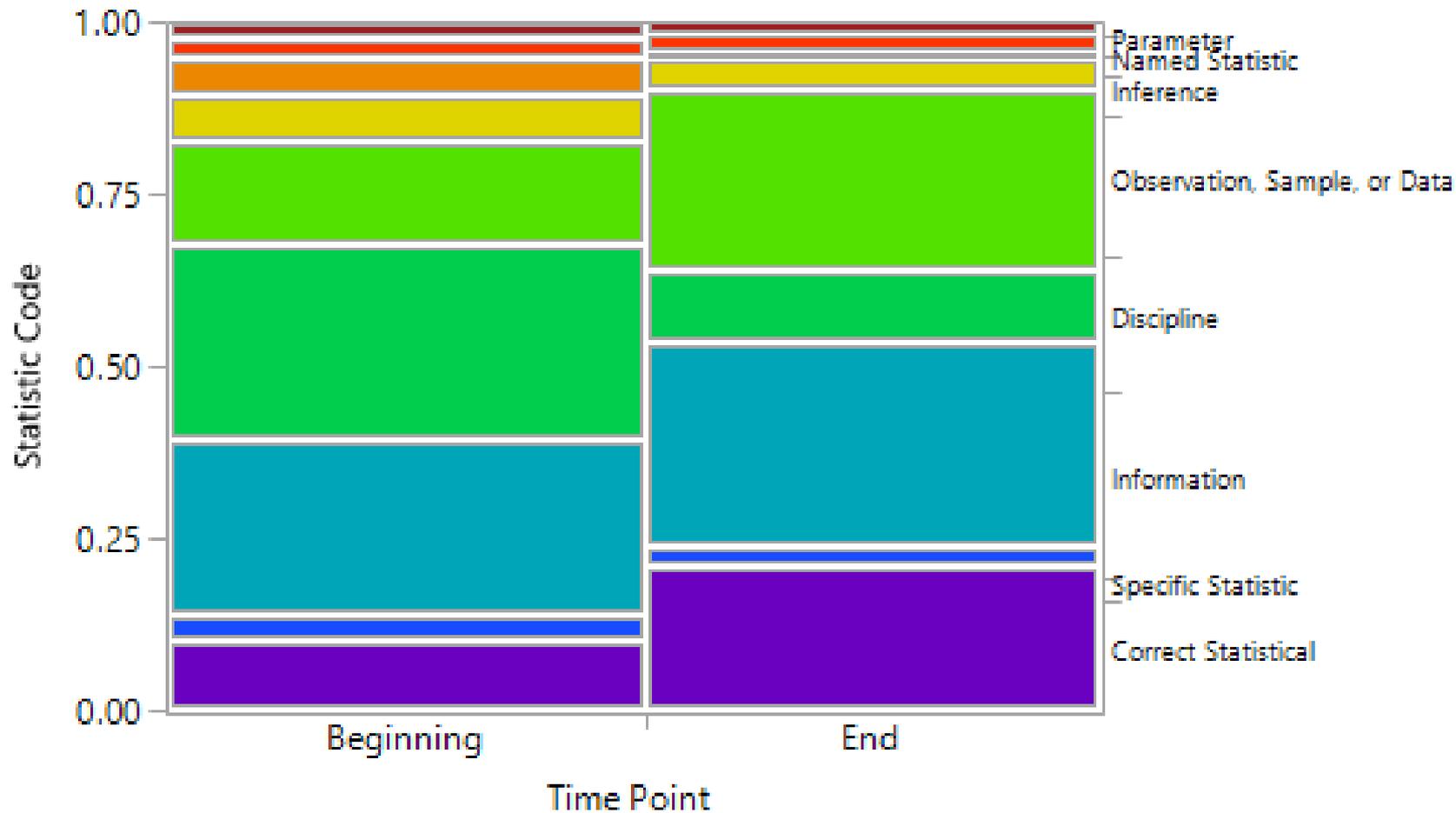
- A statistic is a proportion of a sample used to make an inference about a larger population.
- collecting and analyzing data to infer something
- Statistics is the data provided from tests performed on a sample.

Sample Written Responses - *statistic*

Information

- A piece of information gathered from a set of data.
- A fact based on numerical data.
- A fact or piece of data in a study of a large quantity of numerical data.
- A statistic is a way of representing data.
- A statistic is a fact that conveys a certain message.
- A statistic is an organized collection of analyzed data that gives you some sort of information.

Student Definitions of *Statistic* (no HILT activity)



$n = 1129$

Activity for Parameter and Statistic

- All vs. Small

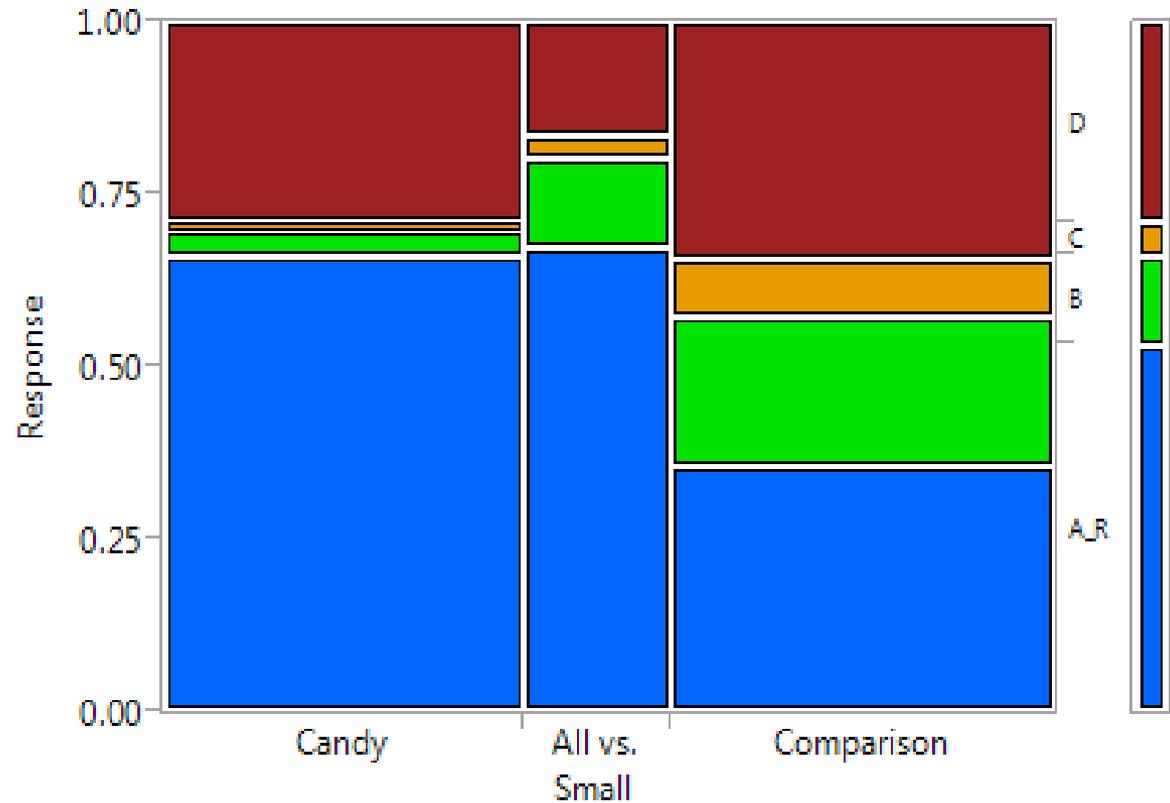
<https://hilt-statistics.wikispaces.com/All+vs.+Small>

Post-Instruction *parameter*

Final Exam Question – HILT vs. non-HILT

The mean GPA of all students at GVSU is an example of a:

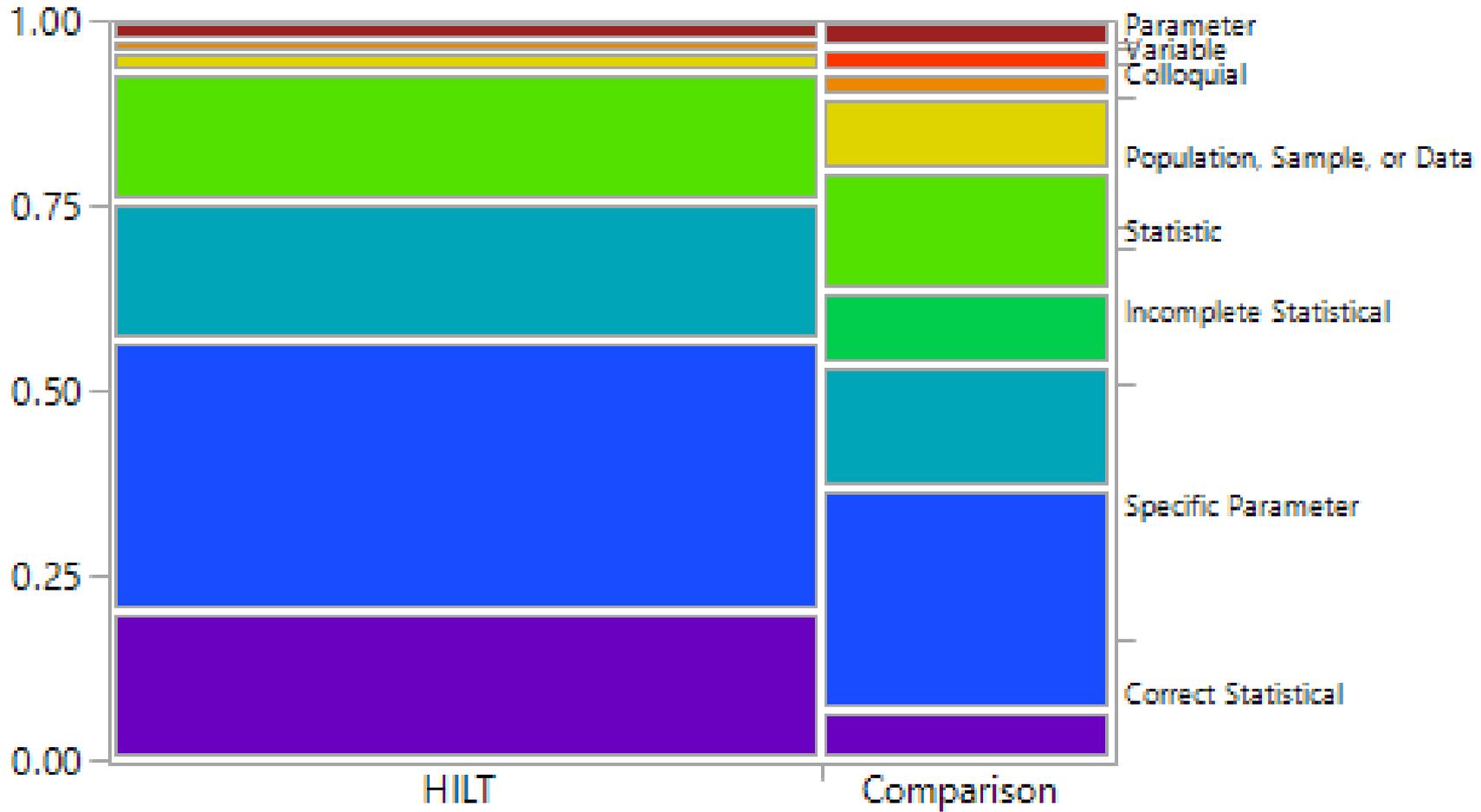
- a. Parameter
- b. Population
- c. Sample
- d. Statistic



Group	Parameter	Population	Sample	Statistic
Candy	89 (65.9%)	5 (3.7%)	2 (1.5%)	39 (28.9%)
All vs. Small	37 (67.2%)	7 (12.7%)	2 (3.6%)	9 (16.4%)
Comparison	51 (35.7%)	31 (21.7%)	12 (8.4%)	49 (34.3%)

Student Definitions of *parameter*

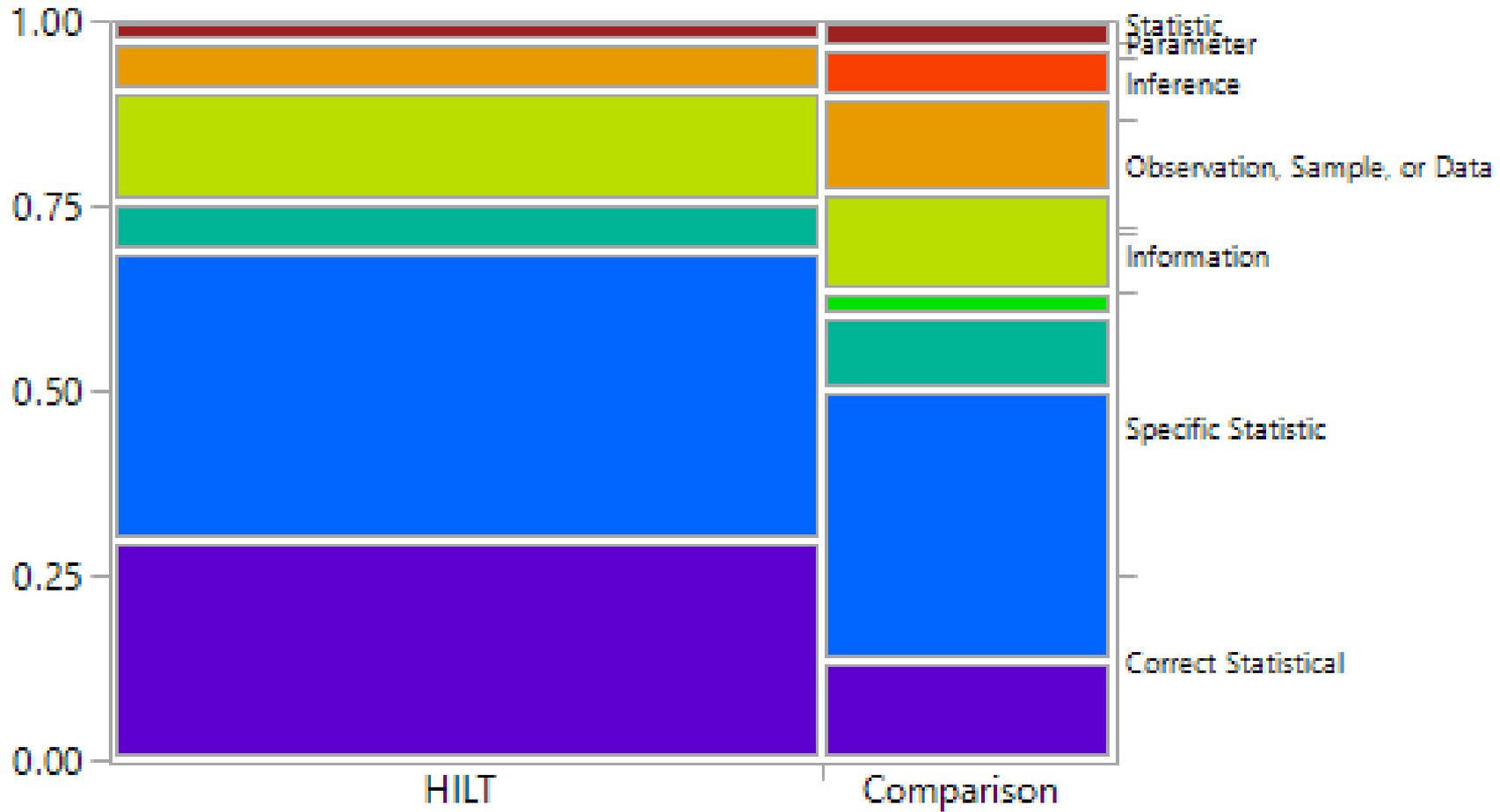
LAI-Post – HILT vs. non-HILT



$n = 104$

Student Definitions of *statistic*

LAI-Post – HILT vs. non-HILT



$n = 104$

Time to Complete

- All HILT Instructors indicated the time needed to implement the HILT activity in the classroom was “About Right.”
- Estimates of the total amount of time to introduce the activity, conduct the activity in class, and provide reminders: varied from 5 to 15 minutes with a mean of 9.4 minutes (SD = 3.8)

How the Project Team Worked with the HILT Instructors

HILT-LAS IUSE Project Overview

- Faculty Learning Community (FLC)-style professional development
- Two academic years
- Six introductory statistics instructors
 - Participated in two Summer Workshops
 - Meet bi-weekly with the PIs over three semesters
 - Semester 1: Classroom tested the “Zebra-Hat” activity
 - Semester 2: Developed/classroom tested new HILT activity for other words of interest
 - Semester 3: Classroom tested a different HILT activity

Online Faculty Learning Community (oFLC) 1.0

- At the end of a Pre-USCOTS 2017 Workshop, a group of workshop participants self-identified as being interested in forming an online Faculty Learning Community (oFLC) related to HILT activities

Online Faculty Learning Community (oFLC) 1.0

- oFLC members met bi-weekly throughout the fall and winter terms to discuss:
 - Classroom usage of existing HILT activities
 - Development of new HILT activities based on additional words of interest
 - *Significant/Significance and Variable/Variance*
 - Drafts of new HILT activities
 - Classroom usage of new HILT activities
 - Data Collection
 - Data collection methods to better understand the everyday meanings students attach to these words (pre-activity)
 - Institutional IRB requirements
 - Identification of Comparison Instructors (instructors in comparable classes who did not use the HILT activities)
 - Data collection methods to measure effectiveness of the new HILT activities (post-activity)

Activity for Significant

- Goose in Sandals

oFLC 2.0: Proposed Plan

- **Summer 2018**
 - Identify participants; determine availability to “regularly” meet (biweekly?) during the 2018 – 2019 academic year
 - Further brainstorm ideas for new words of interest
- **Fall 2018**
 - Identify new words of interest; collect data from students regarding their understanding of the non-statistical meanings of the words
 - Discuss classroom usage of existing HILT activities
 - Develop new HILT activities for use in subsequent term
 - Understand institutional IRB requirements
- **Winter/Spring 2019**
 - Use new HILT activities in classrooms
 - Identify colleagues whose students can serve as comparison students
 - Submit IRB protocols
 - Collect end-of-term data (from students taught by HILT Instructors or Comparison Instructors) regarding student understanding of the statistical meanings of the words of interest

oFLC 2.0

- Would you like to be part of the HILT-LAS oFLC 2.0?
- Please contact:
 - Jennifer Kaplan
 - jkaplan@uga.edu

Development of Wikispace

To share the collection of HILT Activities and classroom videos showing how activities might be incorporated into classes

- <http://hilt-statistics.wikispaces.com/>

Wiki Home Projects + Recent Changes Pages and Files + Members + Settings

Jennifer Kaplan My Wikis Help Sign Out

HILT-statistics

home Edit 0 13 ...

 Welcome to HILT statistics: a project to design High Impact activities that require Little Time to implement in your statistics class!

Lexical Ambiguity

Did you know...?

The use of a specialized vocabulary with a novice in a domain creates a "mystique" about the subject (Lemke, 1990). Furthermore, the use of specialized language that is unfamiliar to the student portrays the subject as more difficult than it is, a subject that can only be mastered by geniuses.

People connect what they hear to what they have heard and experienced in the past (Lemke, 1990; Konold, 1995) so if a commonly used English word is used differently by a technical domain, the students hearing the word for the first time in class may incorporate the technical usage as a new facet of the features of the word they already know.

Domain-specific words that are similar to commonly used English words but have different meanings in statistics are said to have lexical ambiguity (Barwell, 2005).

Lexical ambiguity and the acquisition of a linguistic register associated with a field has been shown to create problems for learners in science (Garvin-Doxas & Klymkowsky, 2008; Lemke, 1990), mathematics (Durkin & Shire, 1991b; Shultz & Pilon, 1973), and statistics (Kaplan et al., 2009, 2014; Lesser et al., 2009, 2013; Makar & Confrey, 2005).

There are some easy ways to address lexical ambiguity in the classroom. Instructors can

1. preempt difficulties by careful use of language in their teaching (Albert, 2003; Lesser et al., 2009; Rangelcroft, 2002).
2. be aware of students' everyday use of lexically ambiguous words and address the differences in meaning explicitly in the classroom (Lavy & Mashiach-Eizenberg, 2009; Rangelcroft, 2002), through the use of multiples modes and representations (Lesser et al., 2009, 2013) and by exploiting the differences between the uses (Adams et al., 2005).
3. help students to build their voices in the technical domain (Adams et al., 2005, Durkin & Shire, 1991a, Lemke, 1990), through vocabulary activities and writing assignments (Adams et al., 2005; Durkin & Shire, 1991a; Lesser et al., 2009, 2013).

Some words that have been shown to be lexically ambiguous are random, spread, association, independence, normal, average, and bias.

HILT Activities for Lexically Ambiguous Words

Search

All Pages

- home
- Random zebra vs hat mnemonic image
- Vocabulary for the Scale Parameters
- edit navigation

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Significant Activity Graphics:

- **Significant Other:** <https://www.acast.com/significantother> and <https://www.rover.com/blog/quiz-love-dog-significant/>
- **Crowd:** <https://www.billboard.com/articles/business/6327747/firechat-may-soon-solve-your-texting-woes-at-crowded-events>
- **Pyramids:** <https://images.pexels.com/photos/71241/pexels-photo-71241.jpeg>
- **Olympic stairs:** <https://pixabay.com/en/olympiad-winning-stairs-olympia-261636/>
- **Goose:** <https://www.pinterest.com/pin/68257750572641601/>

Project Team Publications (for additional information)

- Kaplan, J.J., Fisher, D. & Rogness, N. (2009). Lexical Ambiguity in Statistics: What do students know about the words: association, average, confidence, random and spread? *Journal of Statistics Education*, 17 (3).
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Thank You!

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