Research Methods and Designs

CS 7123, Spring 2025

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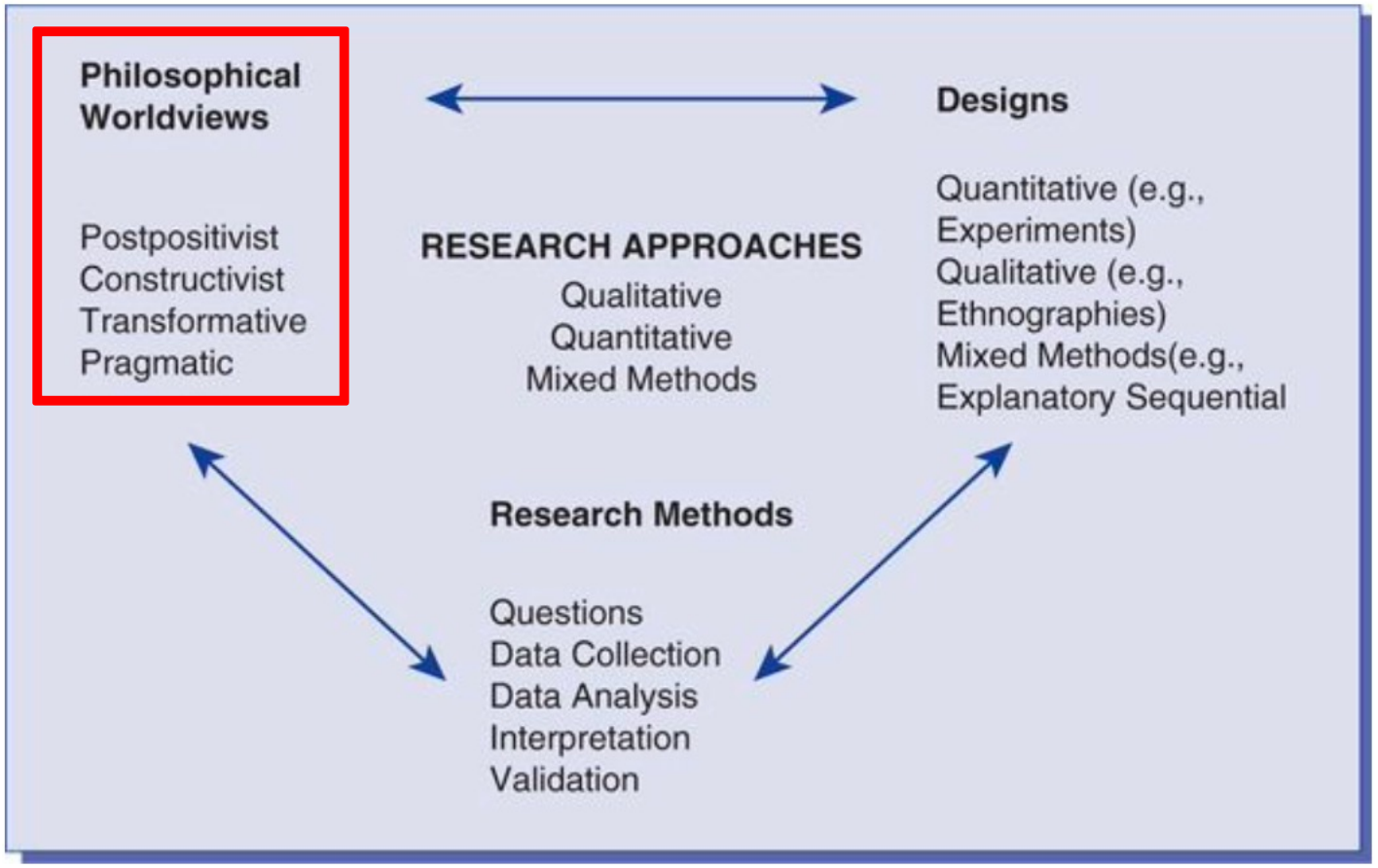
Used/adopted materials from Slides of the “Research Design: Interdisciplinary Research Methods for Information Sciences and Technology” course, taught by Prof. Dongwon Lee, at Pennsylvania State University, and the book Research Design: Qualitative, Quantitative, and Mixed Methods Approaches, by John W. Creswell and J. David Creswell.

A framework for Research



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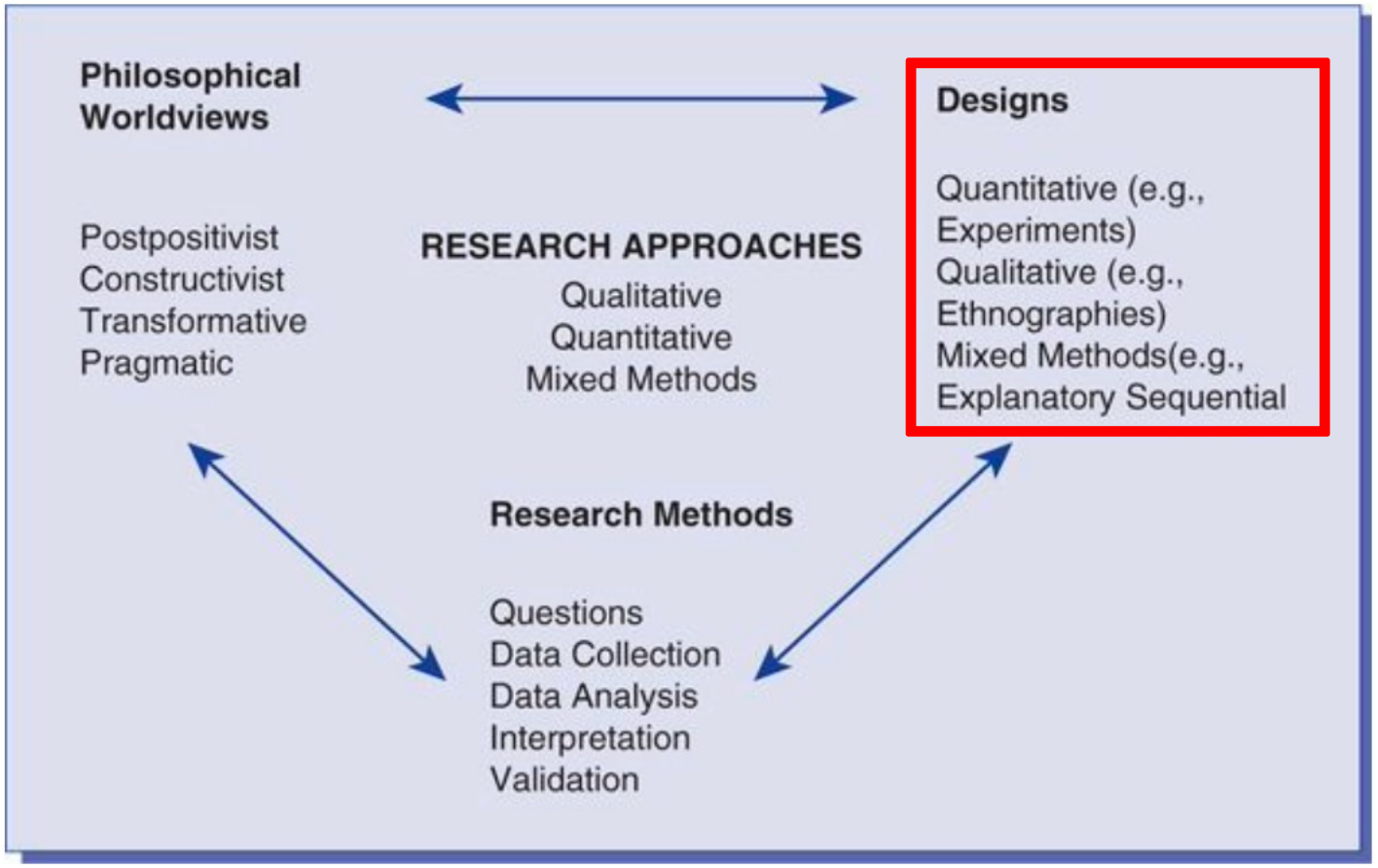

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Research Designs

1. Quantitative
2. Qualitative
3. Mixed Methods

Quantitative	Qualitative	Mixed Methods
• Experimental designs • Nonexperimental designs, such as surveys	• Narrative research • Phenomenology • Grounded theory • Ethnographies • Case study	• Convergent • Explanatory sequential • Exploratory sequential • Transformative, embedded, or multiphase

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1. Quantitative

- Controlled experiments
  - Focus on design of study: independent, dependent, control variables; random assignment; relatively simple statistics
  - mTurk now a popular alternative for large-N online experiments
- Quasi-experiments
  - Observe, sometimes intervening in real world, where random assignment often not possible
- Surveys, often involving large samples
  - Can be exploratory
  - May also lead to model testing (hypotheses based on theory)

Controlled experiment design

- Heavily use statistical hypothesis test
  - Null hypothesis (H_0): a model has no effect
  - Alternative hypothesis (H_a): a model has an effect
- Test to "reject" the null hypothesis
  - Much easier to show that something is false (H_0) than to show that something is true (H_a)
- Two types of errors:
  - Type I: when we reject a true null hypothesis (false alarm)
  - Type II: when we do not reject a false null hypothesis (miss)

Null Hypothesis	Decision	
	True	False
True	Correct acceptance (1-α)	Type I error (α)
False	Type II error (β)	Correct rejection (1-β)

Controlled experiment design

- p-value measures the probability of obtaining a sample "more extreme" than the observed results, assuming that the null hypothesis is true
  - P (observation | H_0)

- Eg, Criterion p = .05 (= significance level = alpha)
  - If the probability to obtain events with standard errors larger than 1.96 is <.05, reject H_0, in favor of H_a

Survey design

- Welcome page to orient and set the tone
  - Introduce & explain project, motivate, note IRB approval
- Organize into sections with brief objective statement
  - Sections should flow, like writing a paper with sections/subsections
- Use established scales if possible (cite accordingly)
  - Develop new instruments as needed
- Always plan to revise and condense

2. Qualitative methods

- Ethnographic (field study) methods
  - Embedded in real world setting, observe, gather artifacts
  - Often end up with field notes, impromptu interviews, key artifacts
  - Result is an integrative narrative (“thick description”)
- Archive analysis (documents, online discussions, video)
  - Online forums, videotaped meetings, photo or news media archives
  - Historically an extensive process of coding, content analysis
  - Has become a common target for text or other data mining
- Interviews, focus groups
  - A “conversation”, typically semi-structured list of probes
  - Content analysis of transcriptions, can be bottom-up or top-down
- Data analysis often involves constructivism with interpretive sense-making

An interview design

- Introduction: why the project is interesting, why they were selected, voluntary nature, option for no response (opt-out)
  - May also define terms you will be using (or ask them!)
- Establish rapport: learn about him/her; relevant roles (e.g., job, family, etc.) and experience
- Main body: Open-ended questions, follow-up for details
  - May be guided by pre-existing framework, or may be exploratory
  - But the questions you ask should reflect your research objectives
  - May use current artifacts or "design probes" to gather thoughts about specific ideas
  - Be careful to frame open questions – do not lead the participant!
- Get summary via integrative or vision-sharing prompts
- Plus, one final "Is there anything else…"

IRB approval

- Institutional Review Board (IRB) is a committee to protect rights and welfare of human participants in research activities

- IRB review is required for all federally-funded research involving human participants
  - Research involving living human beings cannot begin without prior IRB approval

- Human subject research
  - **interact** (eg, survey, interview, focus group) or **intervene** (e.g., physical procedures or manipulation of participants or their environment for research purpose) with humans to get the data
  - Look at pre-existing **identifiable** data (eg, name, SSN, BOD, address, phone #)

3. Mixed Methods

Integration of qualitative and quantitative research and data in a research study.

- Convergent parallel mixed methods
- Explanatory sequential mixed methods
- Exploratory sequential mixed methods
- Transformative, embedded, multiphase mixed methods

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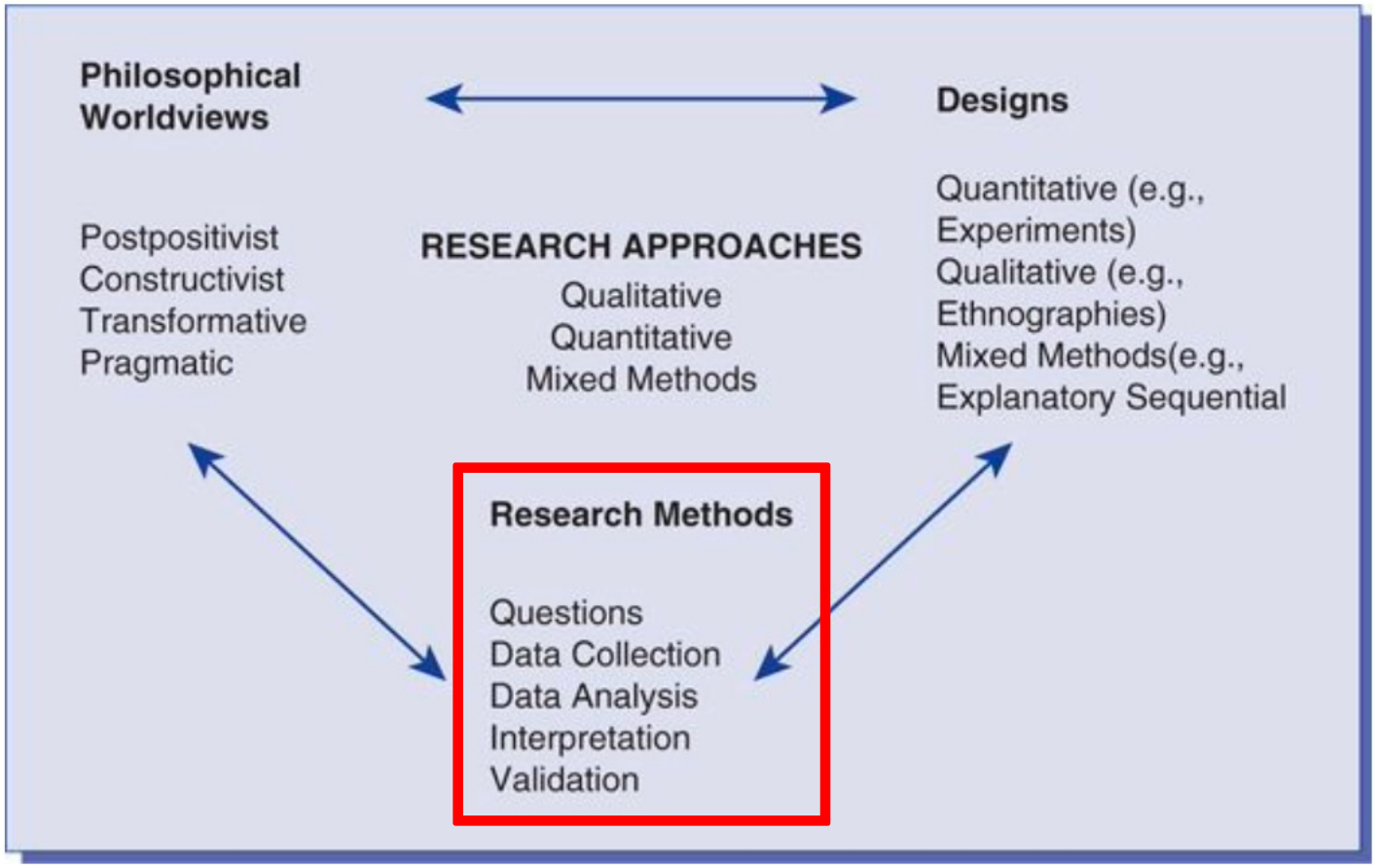

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Research Methods

Data collection, analysis, and interpretation that researchers propose for their studies

Quantitative Methods	Mixed Methods	Qualitative Methods
Pre-determined	Both predetermined and emerging methods	Emerging methods
Instrument based questions	Both open- and closed-ended questions	Open-ended questions
Performance data, attitude data, observational data, and census data	Multiple forms of data drawing on all possibilities	Interview data, observation data, document data, and audiovisual data
Statistical analysis	Statistical and text analysis	Text and image analysis
Statistical interpretation	Across databases interpretation	Themes, patterns interpretation

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Team Discussion

Think about the framework of research we have been discussing:

- Talk about your personal research interests – where do they fit?
- Try to generate new research ideas that address your general research area but pull from a different paradigm