Categorizing Research on Identity in Undergraduate Computing Education

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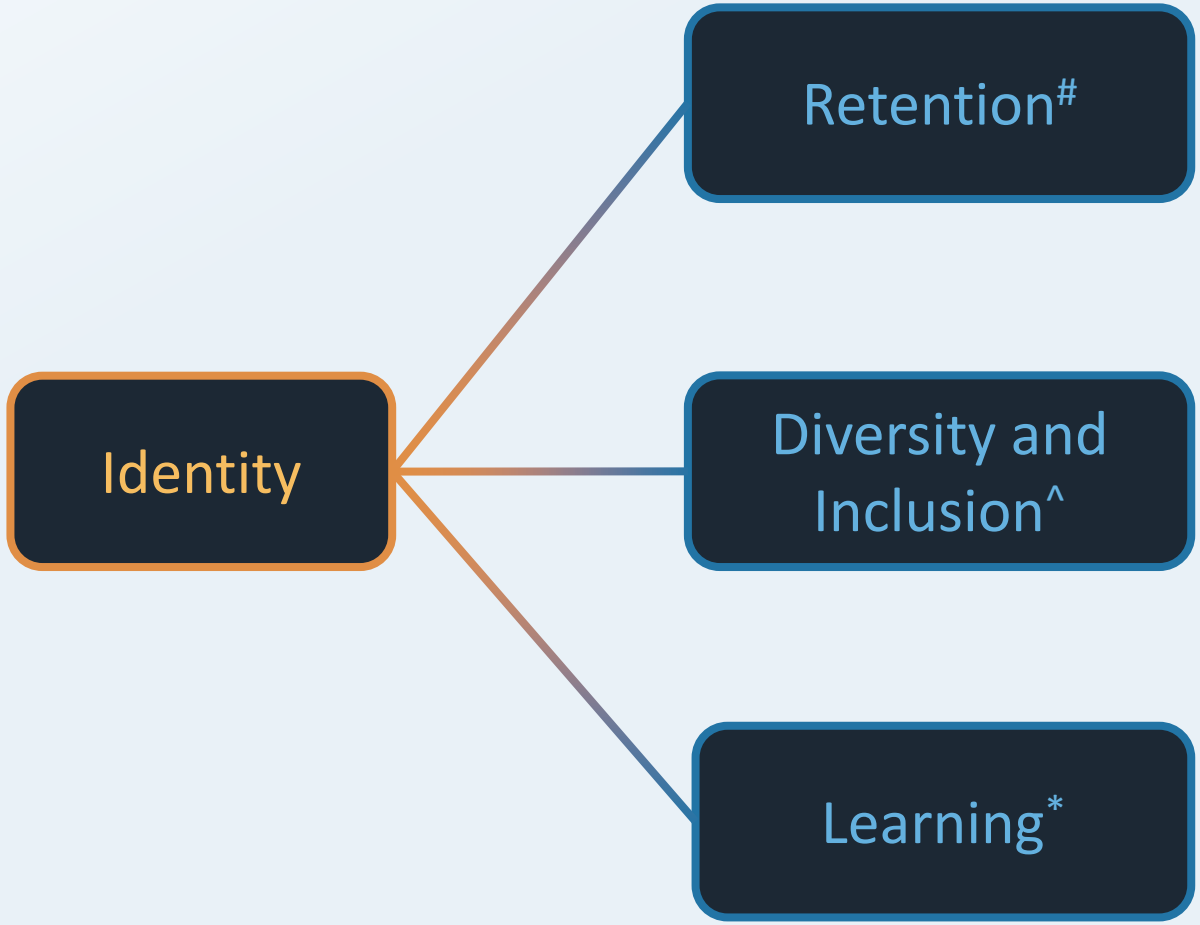
USE CASES OF IDENTITY IN COMPUTING



Examples:
Taheri et al., Exploring Computing Identity and Persistence Across Multiple Groups Using Structural Equation Modeling. ASEE Conference 2019
^ Lewis et al., "I Don't Code All Day": Fitting in Computer Science When the Stereotypes Don't Fit. ICER 2016
* Boyer et al., Increasing Technical Excellence, Leadership and Commitment of Computing Students through Identity-Based Mentoring. SIGCSE 2010.

GOALS

- Provide a categorization model for identification of relevant literature on identity in computing
- Understand gaps and fragmentation in Computing Education Research literature

METHODS

Research Question

What are the types of papers on identity with respect to semantics and contributions **in undergraduate computing identity literature**?

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Systematic literature review following guidelines from (Kitchenham et. al., 2015)[#] to identify and synthesize prior work.

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- Preliminary query: ("student") AND ("identity") AND ("comput*")
- Subsequent query: ("undergraduate" OR "student" OR "education") AND ("identity formation" OR "identity development" OR "form* identity" OR "influenc* identity") AND ("CS" OR "comput*" OR "software engineering" OR "informati*")

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METHODS

Corpus sources

Database/Method
ACM Full-Text Collection
IEEE Xplore
Taylor and Francis
Science Direct
SpringerLink
Google scholar and backward snowballing

METHODS

Corpus sources

Database/Method	Hits	Selected
ACM Full-Text Collection	493	29
IEEE Xplore	24	4
Taylor and Francis	133	3
Science Direct	35	1
SpringerLink	140	1
Google scholar and backward snowballing	-	17
Total	825	**55**

METHODS

Inclusion Criteria

- Study participant demographics or source of data (one or more):
  - enrollment in undergraduate computing, CS, or IT programs
  - students' undertaking an undergraduate computing course or professional development activity
  - practitioners were teaching an undergraduate computing course
  - data consisted of documents related to computing undergraduate programs
- Construct under study was identity or the construct under study had a relationship with identity which was derived systematically; or
- Type of publication (one): journal article, conference paper, dissertation, workshop/work-in-progress paper.
- Publication language was English or a translation in English was available.

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Exclusion Criteria

- Posters, doctoral consortium articles, and any publication less than or equal to two pages
- Non-peer reviewed articles
- Studies focusing on K-12 education
- Opinion papers with no empirical evidence or papers that proposed an opinion based on synthesis of prior work

METHODS

Data Analysis: inductive content analysis/constant comparison

Paper Title	Developing a Computing Identity Framework: Understanding Computer Science and Information Technology Career Choice	Increasing Technical Excellence, Leadership and Commitment of Computing Students through Identity-Based Mentoring	Developing Communities of Practice to Serve Hispanic Students: Supporting Identity, Community, and Professional Networks
Raw Data	"This paper expands on knowledge of computing identity by building on what is known about prior identity models in science and mathematics education. **The model theorizes three primary sub-constructs that contribute to the development of a computing identity** […]. Drawing on data from a nationally representative survey […], the study tested the alignment of the theorized model to the measures on the survey."	**We present Computing Identity Mentoring, an intervention** designed to increase commitment to computing while enhancing students' technical and leadership skills. […] This paper presents early findings on the **effectiveness of the approach** and illustrates Computing Identity Mentoring in the context of three of the seven institutions where it has been implemented.	Results from S-STEM program indicate scholars experience greater retention and higher achievement than their peers, **yet little is known about how S-STEM scholarship programs shape students' professional identities in their fields**. […] The research questions that drive this project are: **What evidence suggests the Cybersecurity S-STEM program supports minority students' development of science identities** through access to performance, competence, and recognition? […]
Primary Code	measure computing identity	assess the efficacy of computing identity mentoring program	assess S-STEM programs' role in identity formation

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Category	Quantitative operationalization of identity to develop a measurement instrument	Assessing interventions for identity development/formation	

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Theme	Identity-centric studies		

Theoretical saturation after coding 27/55 papers

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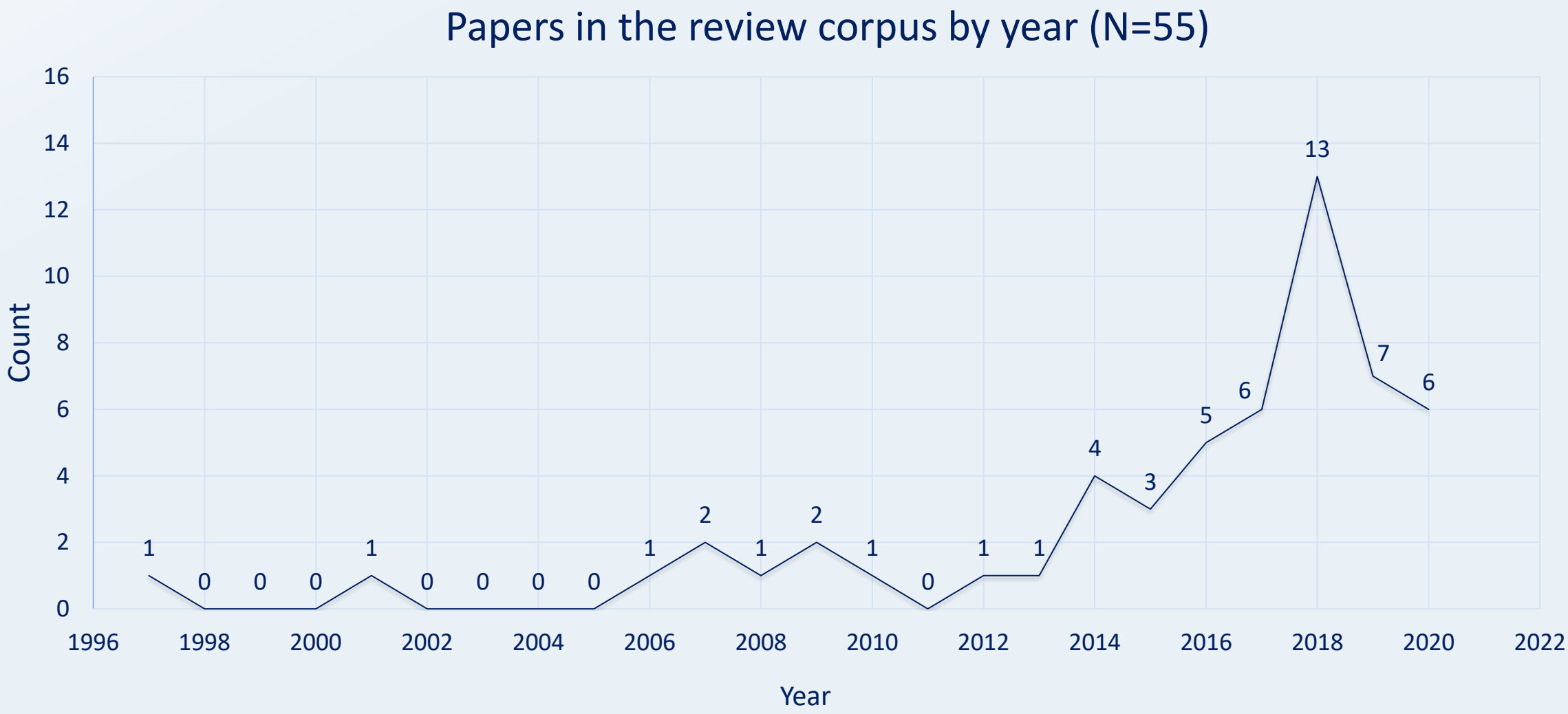

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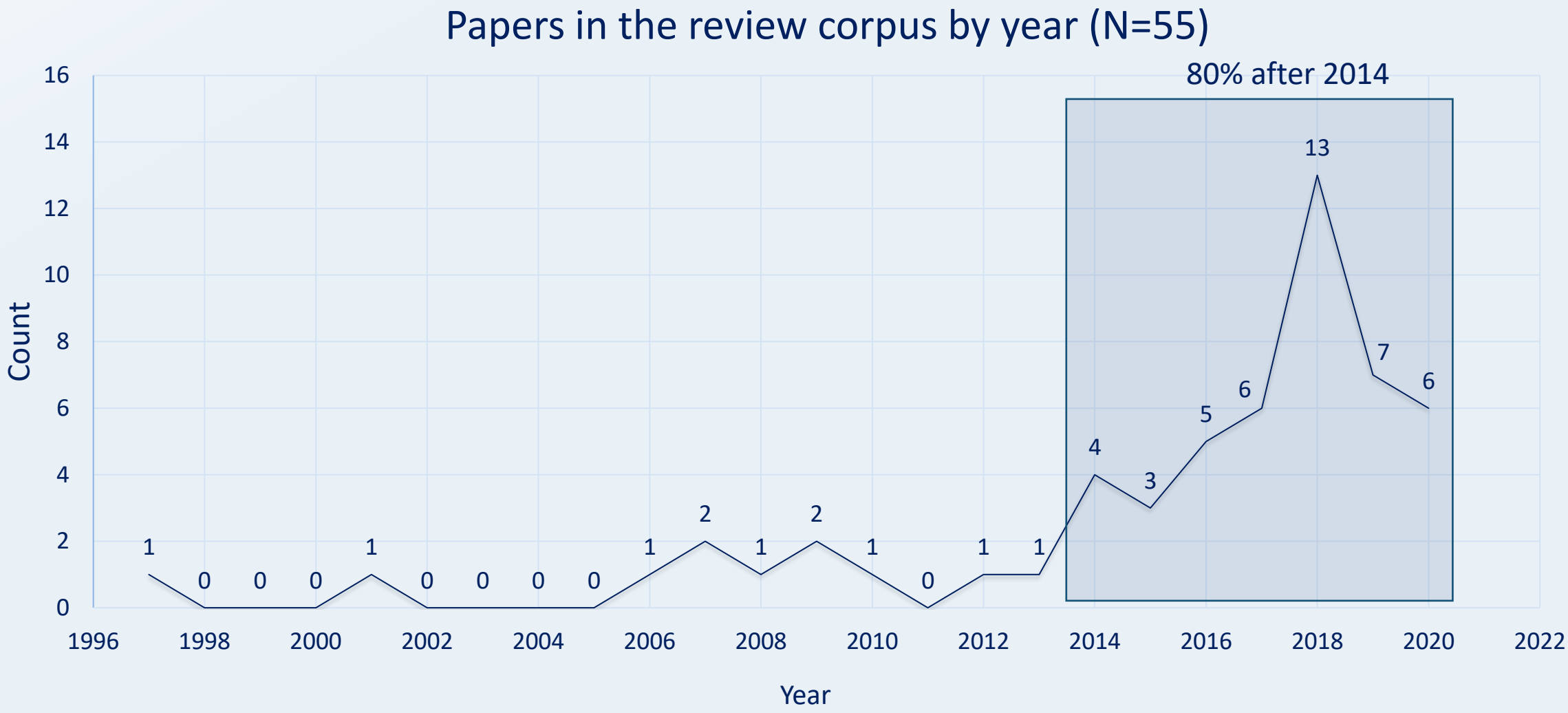

FINDINGS : TRENDS

Types of publications related to identity in computing at the undergraduate level

Types of publications	Count (N=55)
Conference papers	43
Journal articles	9
Dissertations	2
Workshop papers	1

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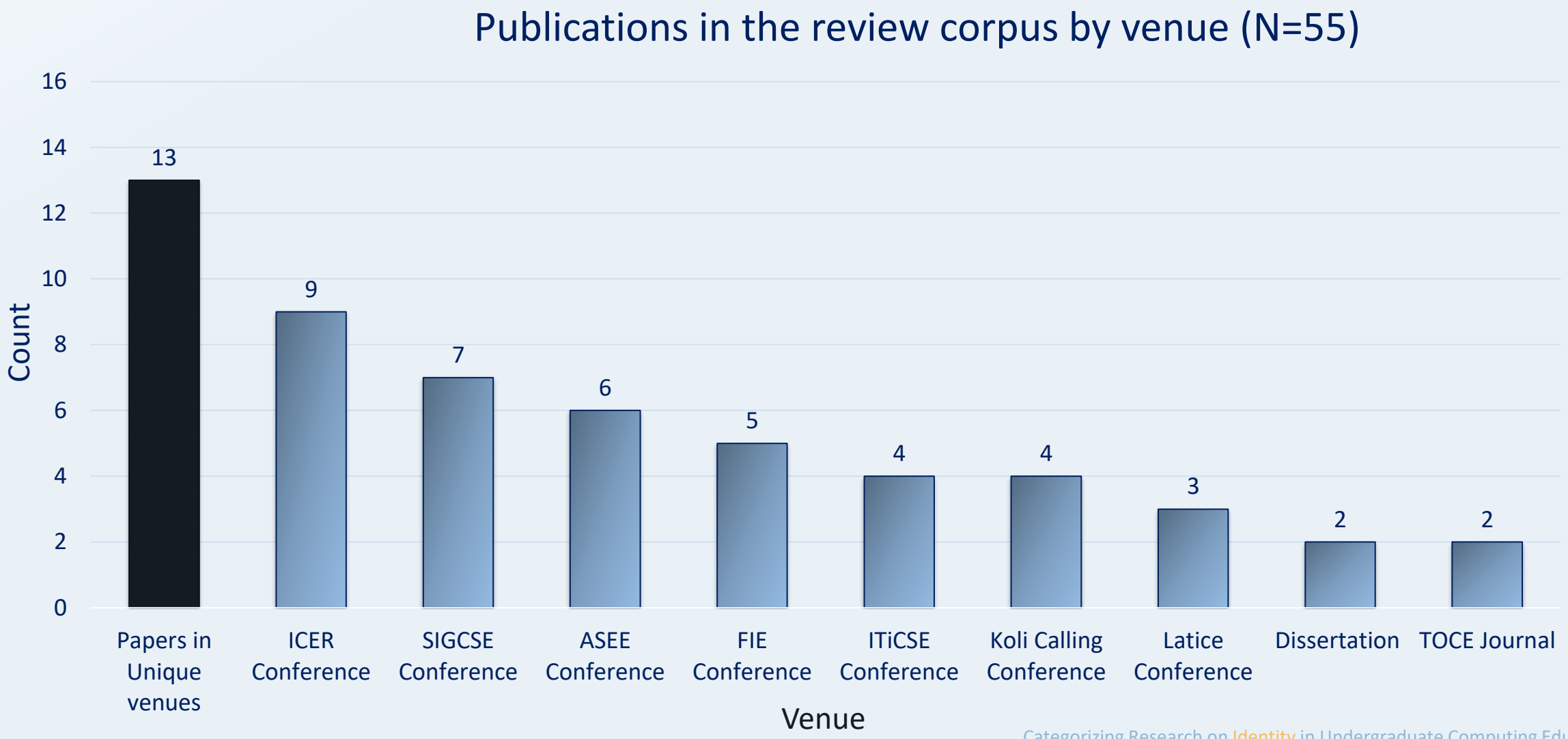

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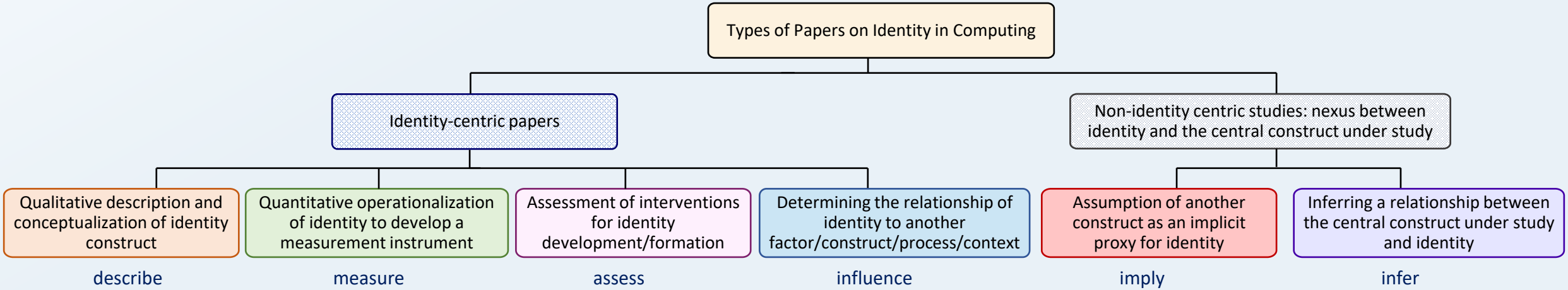

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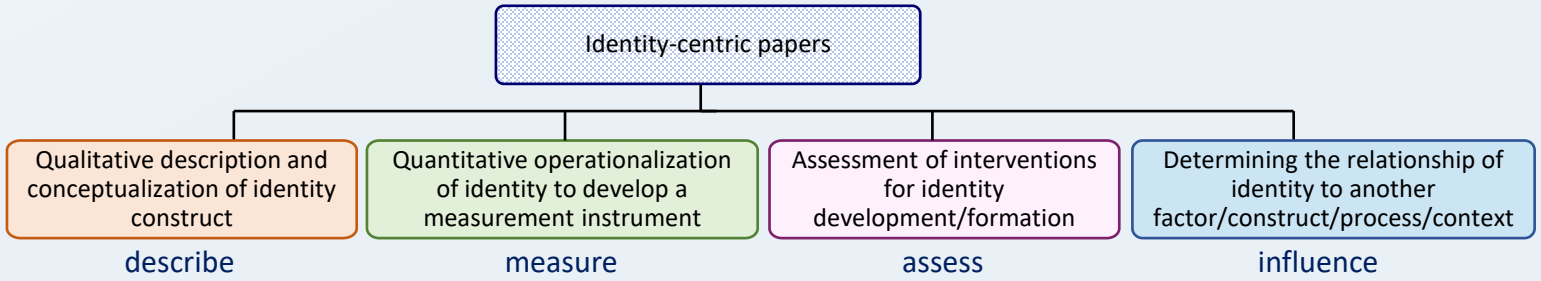
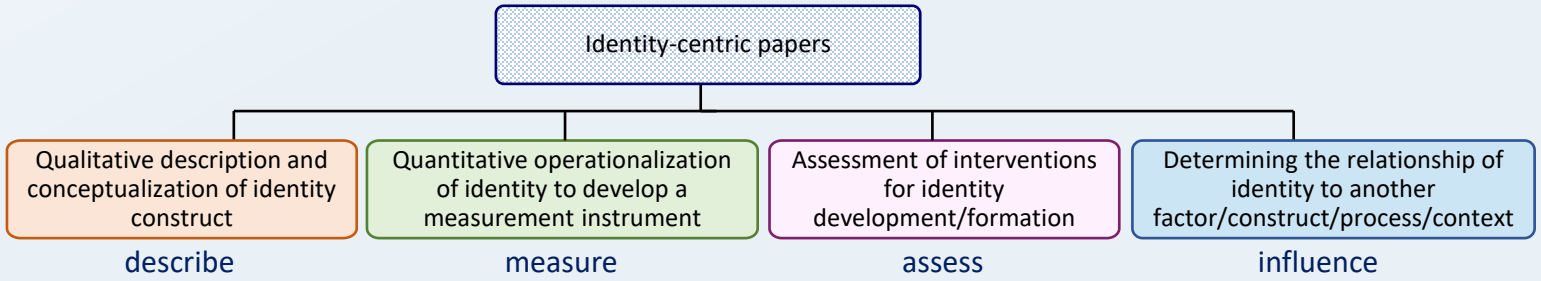


Identity-centric papers (82%, n=45)

FINDINGS: OUR MODEL

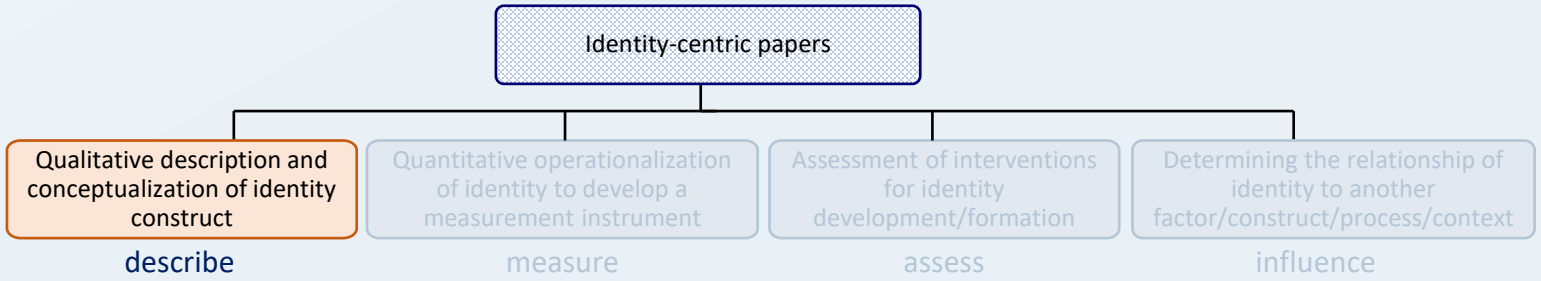


Identity-centric papers (82%, n=45)

Theme entails

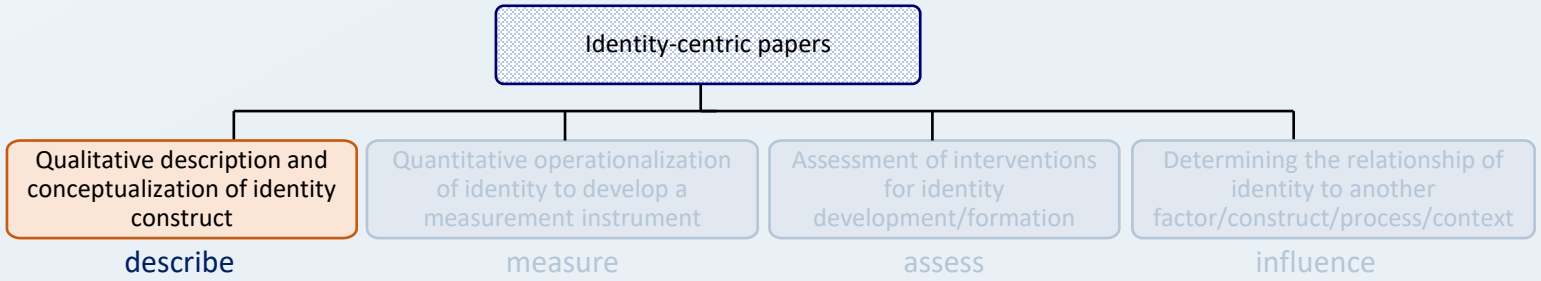
- Papers
  - had identity as the central construct under study; and/or
  - explicitly determined the relationship of a construct to identity through one or more research questions
- Researchers often situated their work in prior work on identity

FINDINGS: OUR MODEL



Qualitative description and conceptualization of identity (42%, n=23)

FINDINGS: OUR MODEL



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- Papers focused on
  - describing a **type or component of identity** such as professional identity, nerd or narrative identity, etc.
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- **Example:** Parker's work on description of CS professional identity in CS, Peters' work on identity formation in CS

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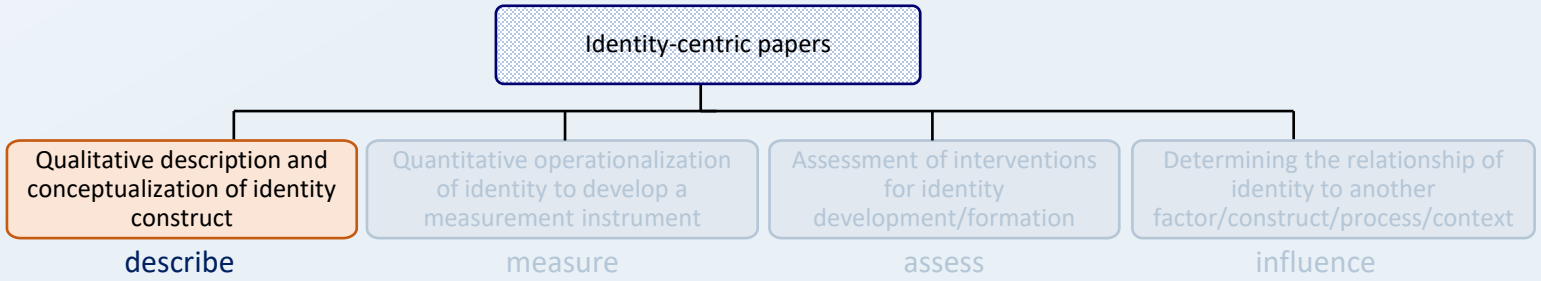

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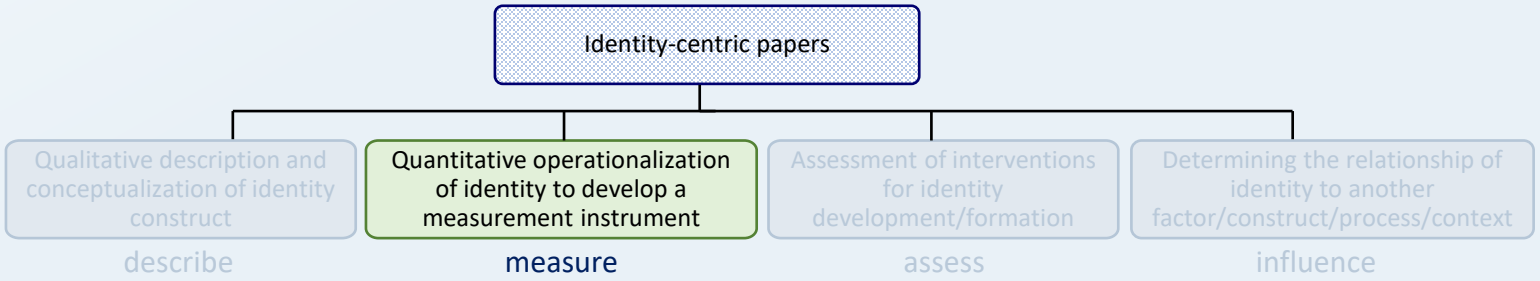
Gaps/Patterns

- Eclectic terminology (20), most common: identity, **computing identity,** and **computing professional identity**
- Divergent descriptions and definitions, e.g., proxy for professional identity in computing as role in a future profession vs association with "nerd" stereotypes
- Descriptions have overlapping and similar constructs but different terminologies

FINDINGS: OUR MODEL



Quantitative operationalization to develop an instrument (5%, n=3)

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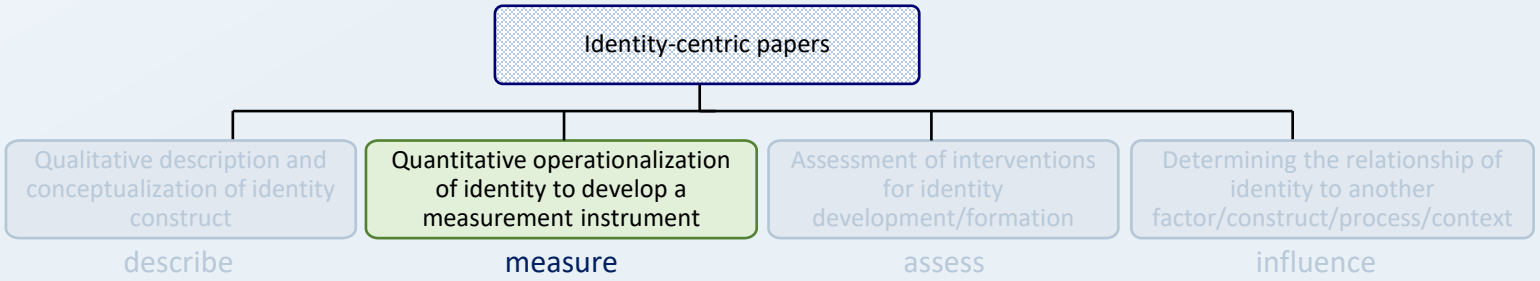

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  - quantitatively operationalizing identity constructs to develop instruments for measuring identity
  - measured constructs: **computing identity** (performance, interest, and recognition), **CS professional identity** (future role alignment), **ethnic identity** (CS Cultural Attitude and Identity Survey)
- **Example:** Mahadeo et al.'s work on determining the efficacy of a STEM identity model in computing

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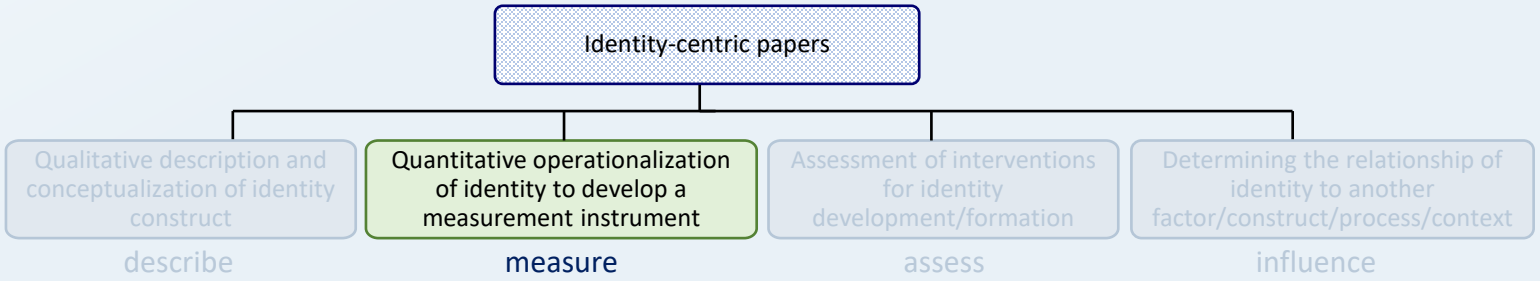

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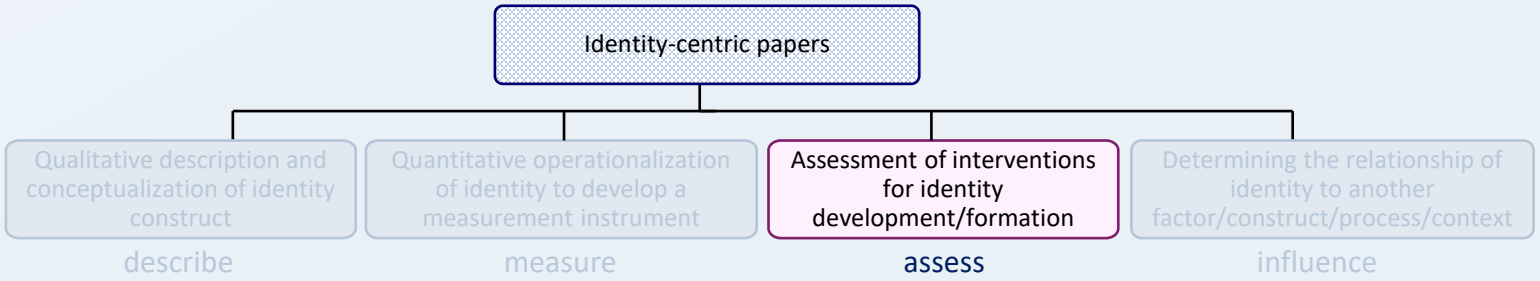
Gaps/Patterns

- Reusing the developed instruments
- One instrument not validated
- Instruments developed rooted in socio-cognitive theories; potential to develop native instruments rooted in socio-cultural theories

FINDINGS: OUR MODEL



Assessing interventions for identity development/formation (16%, n=9)

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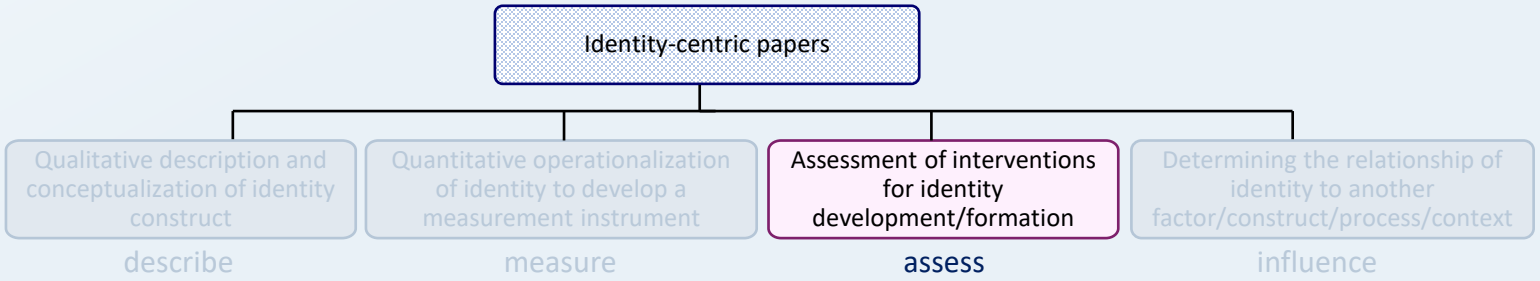

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- Papers focused on
  - studies tested the efficacy of an intervention for promoting identity development indicators.
  - Interventions: undergraduate research (3), professional conference (1), a scholarship program (1), or activities in formal coursework (3).
- **Example:** Boyer et al. work on assessment of Computing Identity Mentoring program or students' participation in undergraduate research.

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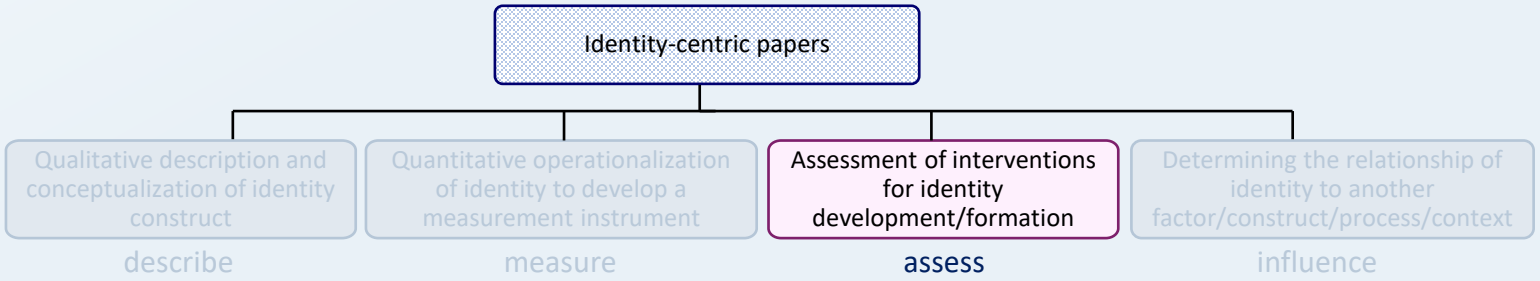

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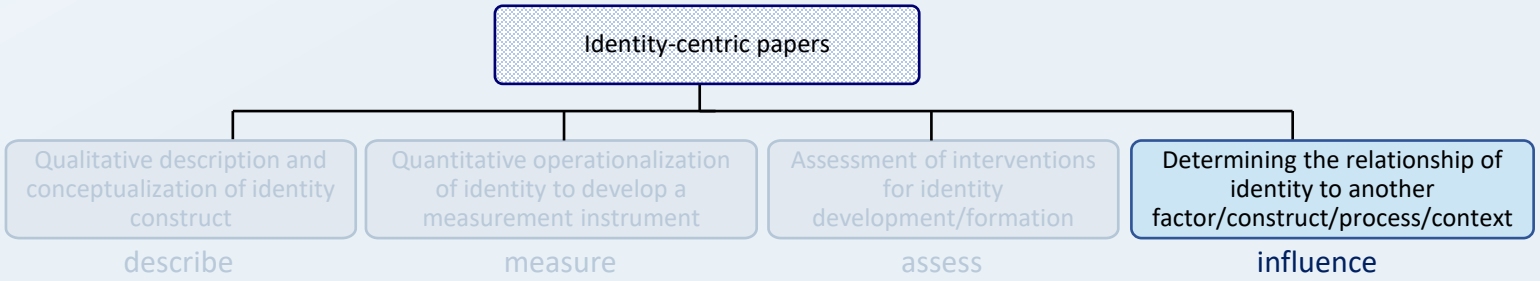
Gaps/Patterns

- Most work used pre-post designs without controls
- All but one paper used self-reported data; opportunities for measuring identity implicitly
- What are the relative strengths of participating in different interventions for identity formation?

FINDINGS: OUR MODEL



Determining the relationship of identity to another factor (65%, n=36)

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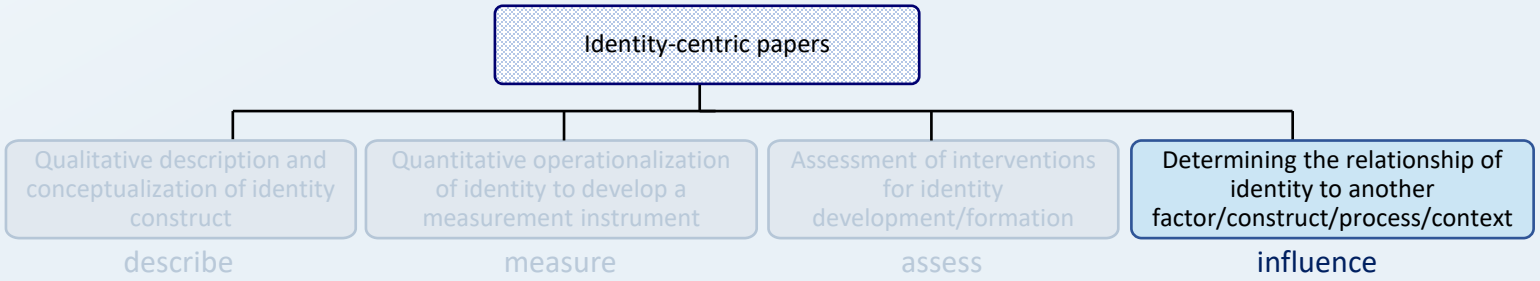

Determining the relationship of identity to another factor (65%, n=36)

Category entails

- Papers focused on
  - describing studies that determined relationship of identity to another factor/construct/process/context
  - Answered research questions:
    - How does a $factor_x$ influence $identity_y$?
    - How does $identity_y$ influence $factor_x$?
    - What is the relationship between $factor_x$ and $identity_y$?
    - How does $identity_y$ vary across a $factor_x$?
    - What factors influence $identity_y$?
- **Example:** Davis et al.'s work on relationship between nerd identity and engagement with CS courses

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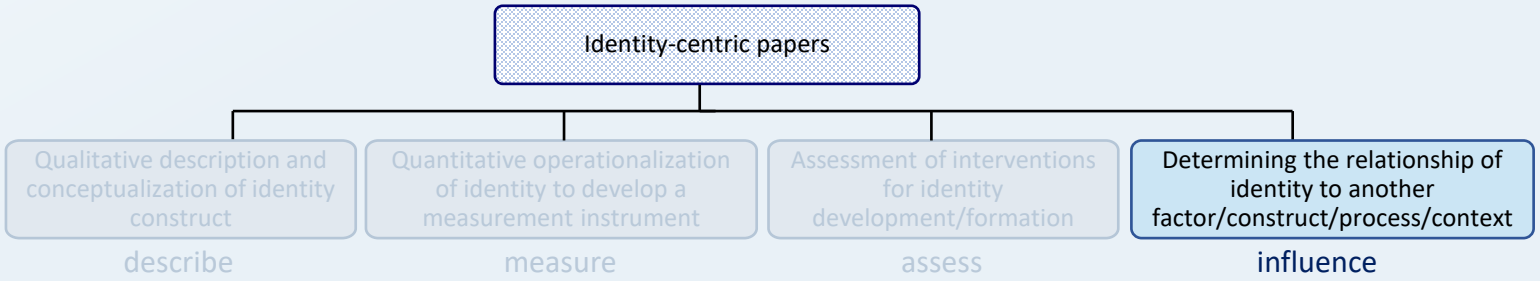

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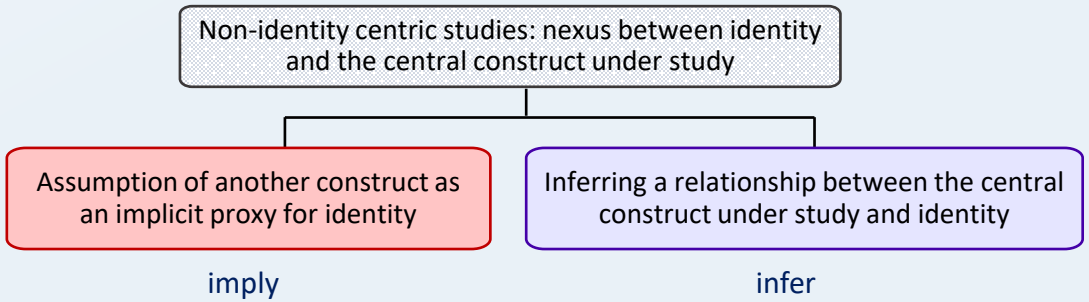
Gaps/Patterns

- Lots of factors but no unifying work that provides a mechanism to organize or synthesize these factors, processes or constructs.
- Strength of associations are missing: How much does a factor/context/construct/ process matter?
- No replication studies whatsoever.

FINDINGS: OUR MODEL



Non-identity centric studies (18%, n=10)

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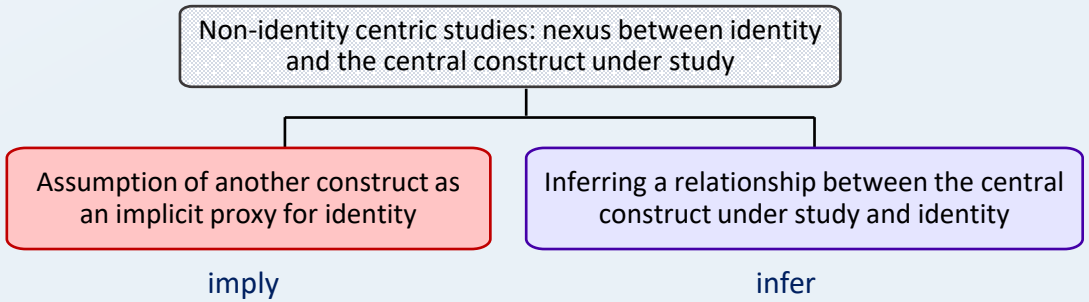
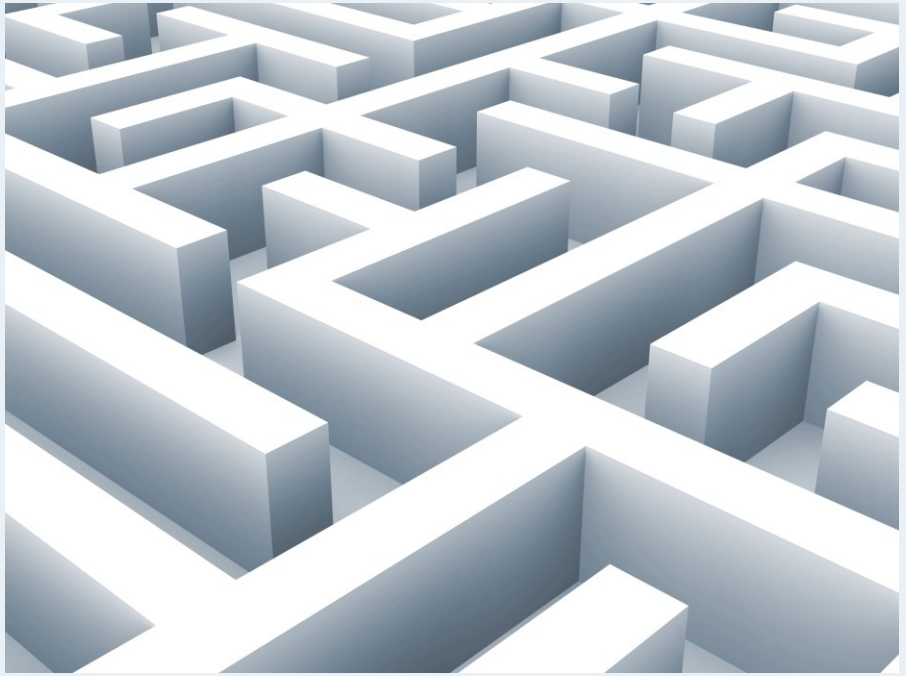


Non-identity centric studies (18%, n=10)

Theme entails

- Papers
  - studied a construct other than identity
  - researchers either assumed or inferred a relationship of this other construct to identity
- papers rarely cited identity literature
- defined research questions in terms of the central construct under study rather than identity



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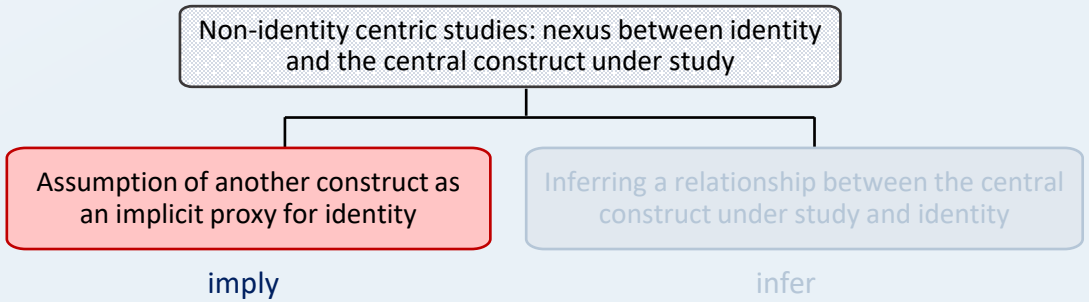

Assumption of a construct as an implicit proxy for identity (4%, n=2)

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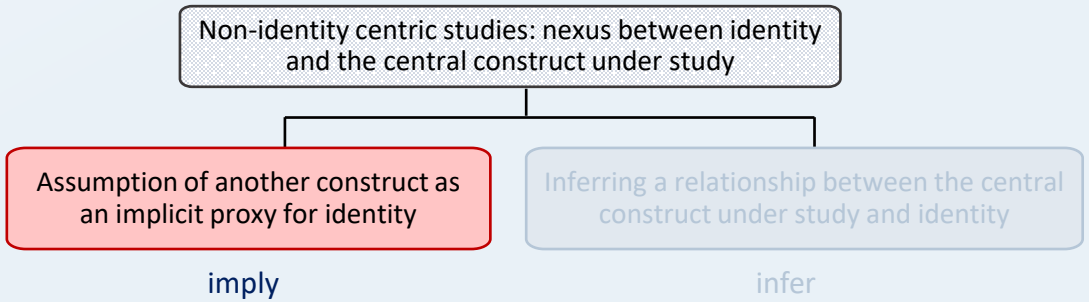

Assumption of a construct as an implicit proxy for identity (4%, n=2)

Category entails

- Papers assumed another construct as a proxy for identity
- Authors never discussed the significance of their findings through the lens of identity
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- **Example:** Lewis et al's work on understanding the relationship between sense of belonging, students' communal goals, and perception of computing

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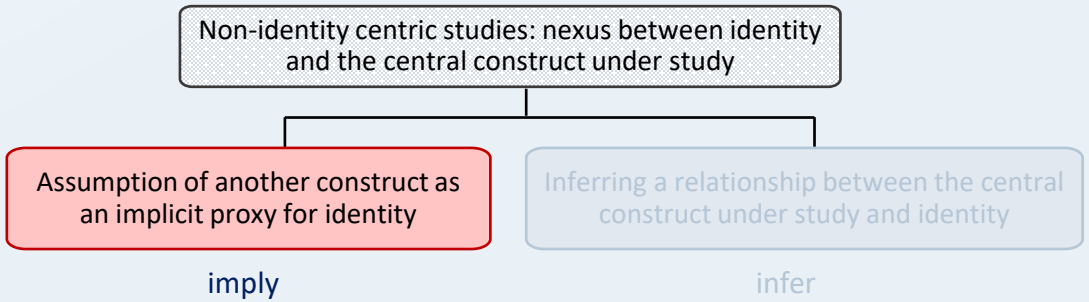

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Gaps/Patterns

- Clarification of assumptions to prevent ambiguity
- Consistency in terminologies

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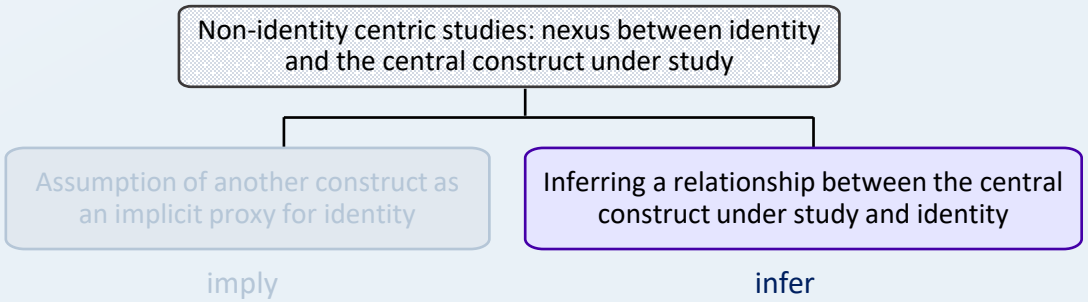
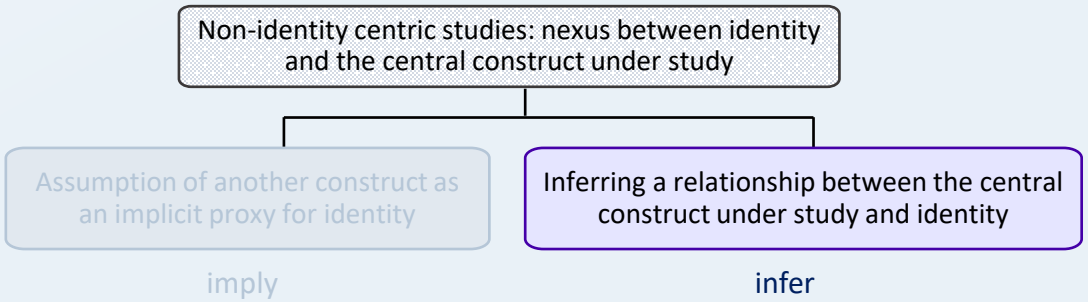


Inferring a relationship between a construct and identity (15%, n=8)

FINDINGS: OUR MODEL



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Category entails

- Papers focused on studying another construct, phenomenon, or intervention and while understanding this construct/phenomenon/intervention, they found an influence on a person's identity
- **Example:** Thayer and Ko's study on identifying barriers faced by coding bootcamp students which found students having difficulties in claiming an identity as a software developer through bootcamps.

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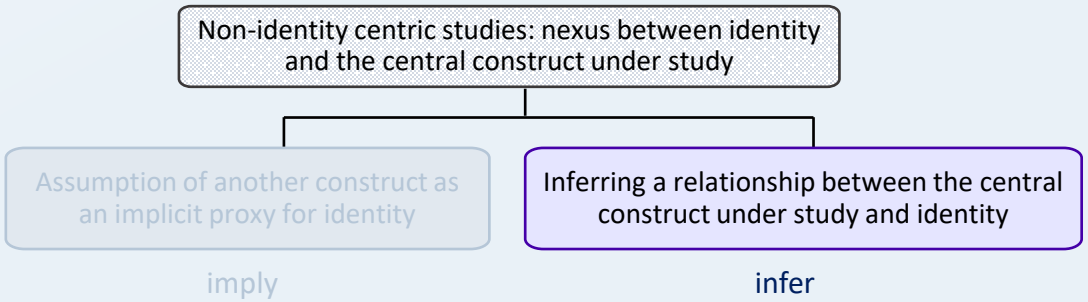

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Gaps/Patterns

- Findings can be grounded in prior work on identity

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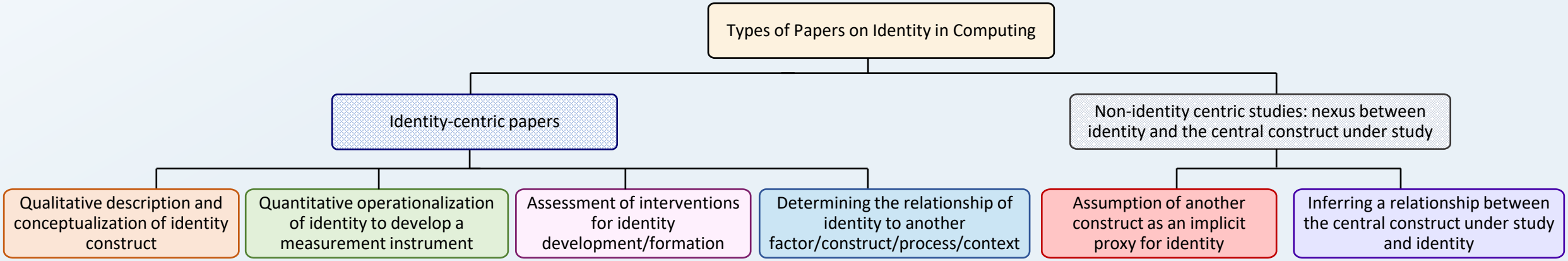

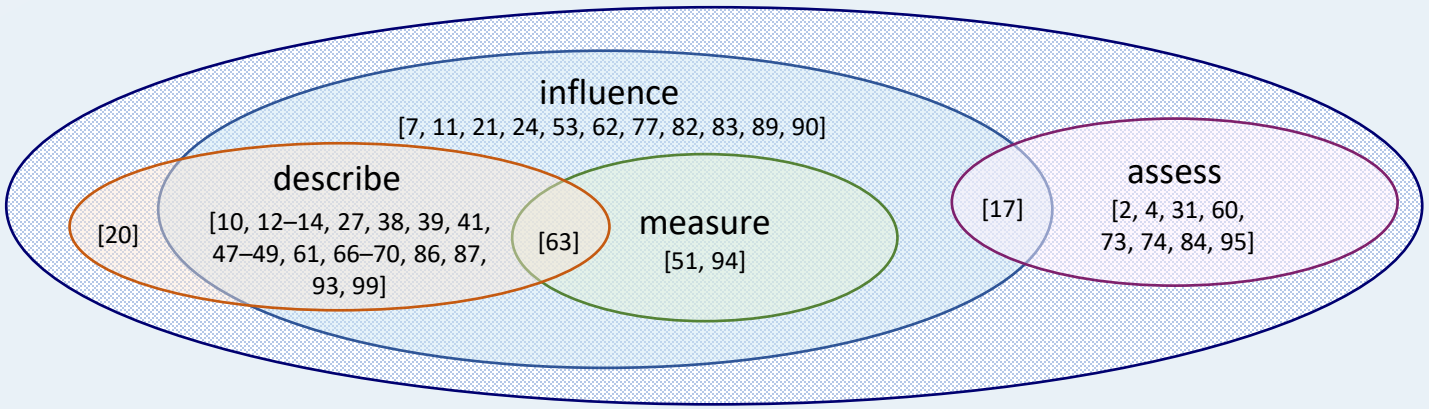

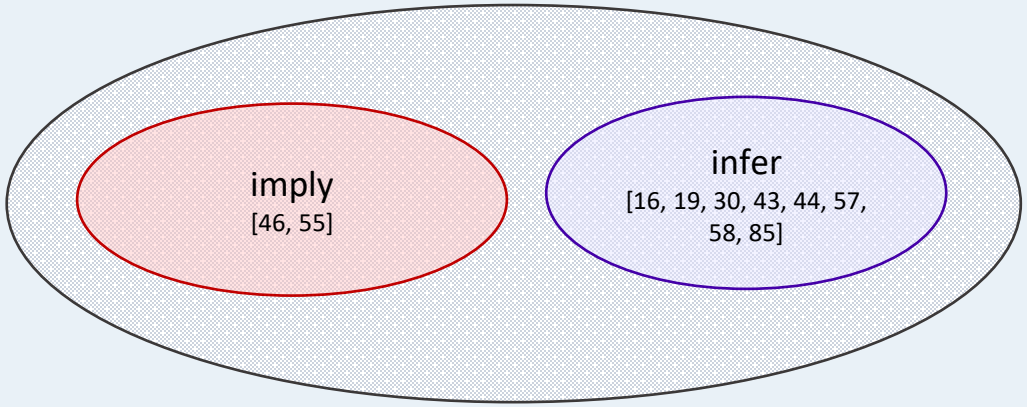

Category abbv.	Category Name	Count
describe	Description, conceptualization, and qualitative operationalization of identity in computing	23
measure	Quantitative operationalization of theoretical identity construct in computing	3
assess	Assessment of interventions for identity development/formation	9
influence	Determining the relationship of identity to another factor	36

Category abbv.	Category Name	Count
imply	Assumption of another construct as an implicit proxy for identity	2
infer	Inferring a relationship between the central construct under study and identity	8

CALL TO ACTION

- As a field, we need to conduct more **rigorous studies** and use more **consistent terminology** when studying similar constructs.
- **Replication studies** are also needed.
- Papers often did not cite relevant literature and we need to ensure upcoming work is **grounded** in what we know about identity.
- We need a cohesive **theory on how identity forms** and develops in computing.
- We should **leverage socio-technical systems** to understand identity formation through implicit means apart from the current status-quo, which is self-reported data from interviews and surveys.

QUESTIONS

Questions?

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