



NIH Director's Pioneer Award (NDPA) Outcome Evaluation

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Outcome Evaluation

Primary Study Questions

- Does NDPA-funded research produce **unusually high impact** as compared to research funded by other programs?
- Are the **research approaches** used by the Pioneers more **innovative** as compared to research funded by other programs?



DATA AND METHODS

Comparison Groups

	Number of Investigators
NDPA (2004-2006)	34*
Matched R01 (matched PI characteristics)	35
Random R01 Portfolios (matched total direct cost)	30 sets of varying size (median \$87.3M direct costs, 78 grants)
HHMI (2005)	39
NDPA Finalists (2004-2006)	30

* One Pioneer gave up award to work at NIH

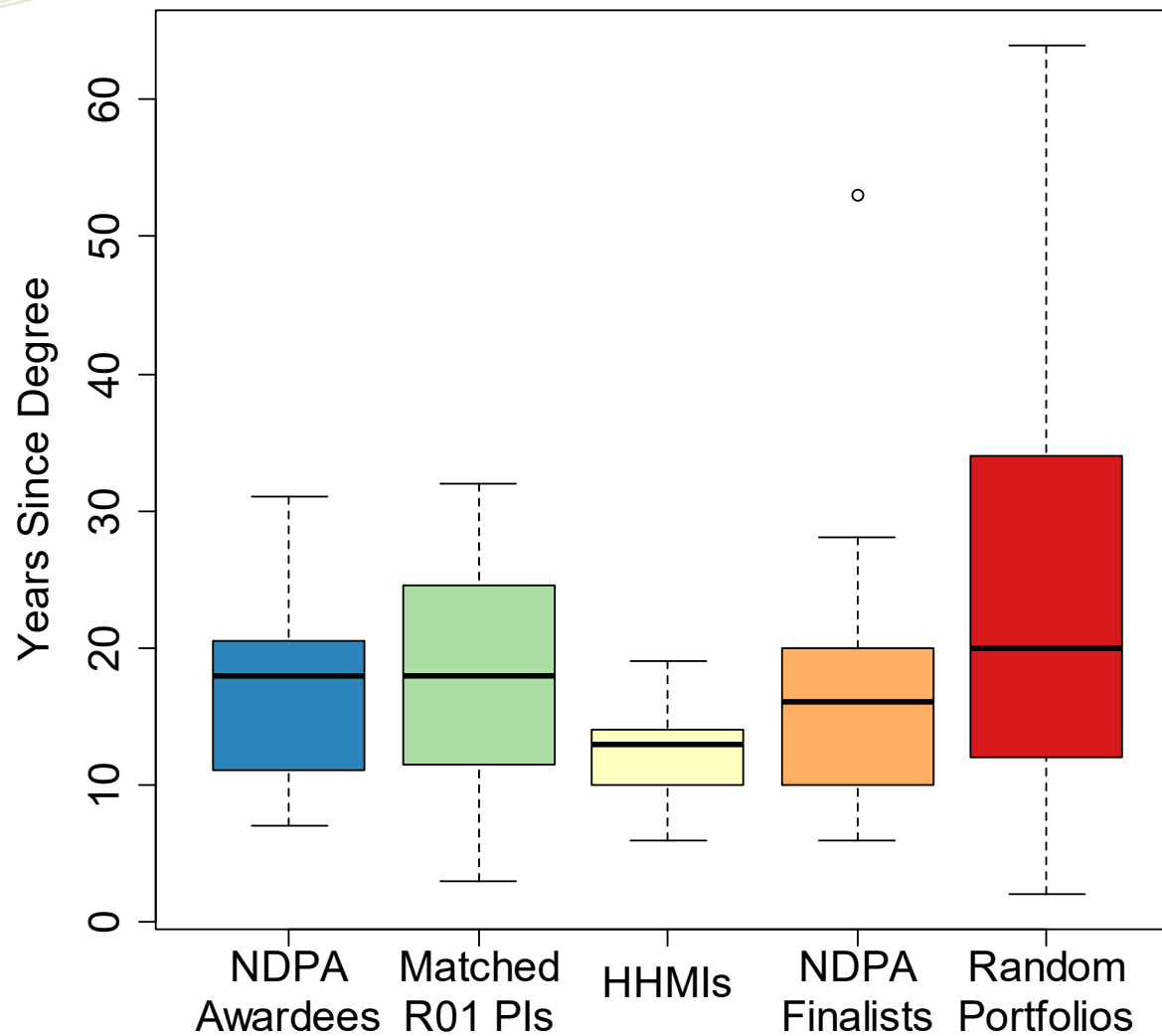
Quasi experimental design

- Choose a comparison group that controls for relevant dimensions of the program
- Operationalize metrics of interest, and assess outcomes from NDPA and comparison groups
- If comparison groups are appropriately selected, differences in outcomes are likely to be caused by differences in “treatment” instead of differences in the underlying populations

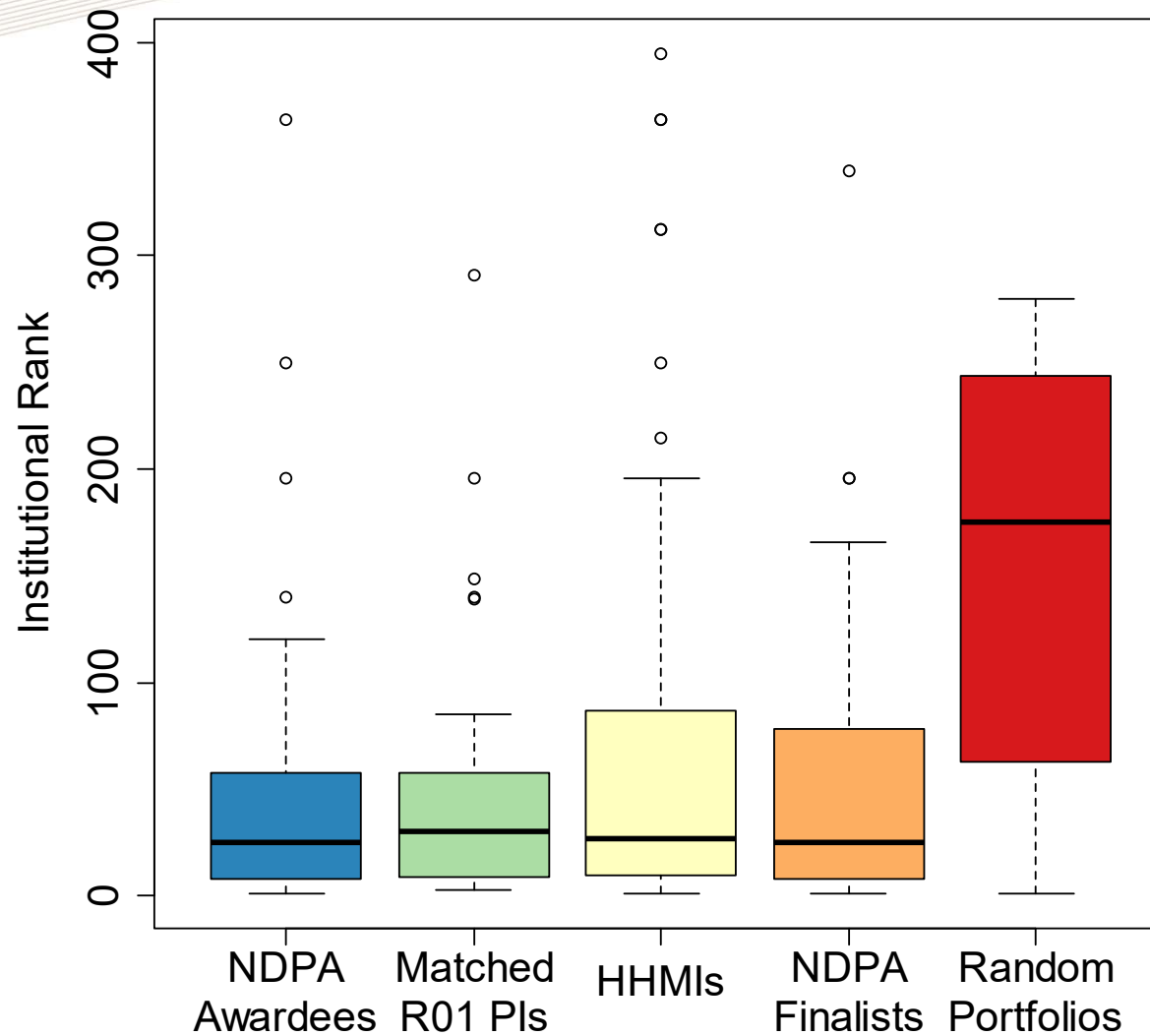
Matching Characteristics

- Research area (of the grant)
- Years since degree
- Clinical/research degree
- Prestige of employing institution
- Early career award?
- Receive of R01 within 5 years of degree?
- Total prior NIH funding (\$)

Years Since Degree

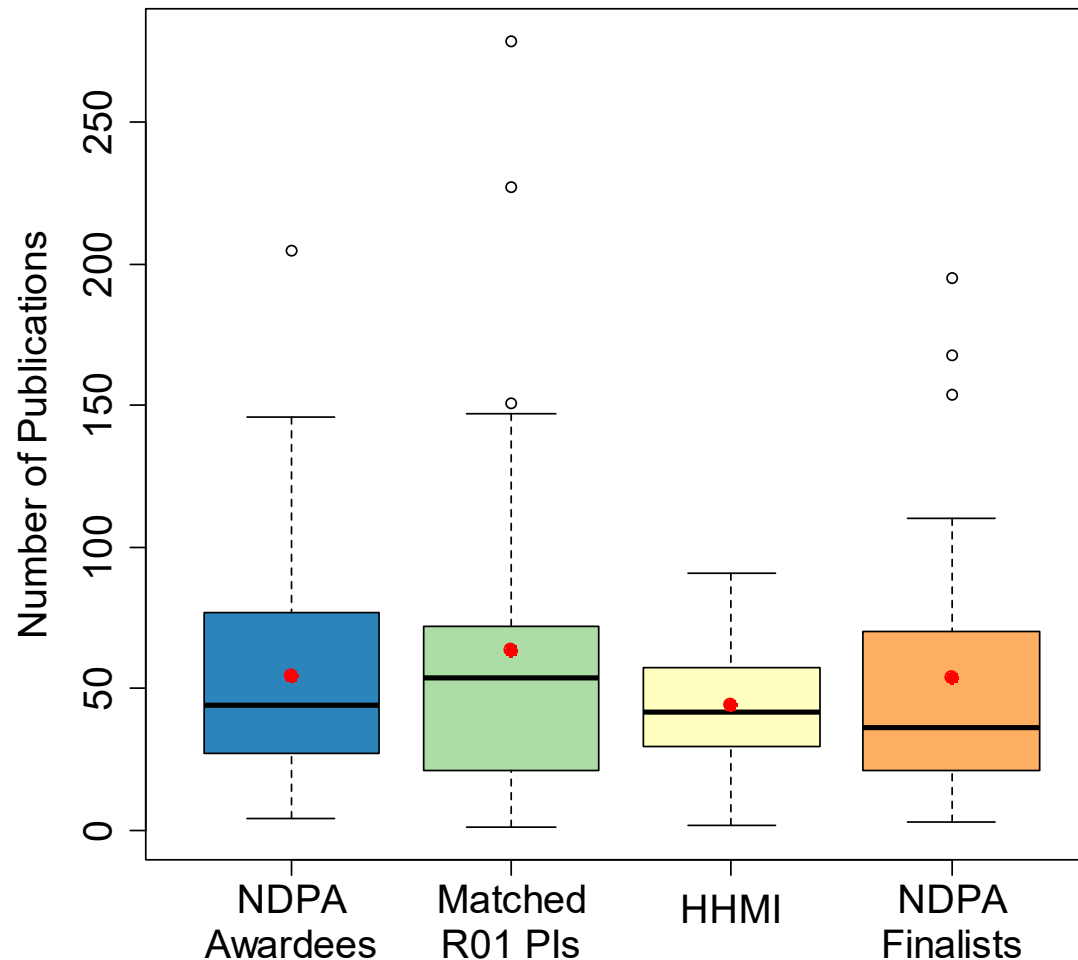


Institutional Rankings



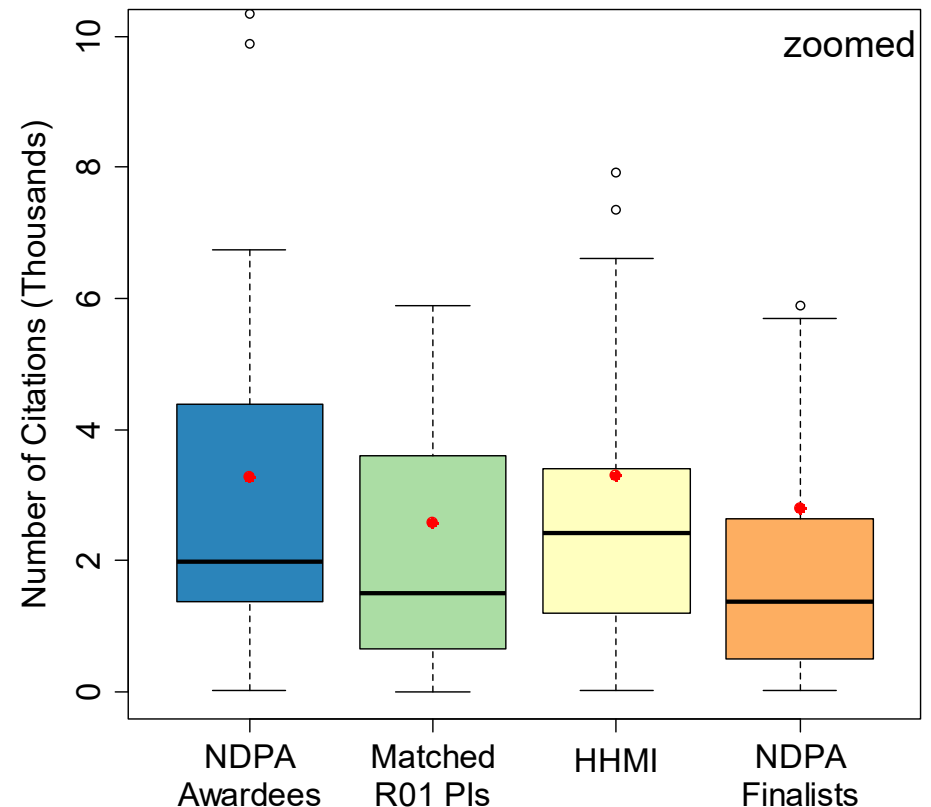
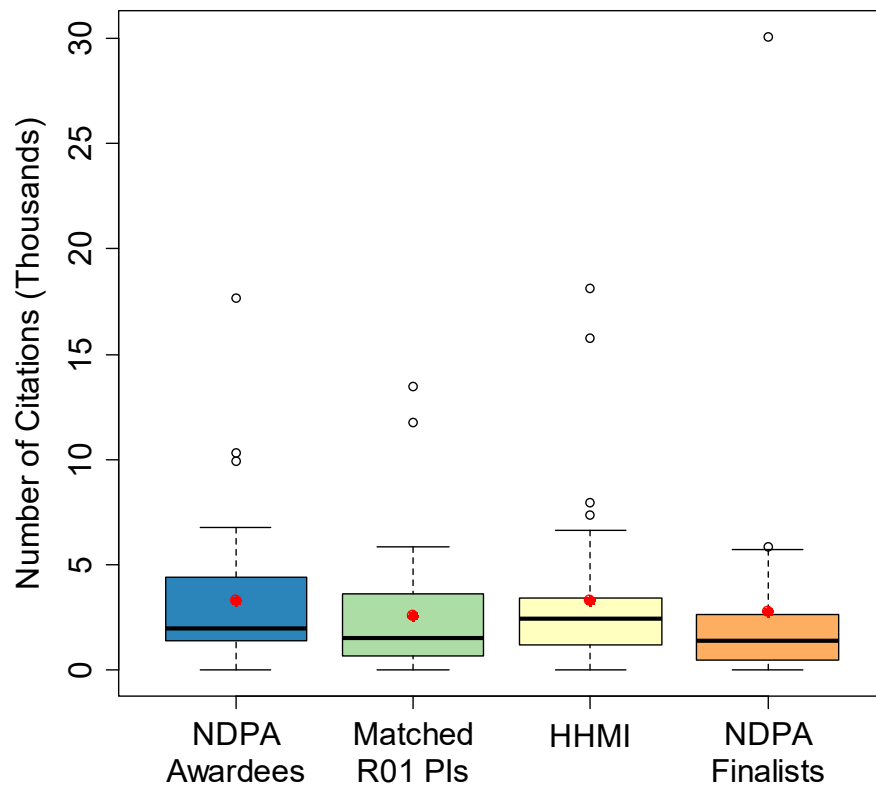
Source: Elsevier SCImago

NDPAs have similar prior productivity to all three comparison groups



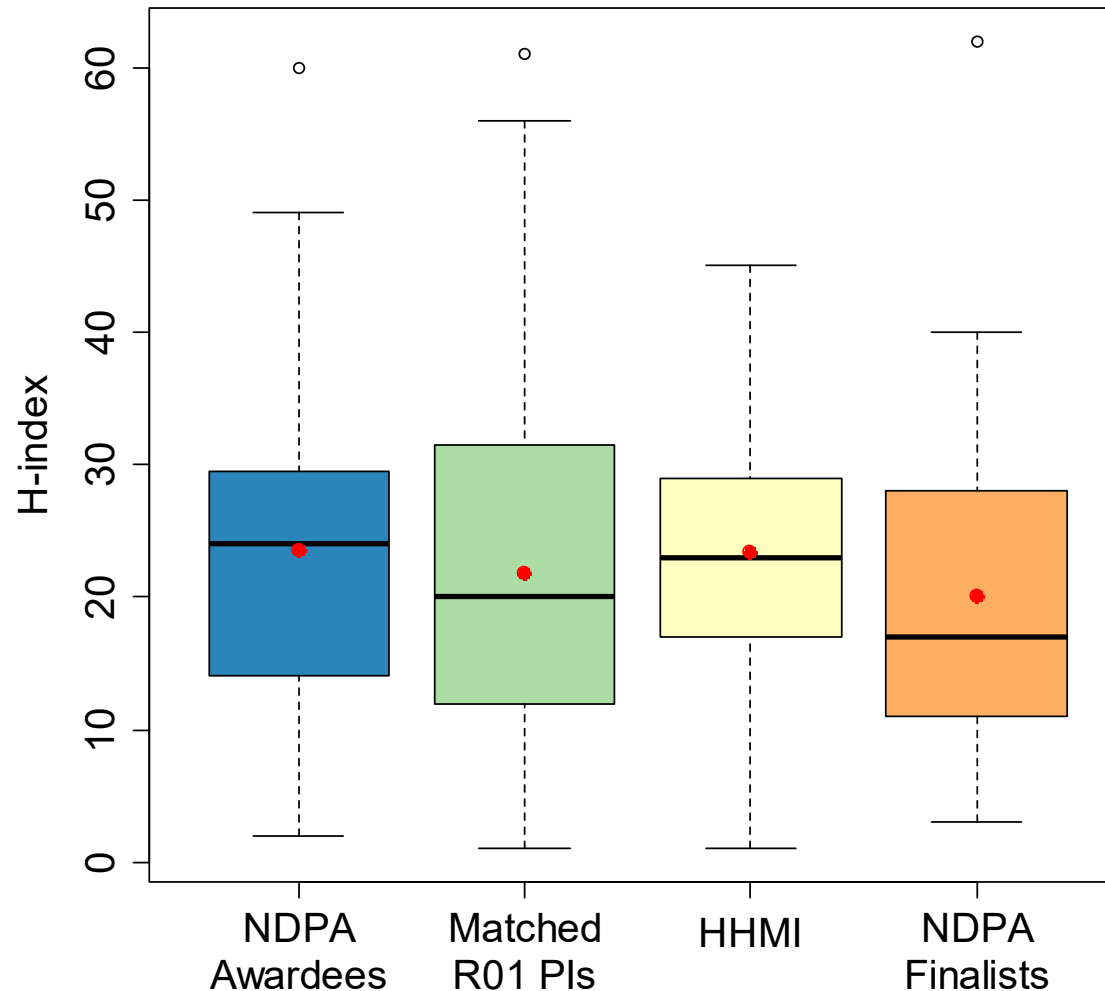
Kolmogorov-Smirnov $p = 0.82, 0.44, 0.62$

NDPAs have similar citation distributions to all three groups at time of award



Kolmogorov-Smirnov $p = 0.28, 0.82, 0.14$

NDPAs have similar h-index values to all three groups at time of award



Kolmogorov-Smirnov $p = 0.60, 0.62, 0.29$

Analyses Conducted

Study Question	Analysis Method	Specific Analysis
Impact	Bibliometric Assessment	Number of Citations (Portfolio & Matched R01s)
		Citation Impact (per publication)
		Citation Impact (per grant)
		Prestige of Journals
		H-index
	Expert Assessment	Bayesian multi-rater ordinal analysis
Innovativeness	Expert Assessment	Bayesian multi-rater ordinal analysis
	Text Mining Assessment	Crowding of Output by Topic
		Similarity (Divergence) of publications
Interdisciplinarity	Bibliometric Assessment	Subject Area Integration
		Subject Area Analysis
Collaborations	Bibliometric Assessment	Number of Unique Coauthors Number of Unique Institutions

Expert Review Approach

- 94 expert reviewers participating
- For each NDPA and comparison group grantee, five most impactful publications identified
 - Submitted by PI and Program officers
 - Supplemented using bibliometric data (highest cited publications, papers in high impact factor journals, highest citations per year)
- Each packet reviewed at least three times
 - Assignment of experts determined by expert's area of expertise and an alias-optimal design within expertise constraints
- Experts asked to assess whether
 - the grantee's body of work is impactful and why
 - the grantee's body of work displays innovative approaches
 - the research in each publication included in the packet is impactful
 - the research in each publication included follows innovative approaches
- Additional questions on alignment of research and reviewer demographics

Not All Analyses on All Comparison Groups

	Bibliometrics		Expert Review
	Grant Level Analyses	Researcher Level Analyses	
NDPA (2004-2006)*	X	X	X
Matched R01	X	X	X
HHMI (2005)		X	X
Finalists (2004-2006)		X	
Random R01 Portfolios	X		

* One Pioneer relinquished award to join NIH

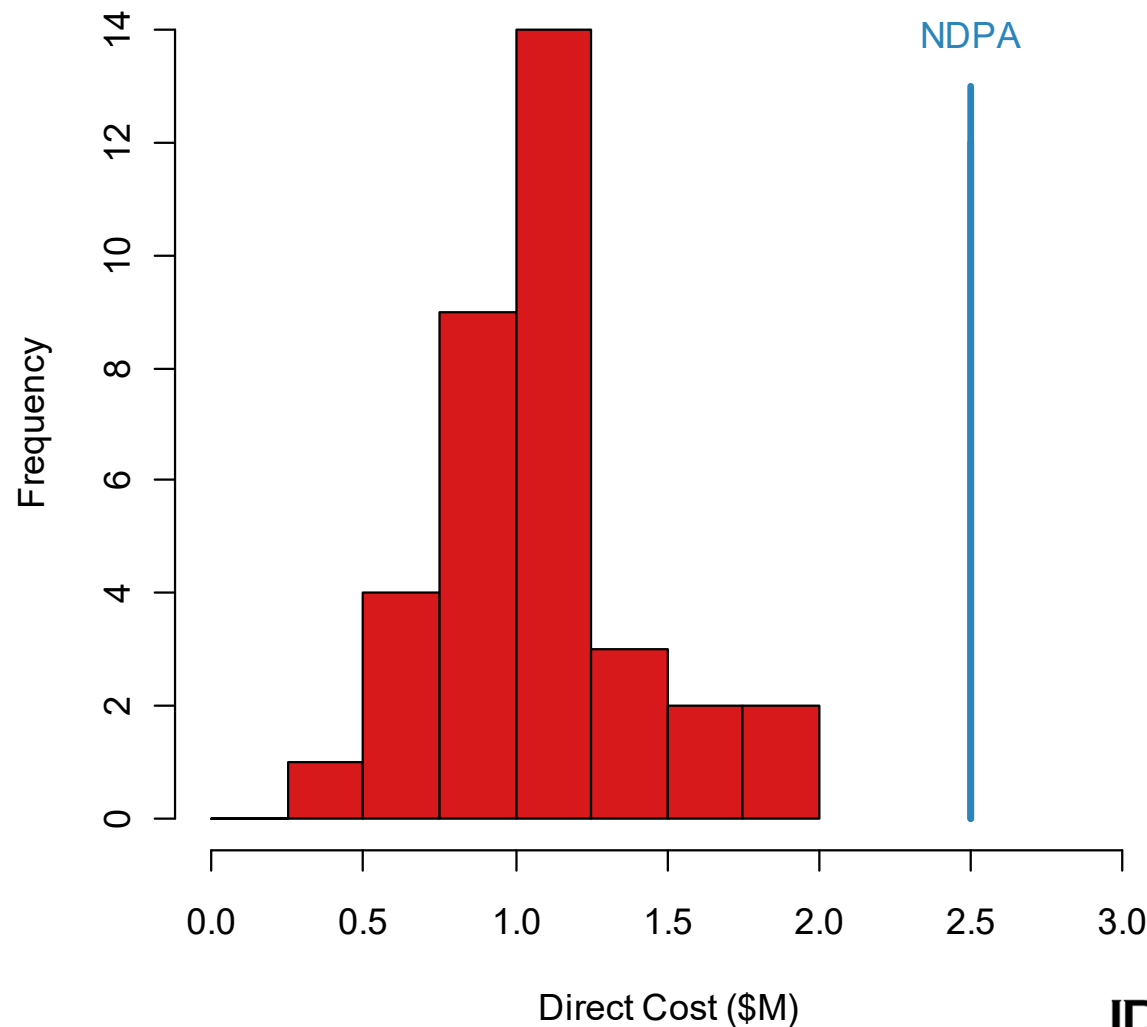
Number of Publications Analyzed

	Bibliometrics		Expert Review
	Grant Level Analyses	Researcher Level Analyses	
NDPA (2004-2006)*	518	3,287	162
Matched R01	295	3,274	154
HHMI (2005)		3,313	194
Finalists (2004-2006)		2,298	
Random R01 Portfolios	11,261		

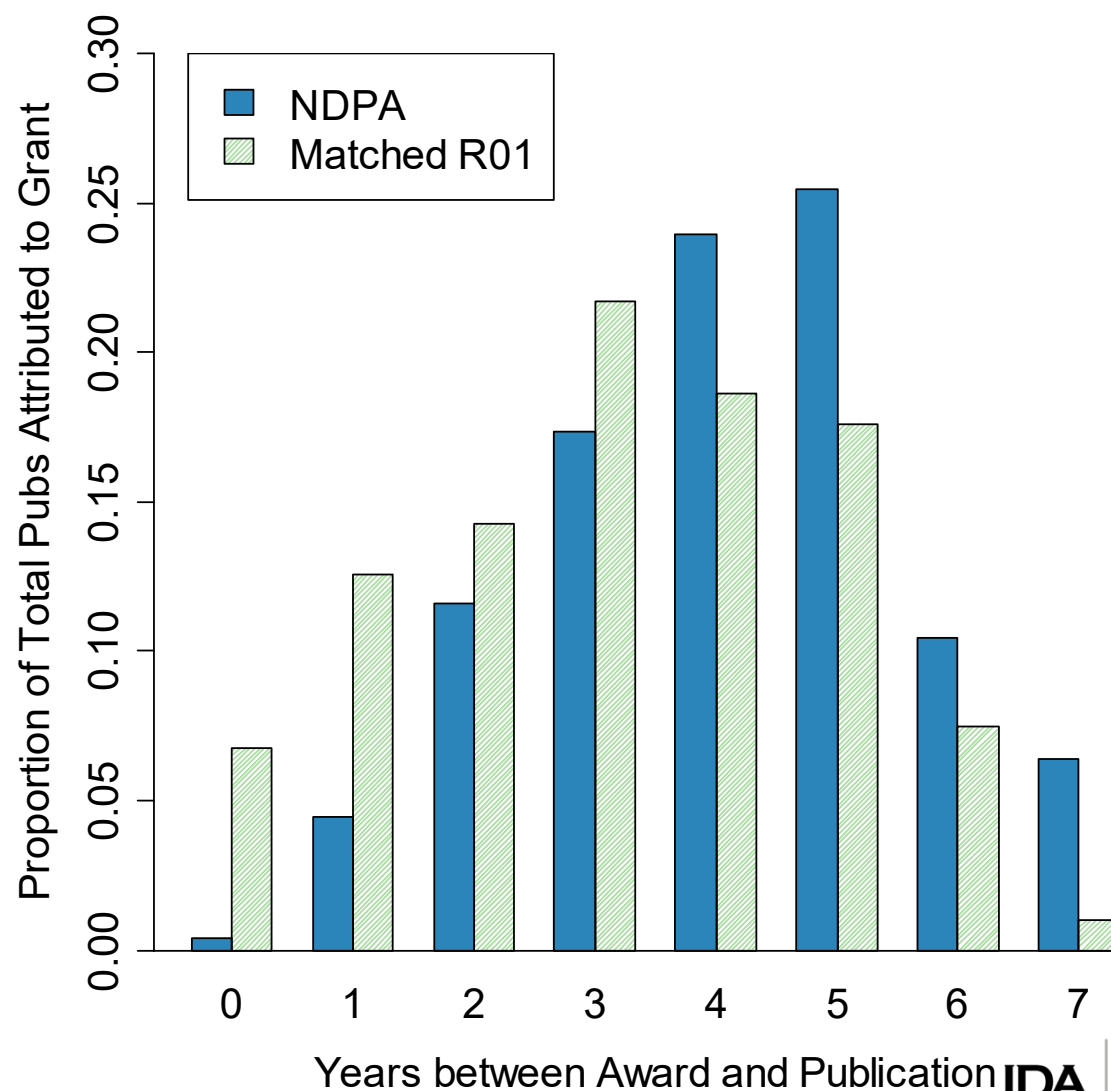
* One Pioneer relinquished award to join NIH

FINDINGS – MATCHED R01

The average matched R01 is about half the size of an NDPA



NDPA-funded research takes longer to publish than the matched R01 group



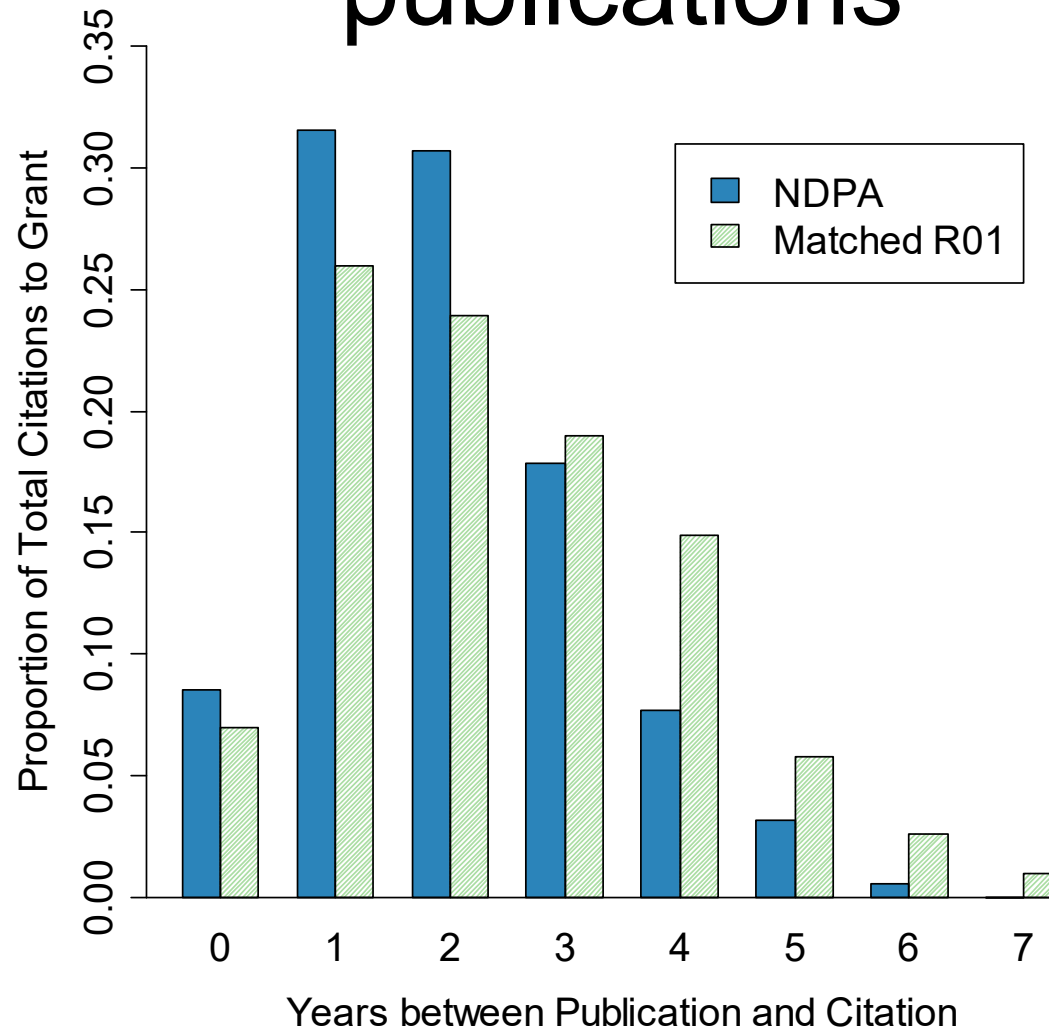
Chi-Squared $p < .0001$

Years between Award and Publication

IDA

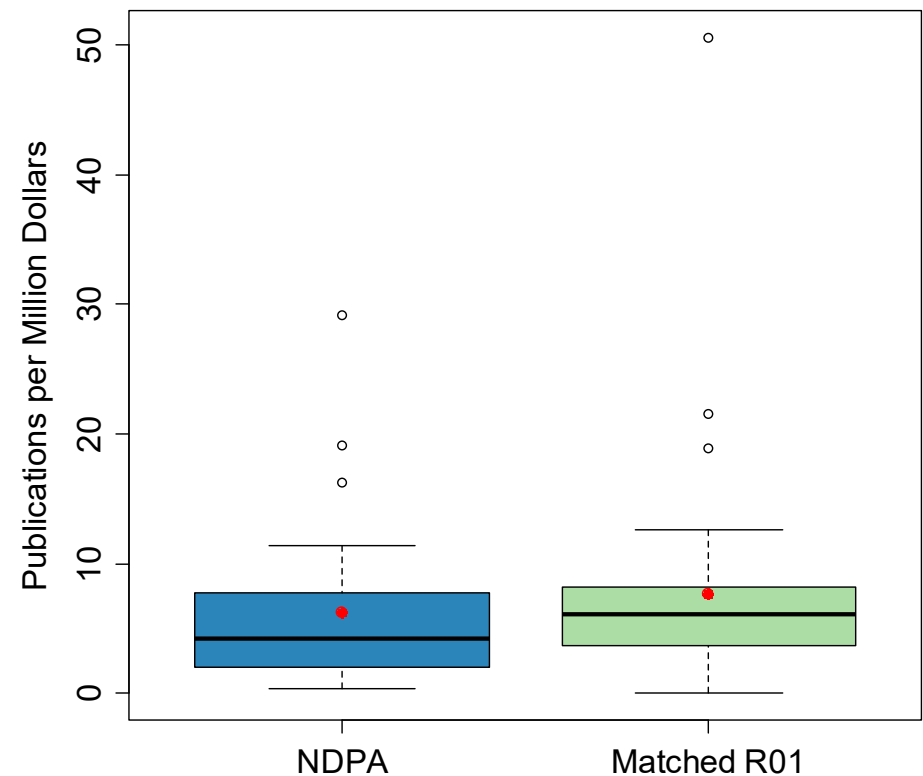
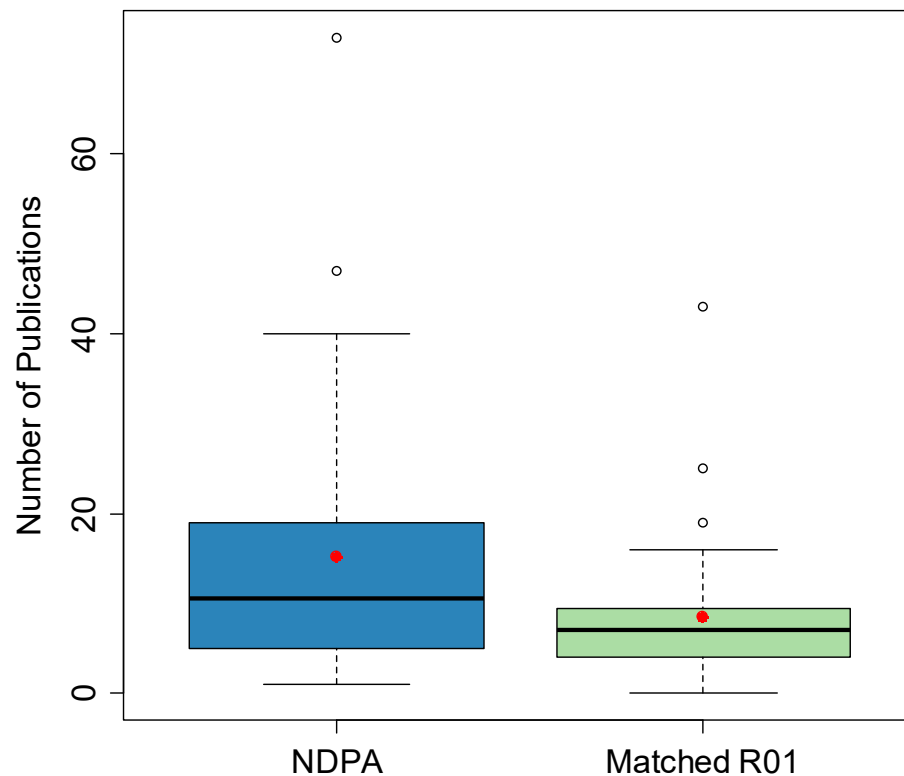
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NDPA-funded publications get cited sooner than the matched R01 publications



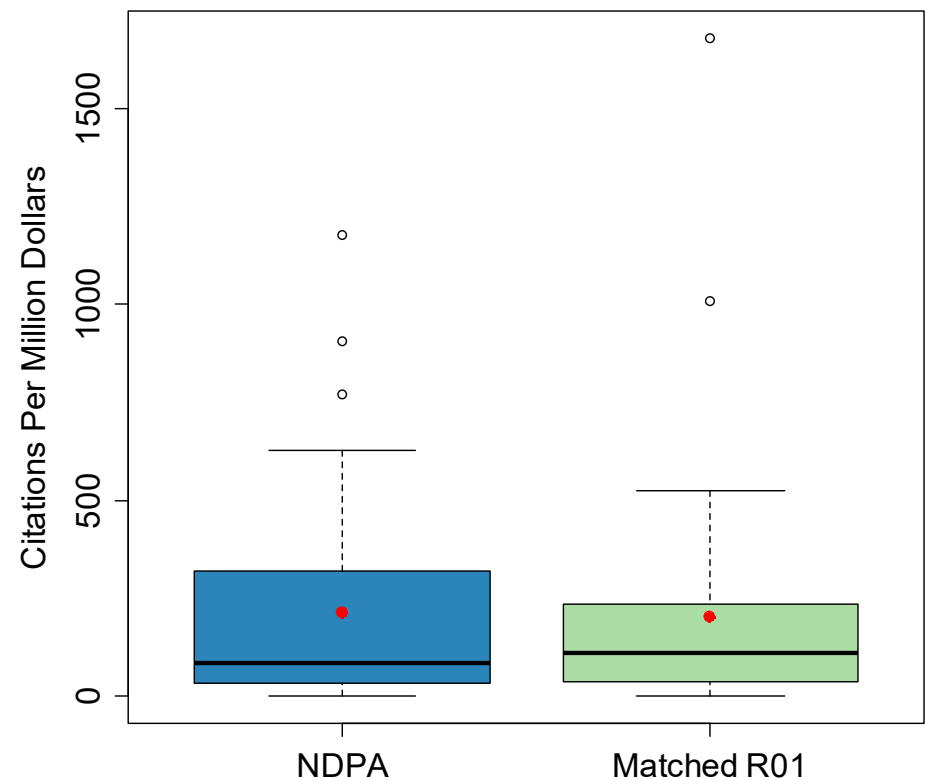
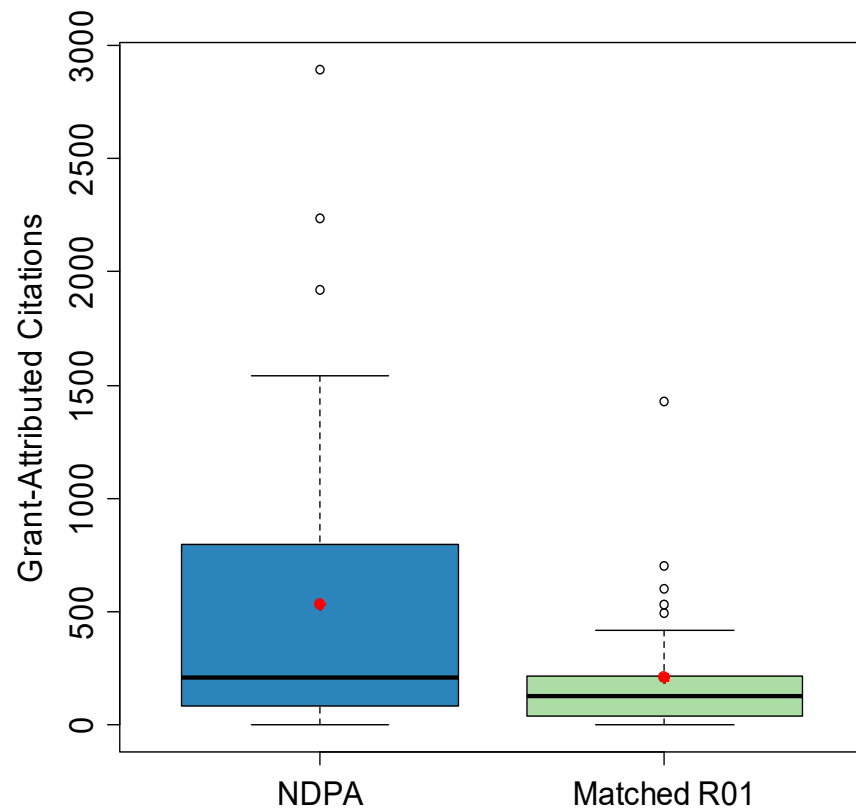
Chi-Squared $p < .0001$

NDPA-funded grants produce more publications per grant (but similar number per dollar) as compared with matched R01s



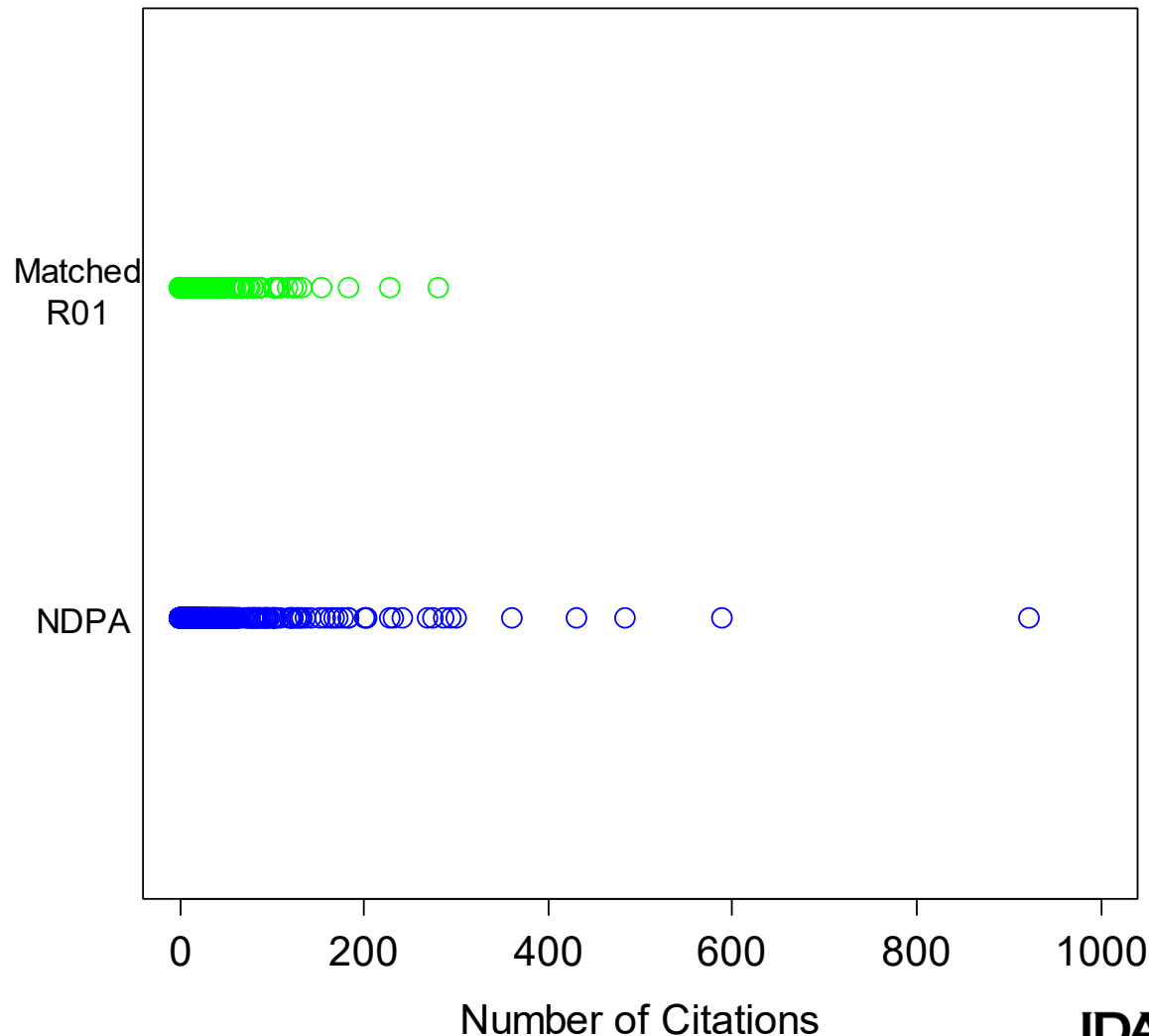
Kolmogorov-Smirnov $p = .04, 0.31$

NDPA and matched R01 publications have similar number of citations per grant (and per dollar)



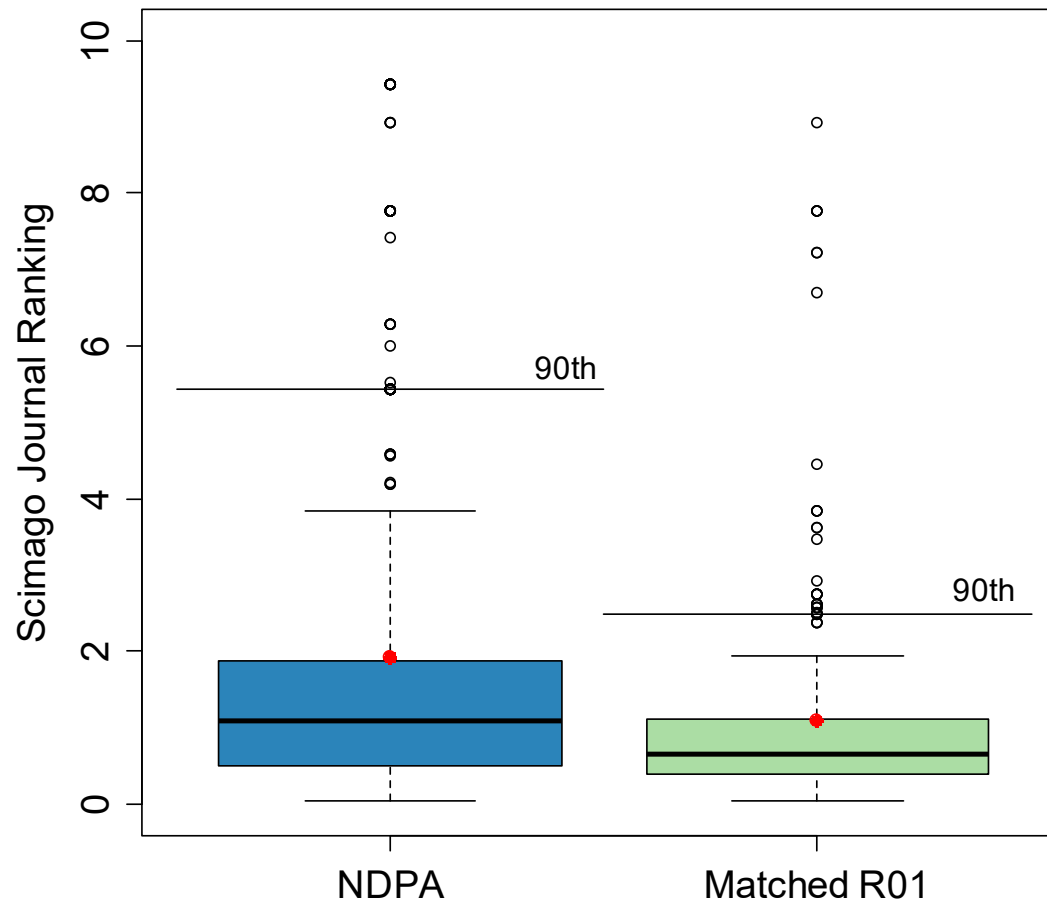
Kolmogorov-Smirnov $p = .06$, $p = 0.89$

NDPA and matched R01 have a similar number of citations per publication; however, the NDPA publications with a large number of citations may be of interest



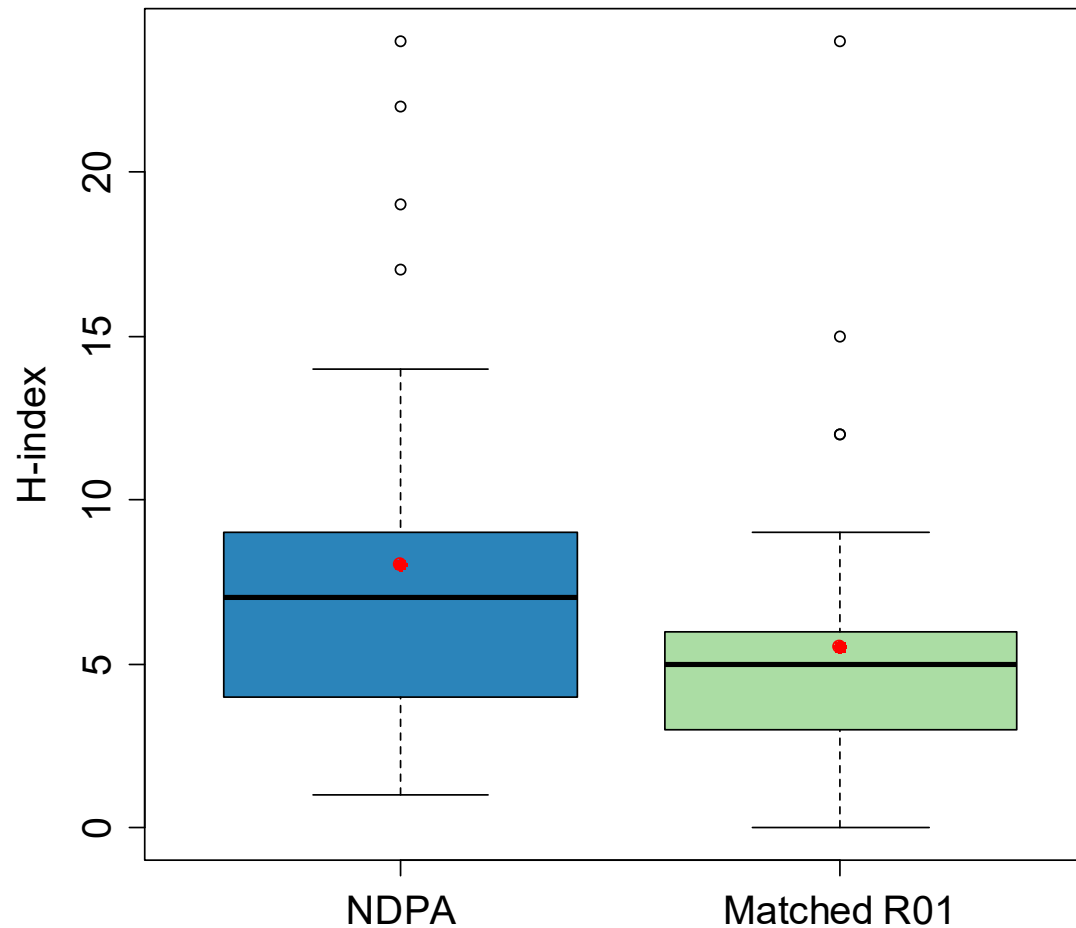
Kolmogorov-Smirnov $p = .34$

NDPA publications appear in journals with a higher journal impact factor



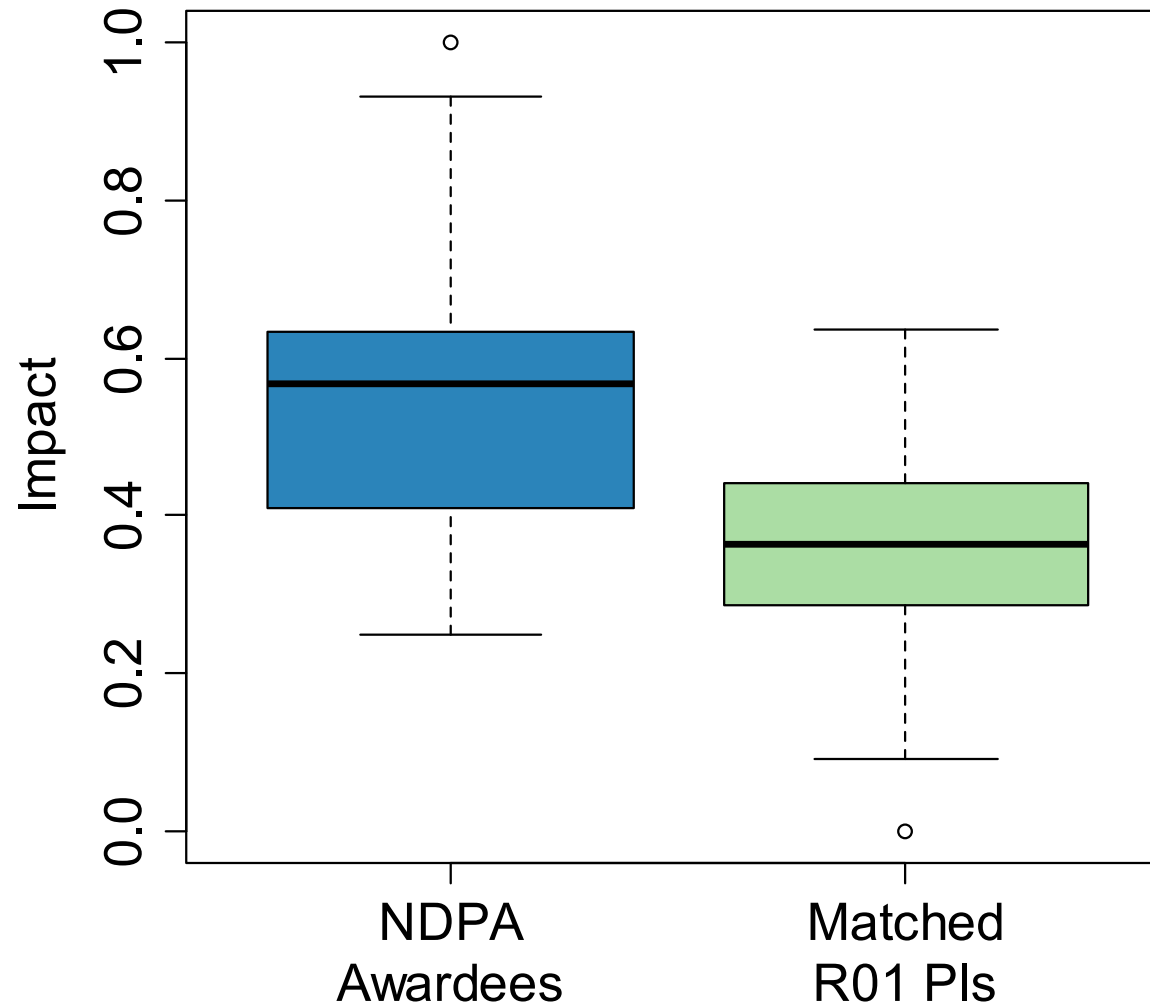
Kolmogorov-Smirnov $p < 0.0001$

NDPA grants have a larger “H-index” than matched R01s



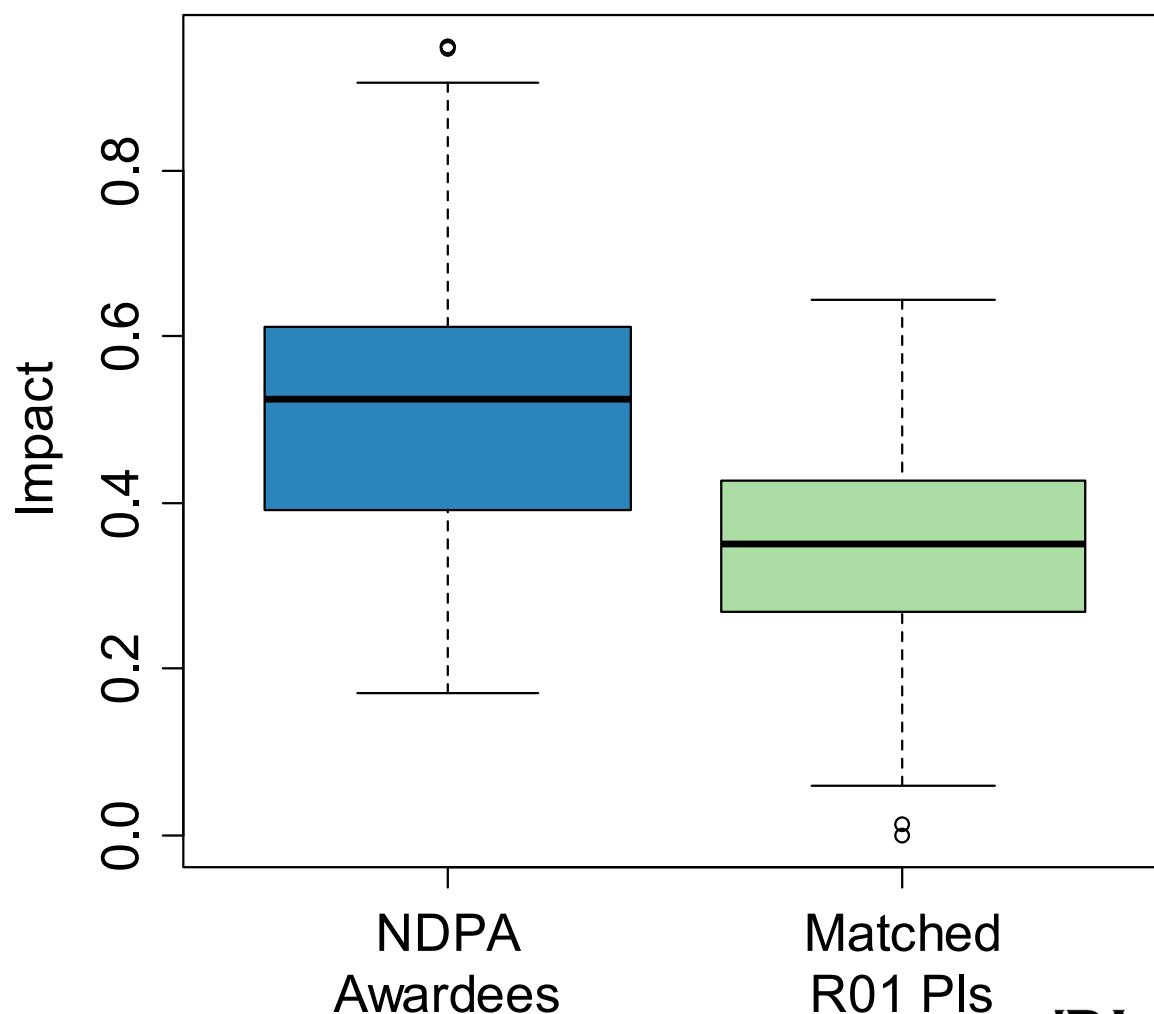
Kolmogorov-Smirnov $p = .003$

Experts assess NDPA research as being more impactful



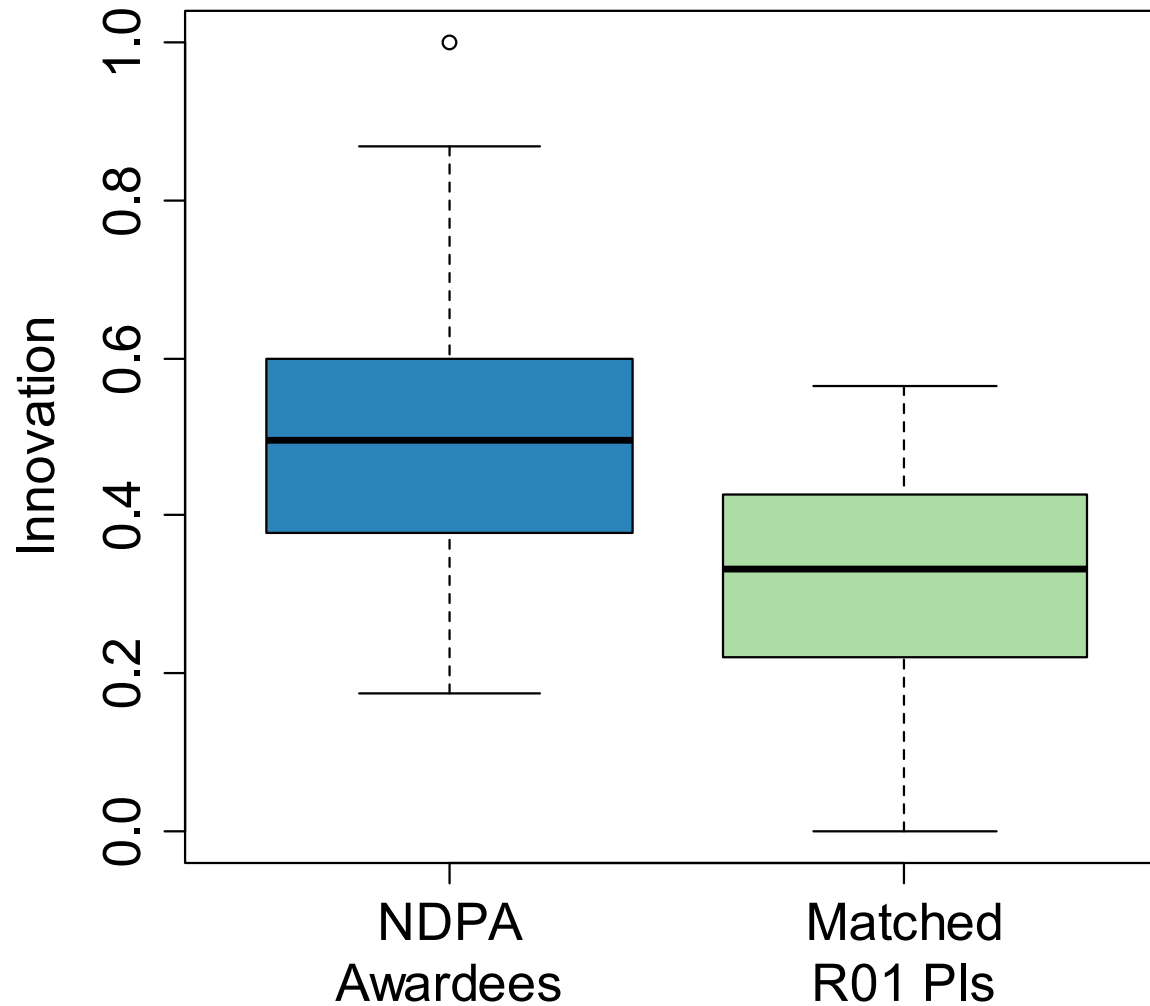
t-test, $p < 0.0001$, K-S, $p = 0.0002$

Experts assess NDPA “top 5” papers as more impactful



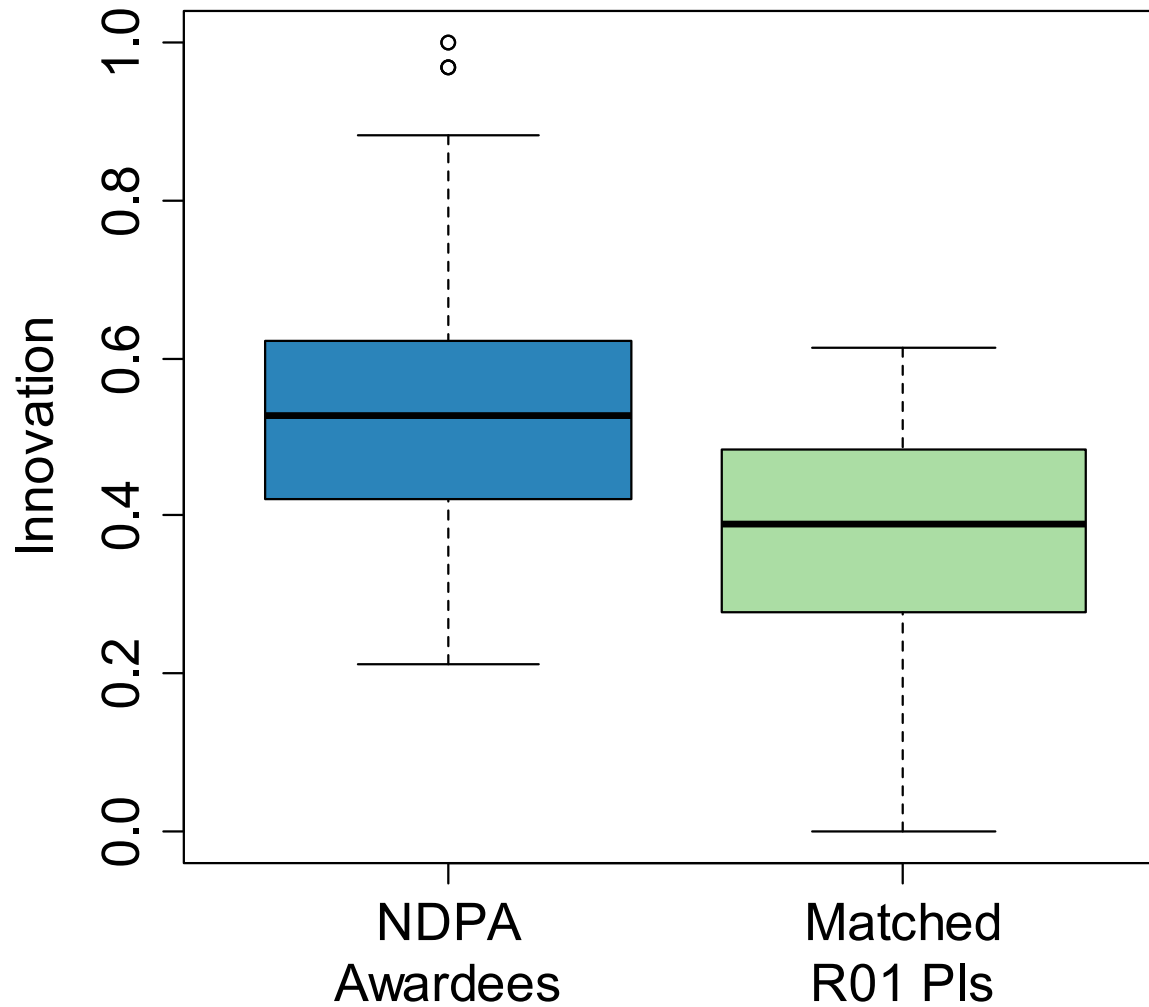
t-test, $p < 0.0001$, K-S, $p < 0.0001$

Experts assess NDPA research approaches as being more innovative than matched R01



t-test, $p < 0.0001$, K-S, $p = 0.0005$

Experts assess NDPA “top 5” papers as being more innovative than matched R01



t-test, $p < 0.0001$, K-S, $p < 0.0001$

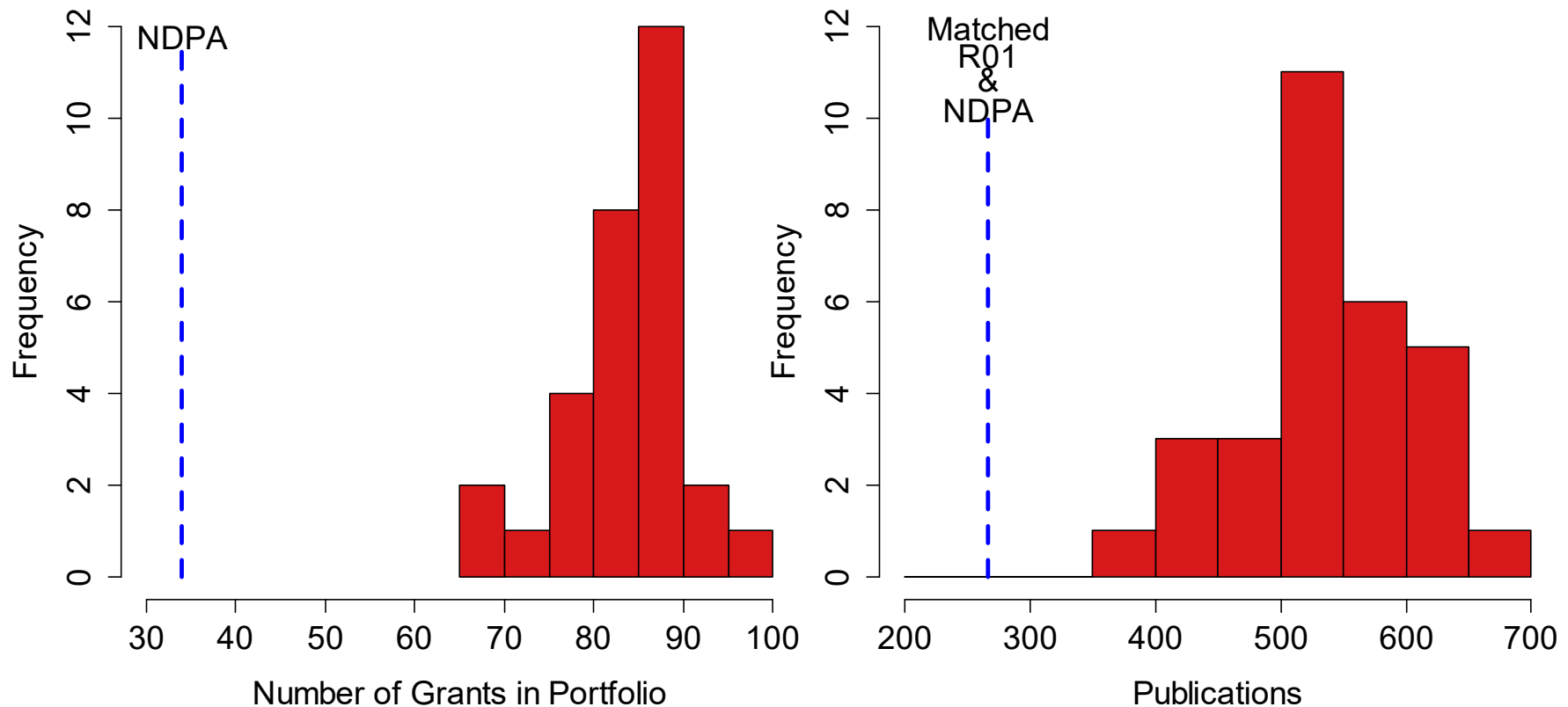
FINDINGS – RANDOM R01 PORTFOLIOS

Identifying “Random” Portfolios

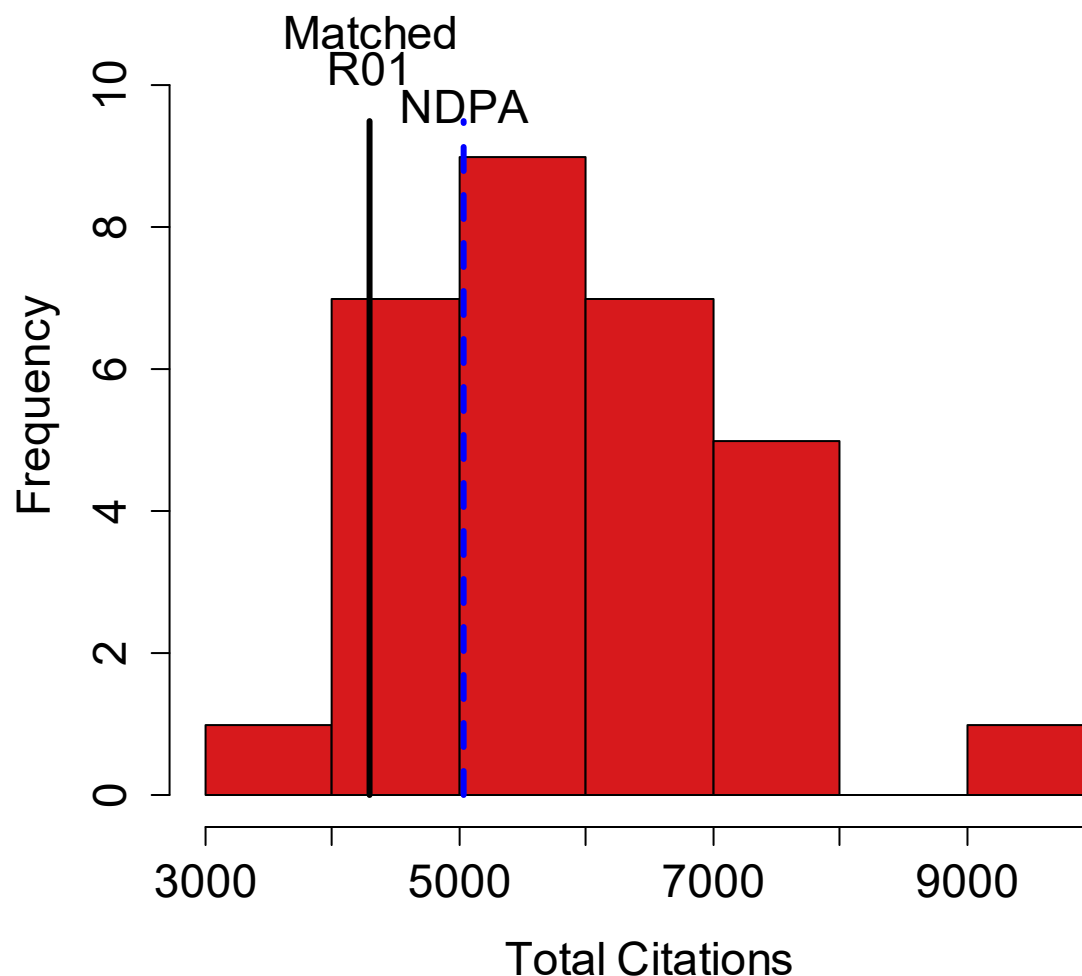
30 random portfolios of funded (Type 1) R01 grant applications were selected such that:

- The total direct cost of each portfolio approximately equals that of NDPA (\$87.5M)
- Direct costs totals were matched on an annual award base such that
 - FY2004 - \$22.5M (9 NDPA awards)
 - FY2005 - \$32.5M (13 NDPA awards)
 - FY2006 - \$32.5M (13 NDPA awards)

A random portfolio has more grants and publications than NDPA

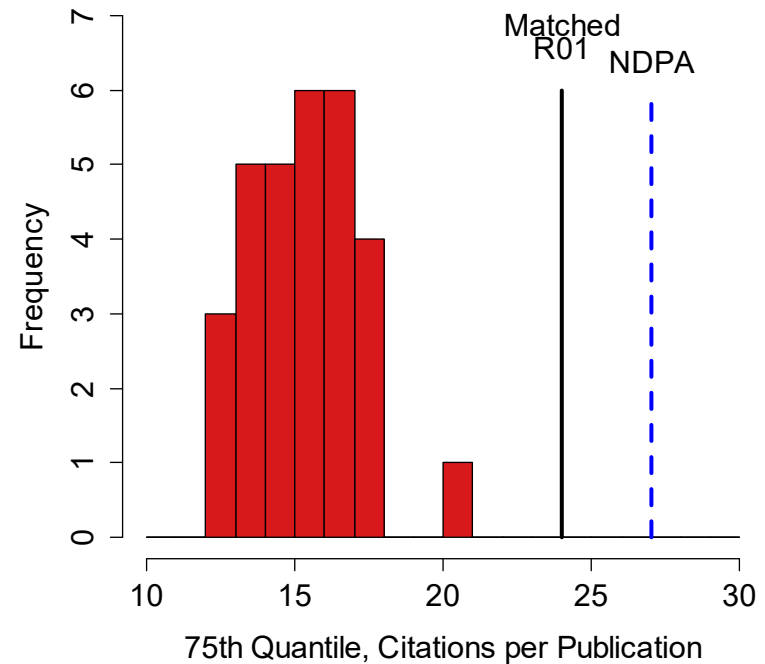
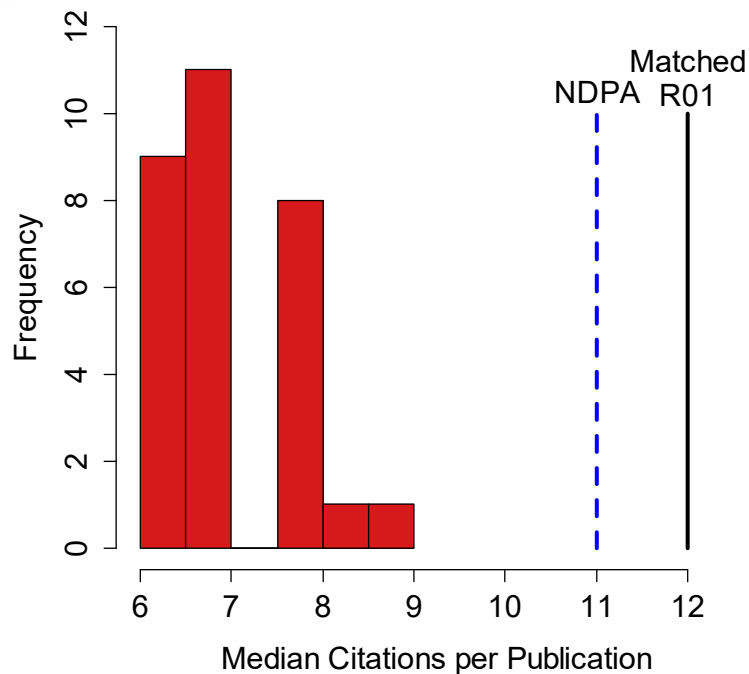


However, NDPA has a similar number of citations



Note: Data in this analysis is drawn from eSPA, which is restricted to publications in SPIRES through 2010

The distribution of citations per publication is shifted for NDPA.



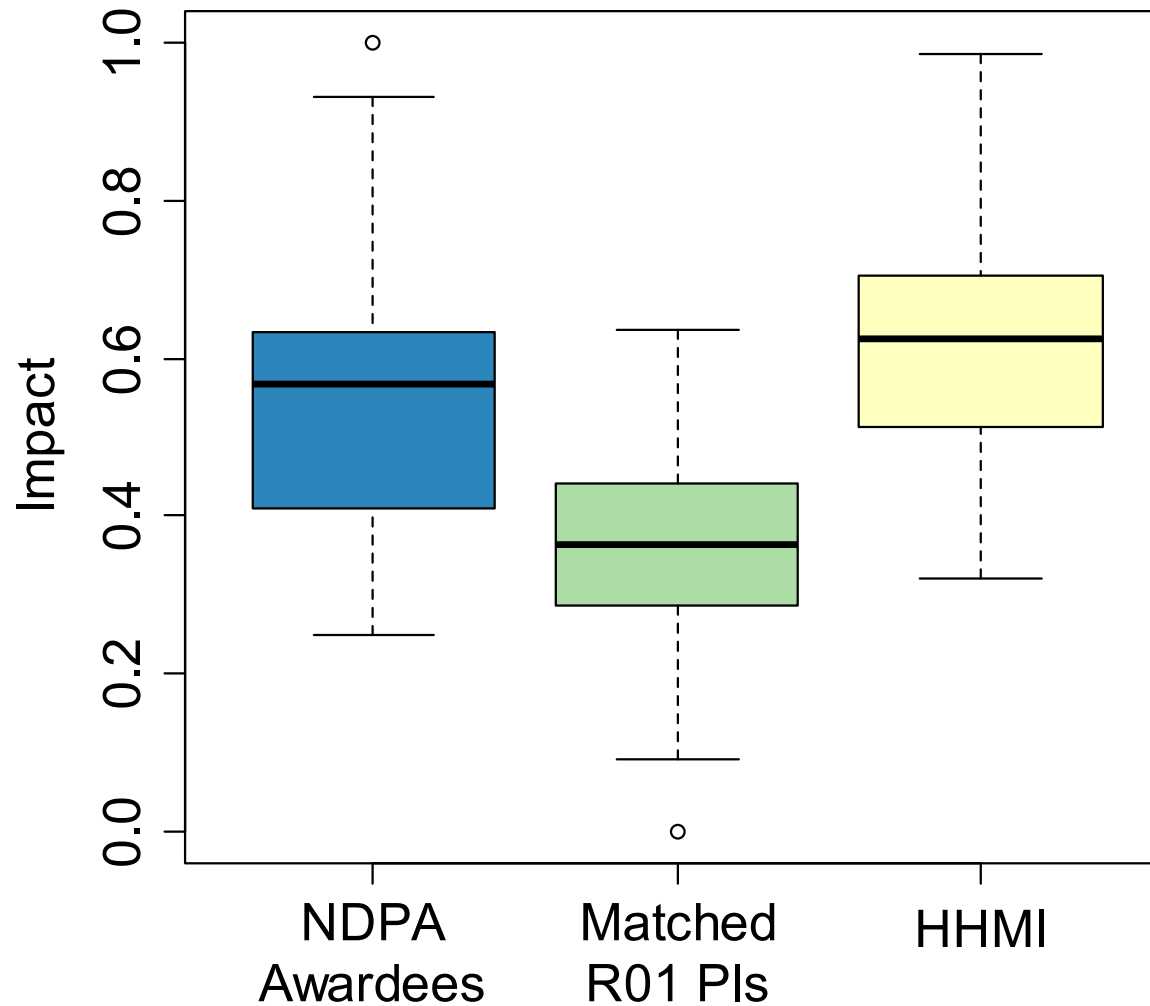
	Median			75th Quantile			90th Quantile		
	Min	Max		Min	Max		Min	Max	
NDPA	--	11	--	--	27	--	--	55	--
Matched R01	--	12	--	--	24	--	--	52	--
Random R01	6	7	9	13	15	21	26	32	51

FINDINGS – HHMI

Data Discussion

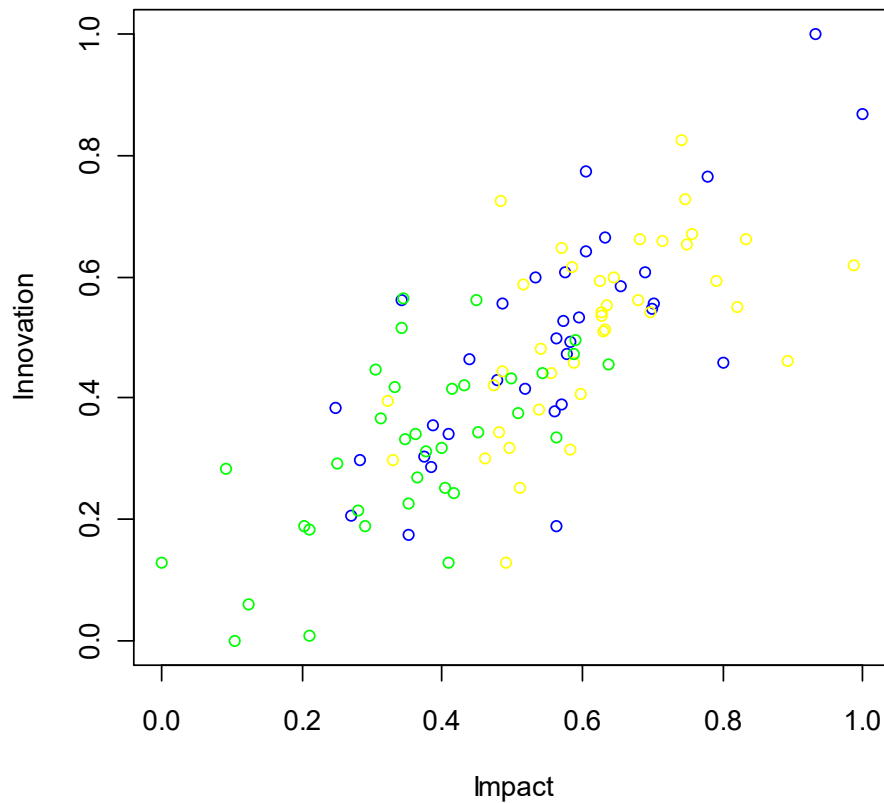
- PI names and 5 top publications were provided by HHMI
- Since the HHMI award is not a grant, all analysis is at the researcher level
 - Comparison is to NDPA awardees and R01 PIs.
- HHMI grants are bigger than NDPA – about \$650,000 per year

Experts assess NDPA research as being similarly impactful as HHMI

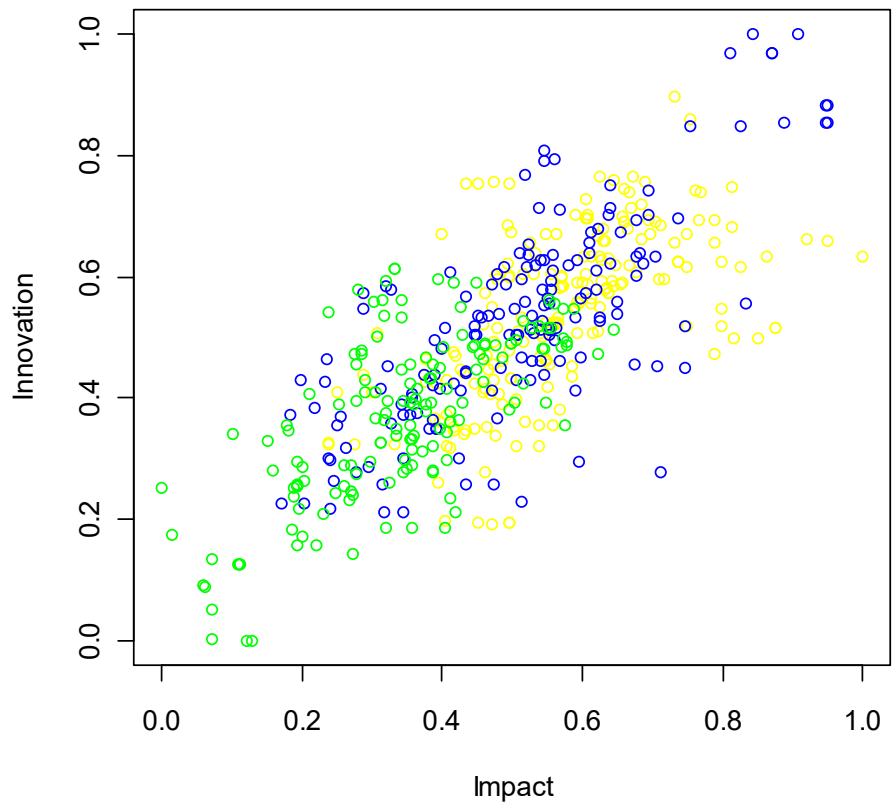


t-test, $p = 0.08$, K-S, $p = 0.17$

Expert-assessed impact and innovativeness of approaches is highly correlated

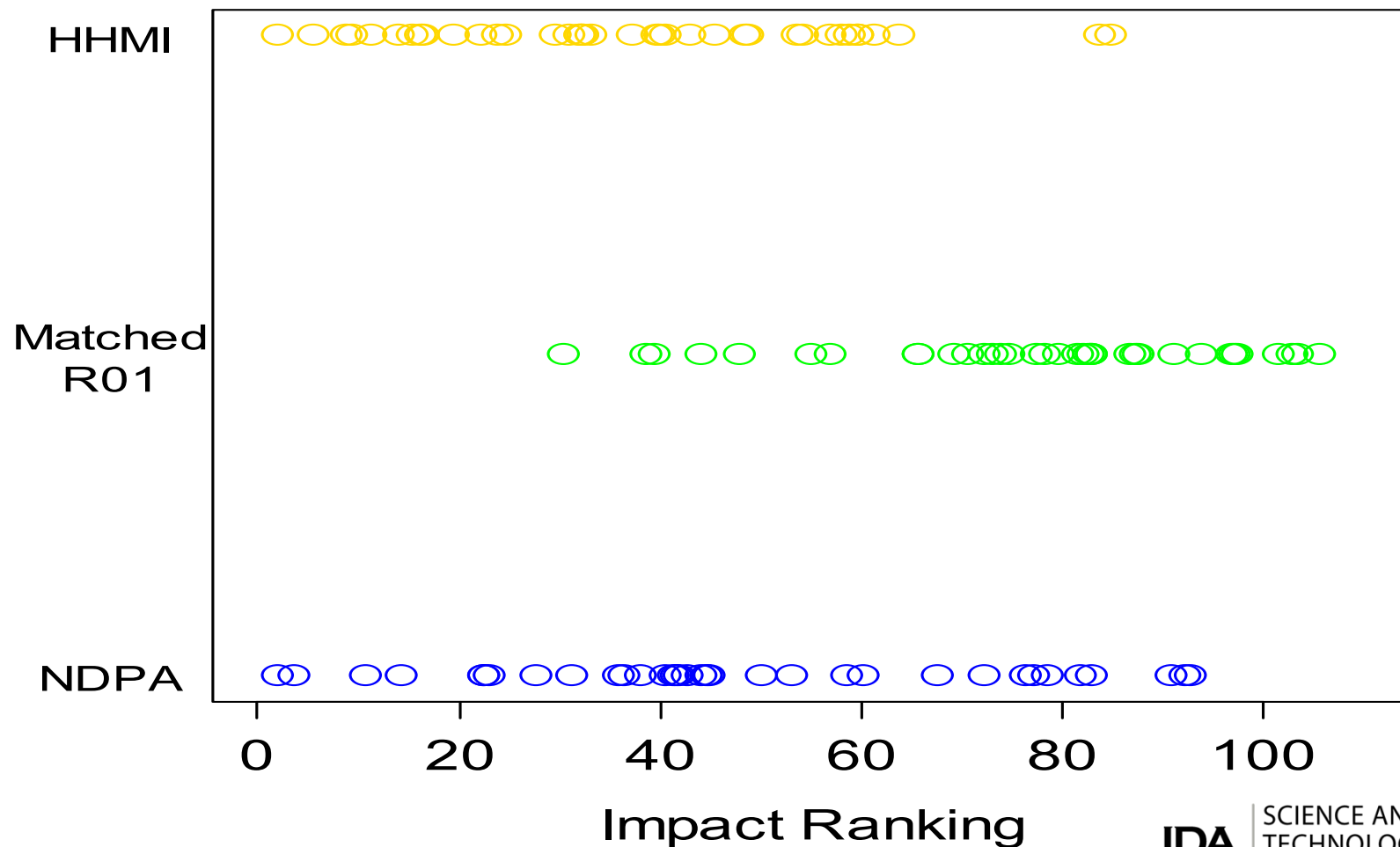


Packets

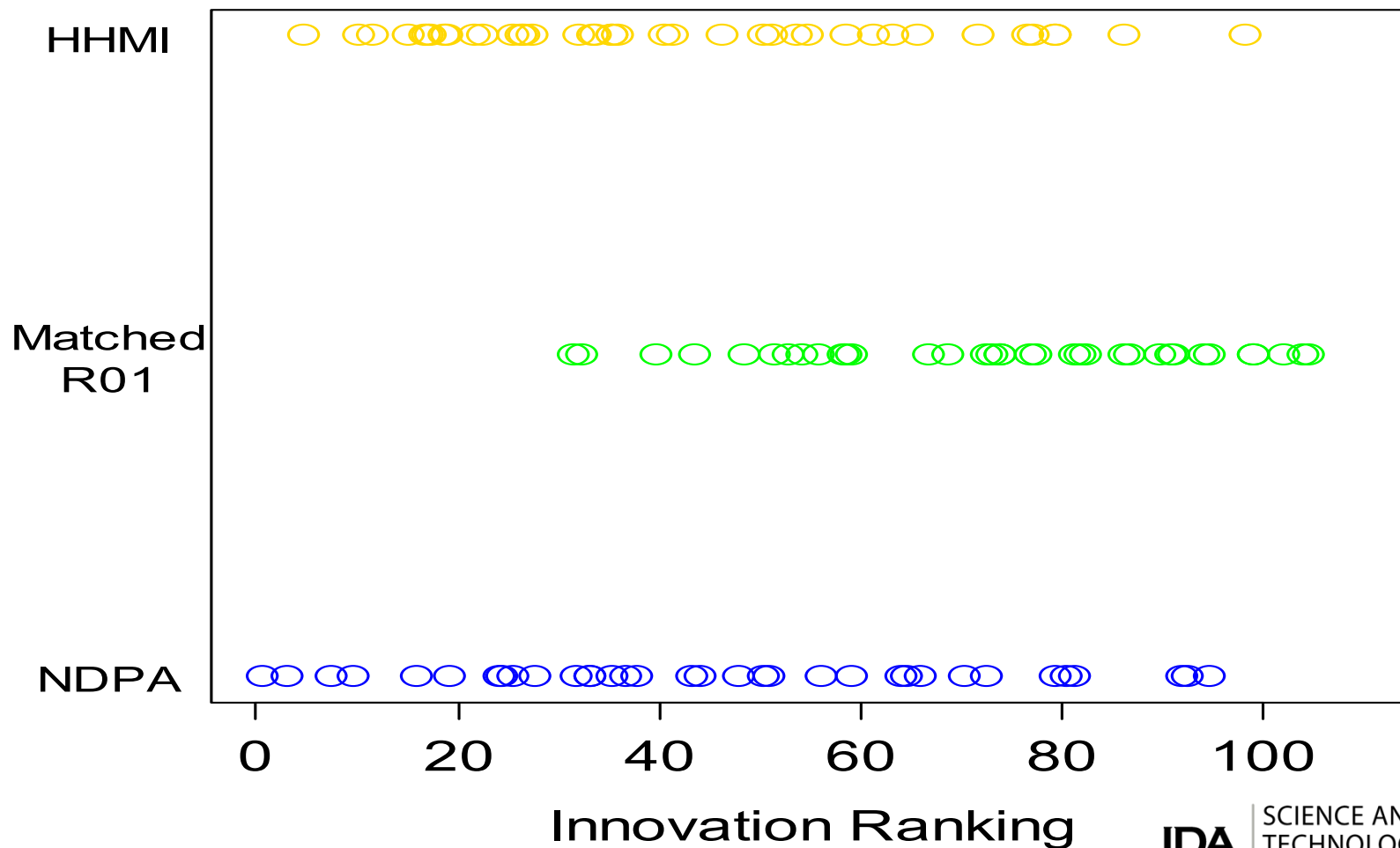


Top-5 Publications

NDPA and HHMI research have higher estimated impact rankings than matched R01s



NDPA and HHMI research have higher estimated innovativeness rankings than matched R01s



ADDITIONAL STUDY QUESTIONS

Additional Study Questions

- Is NDPA research more **interdisciplinary** as compared to research funded by other programs?
- Is NDPA research more **collaborative** as compared to research funded by other programs?

Computing Interdisciplinarity

- Operationalized by quantifying the diversity of knowledge integration into a set of publications.
- Integration score is calculated by:
 - Extracting the cited references from a journal article
 - Mapping journal titles of cited references (e.g., Nature) to 221 subject categories (SC) (e.g., Physics and Biomedical Science)
 - Determining the similarity of one SC to all other SCs (calculated from over 30k Web of Science publications)
 - Summing over all pairwise similarity values for each cited reference in a single article

A. Porter and I. Rafols, Scientometrics. Vol 81, No. 3 (2009)

SUMMARY

Findings At-A-Glance

NDPA vs.

Analysis Category	Metric	Matched R01 (Grants)	Matched R01 (Researchers)	HHMI Investigator	Random R01 Portfolio	Finalists
Productivity	Publication Counts	Green	Gold	Red	Red	Gold
	Publications per Dollar	Gold				
Bibliometric Impact	Number of citations (by grant/PI)	Gold	Gold	Red	Gold	Gold
	Number of citations (by publication)	Gold	Green	Gold	Green	Green
	Citations per Dollar	Gold				
	Journal impact factor	Green	Green	Red		Green
	Publications in Top Journals	Green	Green	Red		Green
	H-index	Green	Gold	Gold		Gold
Expert Assessment of Impact	Packets	Green		Gold		
	Papers	Green		Red		
Expert Assessment of Innovativeness	Packets	Green		Gold		
	Papers	Green		Gold		
Interdisciplinarity	Integration	Gold	Gold	Gold		Red
Collaboration	Co-authorships	Green	Gold	Red		Gold
	Author Affiliations	Gold	Gold	Red		Gold

Legend: **Green** – NDPA higher rated. **Red** – NDPA lower rated. **Gold** – NDPA same