Infrastructure for Interdisciplinarity

A Science Policy Research Report

Erin Leahey

Professor of Sociology

University of Arizona

Support for this research was provided by NSF's SciSIP program (award #1723536), and by research assistant Jina Lee.

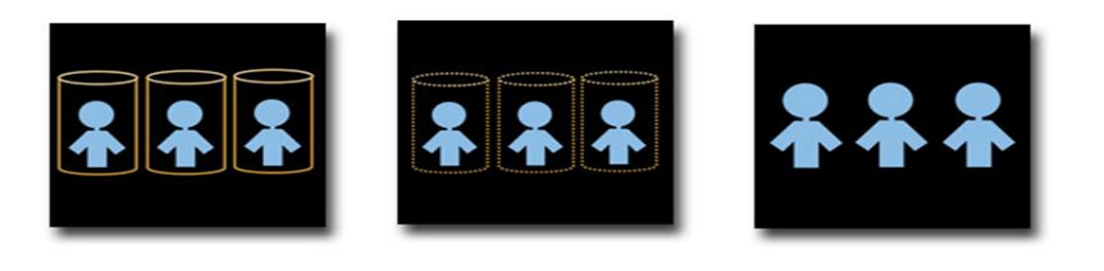
Inter-Disciplinary Research (IDR)

"...integrates information, data, techniques, tools, perspectives, concepts, and/or theories from two or more disciplines or bodies of specialized knowledge."

(National Academies of Science 2005)

Goals of IDR

- overcome conceptual blinders
- solve problems whose solutions are beyond the scope of a single discipline
- produce innovative, groundbreaking work



Benefits of IDR

Scholarship on innovation in science reveals:

Domain-spanning is advantageous in terms of citations and impact

(Larivière and Gingras 2010, Larivière, Haustein,& Börner 2015; Leahey, Beckman, & Stanko 2017, Leahey and Moody 2014, Lo and Kennedy 2015, Schilling and Green 2011, Uzzi et al. 2013)

…just as long as domains are not too distal

(Yegros-Yegros, Rafols and D'Este 2015)

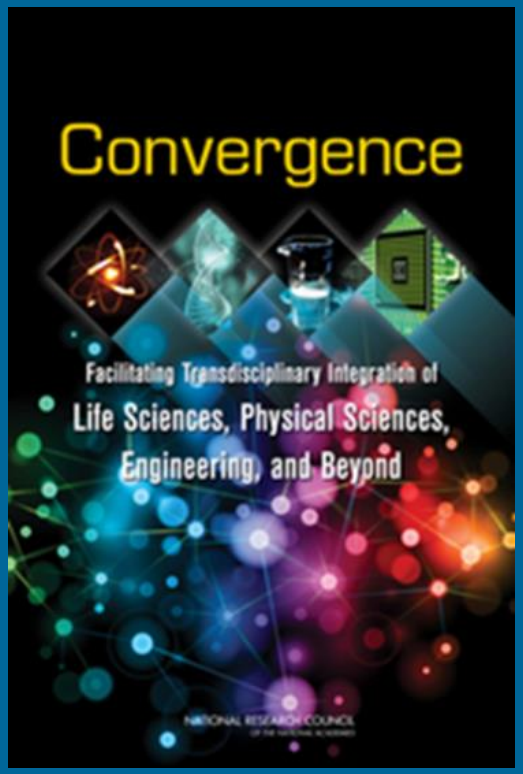
For science policy makers, it is useful to know that IDR is beneficial, but is more useful to know the wide variety of mechanisms that have been used to facilitate IDR.

For example, universities are pursuing cluster hiring (Brint), fellowship programs (Hewitt, Dingwall, Turkmendag 2017), and internal grant competitions (Sa 2008).

But what about federal agencies like NSF?

How can federal agencies best support and promote IDR?

What policies and investments are most effective?



Possible mechanisms in federal agencies' realm of influence

- research center support
- interdisciplinary graduate training
- research funding
- team collaboration

Research Centers (RCs)

- Most evaluations of RCs don't examine IDR as outcome
- Tendency to presume that all RCs are interdisciplinary (this isn't true) & produce IDR
- Some indication that interdisciplinary RCs promote IDR
  - Bishop, Schuyler, Ownley, Richards, & Skolits (2014)
  - Yang and Heo (2014)
  - Biancani, McFarland and Dahlander (2014)
  - Parker, Hackett, Leahey, & Rafols (in progress)
- Other RCs can promote IDR too (Rogers, Youtie, and Kay 2012)

Recommendation 1

- Continue to support infrastructure initiatives like research & synthesis centers

Interdisciplinary graduate education

2 types of evaluations (Mitrany & Stokols 2005)

1) assess training in situ by examining curricula, interactions, & mentoring

   Boden, Borrego, and Newswander (2011)
   Newswander and Borrego (2009)
   Borrego, Boden and Newswander (2014)

2) assess the quality and scope of the products of such training

   Carr et al. (2017)
   Hackett and Rhoten (2009)

Recommendation 2

- Approach interdisciplinary graduate education via programs like the NSF Research Traineeship program (NRT) with care by:
  - clarifying the type of integration intended
  - making challenges apparent
  - developing standard ways to evaluate them
  - training faculty about value of IDR
  - developing clusters of training programs at the same institution
  - beginning with strong disciplinary foundations

Research Funding

Universities can use federal funding to facilitate and fund an internal grant program designed to foster IDR (Denne, Sajdyk, Sorkness, Drezner, and Shekhar 2013)

- NIH's Clinical and Translational Science Awards, designed to foster interdisciplinary teams and IDR
- Used funds to develop project development teams to help with grantsmanship.
- Funds influenced:
  - scholars' approaches & collaboration choices
  - external grant dollars, patents, and start-ups
  - new cross-disciplinary collaborations across 88 departments

Recommendation 3

- Support university efforts to offer seed grants to scholars from different disciplines to support proposal development and grant activity.

Research Funding

Studies by Jon Garner and Alan Porter and colleagues (2012, 2013):

- Evaluate NSF's Research Coordination Network (RCN) & HSD programs
- Compare outcomes across treatment (funding) and control groups (no funding), and across time periods (pre- and post-funding).
- Find that such funding boosts interdisciplinarity by about 10%.
- Conclude: "external funding is one effective means to incentivize research spanning the natural and social sciences" (Garner et al. 2013:142)

Huang, Zhang, Youtie, Porter and Wang (2016) study the field of big data and find that in the U.S. context, NSF relies on co-funding to promote interdisciplinary approaches to Big Data, which have increased over time.

Recommendation 4

- Fund scholars' efforts generously (in terms of both money and time) so they can make new interdisciplinary connections and overcome challenges associated with IDR. This may entail funding individuals rather than specific projects, and/or broadening the scope of fundable research so that IDR is not confined to a few specific (if timely) issues.

Team collaboration

- Collaboration and interdisciplinarity are typically confounded, but this linkage is not warranted
- Interview and survey based studies extract key elements of successful interdisciplinary collaboration
  - Boix-Mansilla, Lamont and Sato (2016)
  - Woolley et al. (2015)
  - Borrego and Newswander (2008)

Recommendation 5

- Funding agencies can encourage interdisciplinary research by:
  - working with professional associations to encourage cross-disciplinary interaction
  - being explicit about expectations for interdisciplinary work
  - encouraging interdisciplinary team formation at the same university

Team collaboration

But does interdisciplinary collaboration actually result in IDR?

We located one study that examined this:

- Basner et al. (2013)
- Study center-affiliated cancer researchers in Australia
- Use a prospective design to address the question: “Does cross-disciplinary collaboration affect the type of science generated”?
- Find that only half of interdisciplinary collaborations result in interdisciplinary publications.
- But IDR produced by interdisciplinary teams appeared in the highest impact journals (on average 11.1), compared to IDR produced by disciplinary teams (10.8) and research produced by *intra*disciplinary teams (6.3).

Concluding remarks

Goal = detailed recommendations

Research on graduate training examines detailed conditions of when and how training is effective

→ so we could provide detailed recommendations

Research on funding and centers tends to focus on single cases (or types of cases), rather than examine the types and qualities of those initiatives and whether and how those aspects influence IDR

→ so we could provide only broad recommendations

Other helpful tactics

- Encourage the integration of disciplines that are somewhat but not too distal

  (Larivière et al. 2015, Yegros-Yegros et al. 2015)
- Discourage jargon in research proposals

  (Vilhena et al. 2014)
- Help train scientists and panelists how to review and appreciate IDR efforts

  (Lamont et al. 2006, Lamont 2009)

"*Research funders clearly have a role to play in framing calls for interdisciplinary proposals and developing rigorous evaluation processes*"

(Lyall et al. 2013:67)

Which mechanism is most effective in promoting IDR?

Difficult to say because the scholarship tends to rely on:

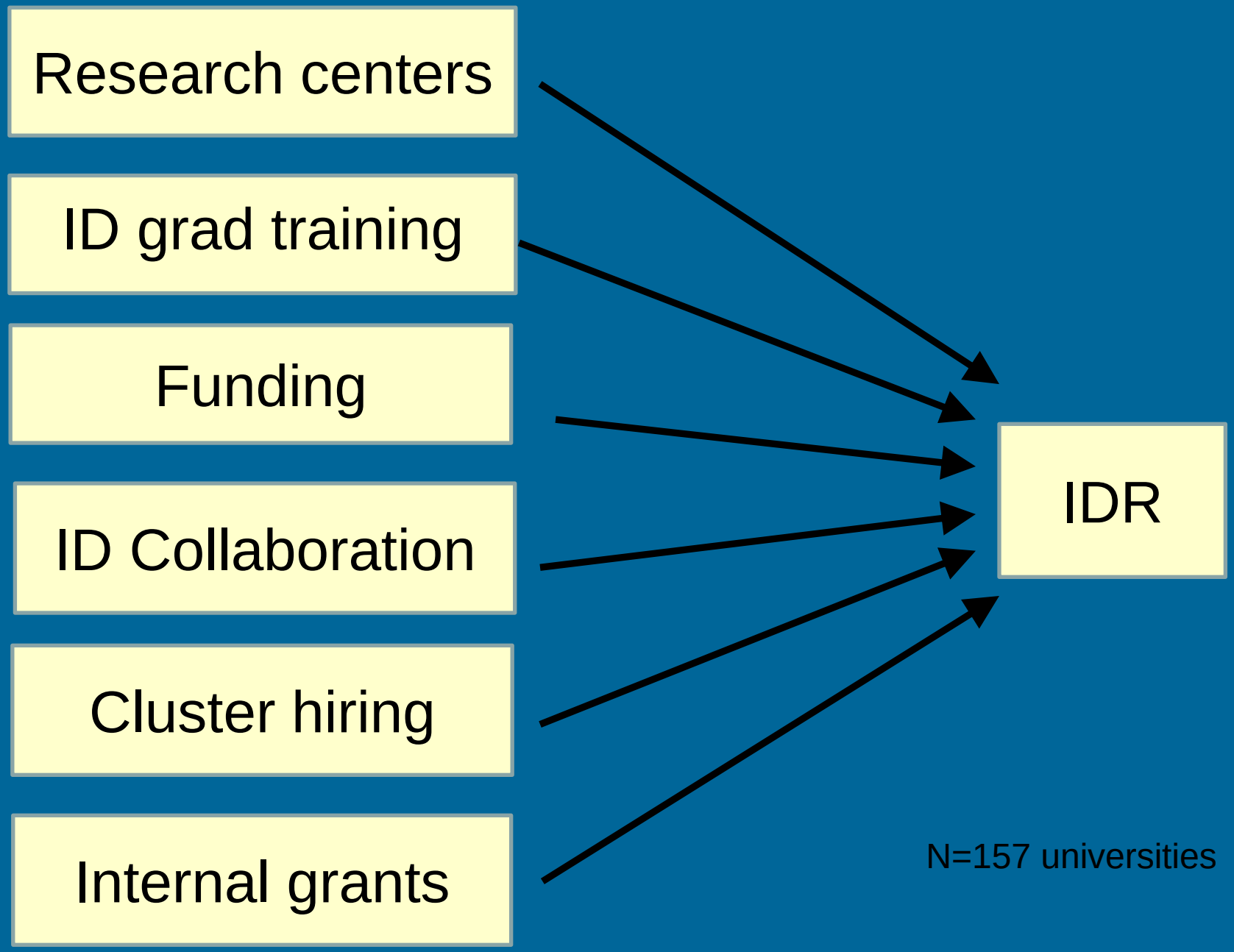
- small samples
- subjective self reports
- case studies, limiting generalizability
- cross-sectional data, limiting causal conclusions

What is needed?

- Large-scale empirical investigations that not only examine more than a handful of centers, funding programs, or graduate training programs, but which also measure and assess the relative effects of multiple types of mechanisms at once.

What will help with this?

- Large, detailed, and comprehensive data pooled from various sources, like:
  - Institute for Innovation and Research on Science (IRIS)
  - Connecting SED/SDR, WoS, Patent data
  - Multiple SciSIP supported projects....
    - Leahey & Barringer (award #1461989)
    - Brint (award #1736146)


Research centers
ID grad training
Funding
ID Collaboration
Cluster hiring
Internal grants
IDR
N=157 universities

Thank you!

Erin Leahey
leahey@arizona.edu