Exploring Fragmentation in Emerging Fields of Research

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| frag · men · ta · tion |

(noun) the process or state of breaking or being broken into small parts

Is fragmentation within emerging fields a sign of positive diversity and **dynamic heterogeneity**, or a **threat** to scientific **progress** and **collaboration**?

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Is a fragmented research ecosystem slowing global progress?

- Fragmentation and the research ecosystem (Digital Science 2023 campaign)

- Fragmentation critically limits scientific progress (Balietti et al. 2015)

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Fragmentation in Translational Psychotherapy

Translational Psychotherapy
||
translating
psychological basic research
into
therapeutic interventions

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bibliographic coupling
indicated **thematic
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In the 'behaviour analysis island', the term **'translational'** is more common

The 'mainland' prefers other terms
(e.g. **'process-based'**)

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(e.g. ***'process-based'***)

Inconsistent terminology hinders **findability** of studies!
Low self-awareness?

translating family-focuse
evolving an idionomic app
das streben nach euthymie
why ineffective psychothe
generalized reflexive res
exposure and cognitive-be   emotion regulation in dep
mental imagery in depress
context and ambiguity in
age moderates link betwee
bridging the gaps between
reduction of fear of move from neuroscience to evid
optimizing long-term outc
memory reconsolidation an
the potential impact of m
renewal of fear and avoid
multiple memory systems,
a behavioural neuroscienc
tackling maladaptive memo
how the neurocircuitry an
fear extinction and relap
combined pharmacotherapy
enhancing exposure-based
d-cycloserine as an augme
a meta-analysis of d-cycl
enhancement of psychosoci
d-cycloserine enhancement

baseline reinforcement ra   a translational evaluatio   translational behavior an
renewal during functional
renewed behavior produced

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Fragmentation and Self-awareness

- Low self-awareness can lead to a 'reinventing the wheel'-scenario and may slow down scientific progress.

- **Intra-field citations** can be used to operationalise self-awareness of the field (citations as evidence of awareness of other research work).

  - Levy et al. (2020) called this the **self-referentiality** of a research field, and found that low self-referentiality indicates fragmentation.

- In addition, **modularity** may provide helpful information about the structure of the network (Shwed & Bearman, 2010).

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Can **citation-based self-awareness** help distinguish between **'good'** and **'bad' fragmentation?**

?

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Predictors

Outcomes

Self-referentiality (SR) (Levy et al., 2020)

Productivity

Modularity (Q) (Shwed & Bearman, 2010)

Collaboration

?

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Predictors

Outcomes

Self-referentiality (SR): inter-document citation rates (intracluster direct citations) normalised for better interpretability

$$SR = \frac{number\ of\ direct\ citations}{number\ of\ documents}$$

$$SR_{normalized} = \frac{observed\ self-referentiality}{maximum\ self-referentiality}$$

Modularity (Q): measures the strength of division of the network into clusters.

Productivity:
Publication volume

Collaboration:
Mean number of unique affiliations per paper

* all variables computed annually

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Predictive Modelling

$PRODUCTIVITY_i = \beta_0 + \beta_1*YEAR_i + \beta_2*SR_i + \beta_3*PRODUCTIVITY\_LAG1_i + e_i$

$COLLABORATION_i = \beta_0 + \beta_1*YEAR_i + \beta_2*SR_i + e_i$

MODULARITY **not included**, as it was highly correlated with *YEAR*

(τ = .717, p < .001) and VIF > 10

Bootstrapping with 10,000 samples to calculate confidence intervals

(to ensure the inferential robustness of the results)

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Results: **Productivity**

```
Call:
glm(formula = Publications_yearly ~ Year + SR_normalized +
Publications_lag1,
    family = poisson(link = "log"), data = srq_filled)

Coefficients:
                   Estimate Std. Error z value Pr(>|z|)
(Intercept)       -1.920e+02  2.601e+01  -7.380 1.59e-13 ***
Year               9.625e-02  1.299e-02   7.408 1.29e-13 ***
SR_normalized      6.709e-01  1.154e-01   5.816 6.03e-09 ***
Publications_lag1  2.051e-02  3.966e-03   5.172 2.31e-07 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

(Dispersion parameter for poisson family taken to be 1)

    Null deviance: 1108.704  on 39  degrees of freedom
Residual deviance:   45.519  on 36  degrees of freedom
AIC: 181.01

Number of Fisher Scoring iterations: 5
```

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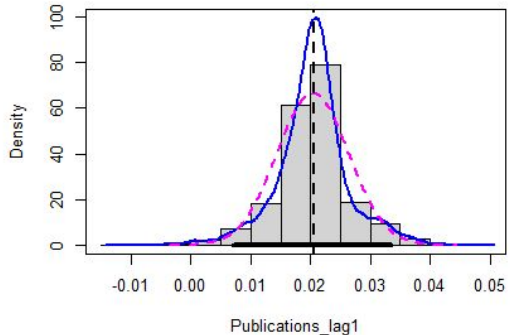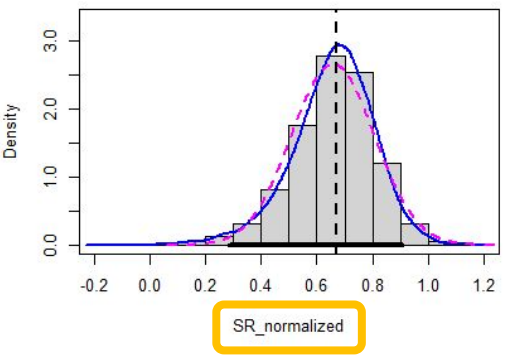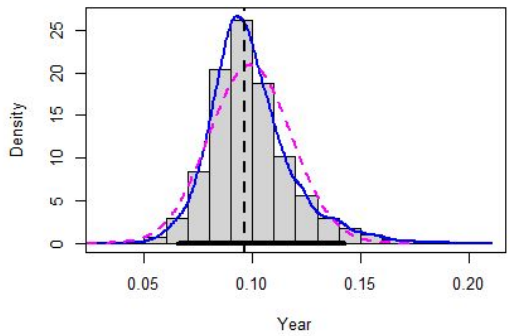
exp(0.6709) ≈ 1.956

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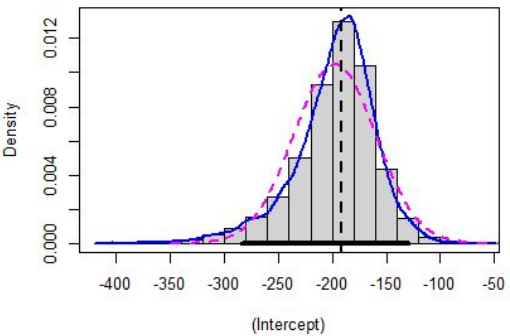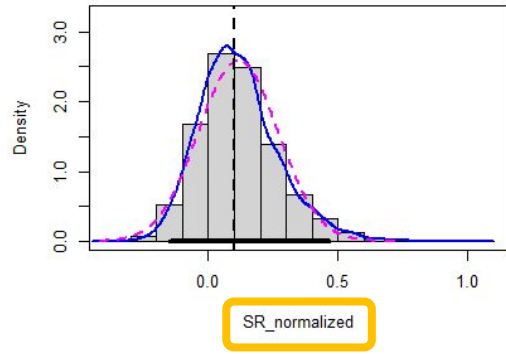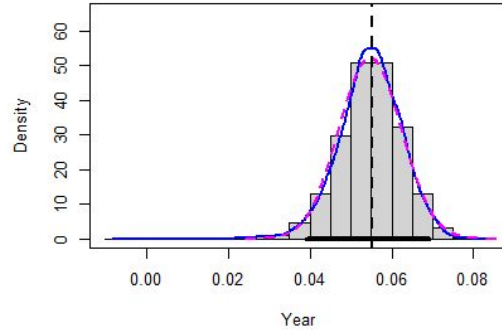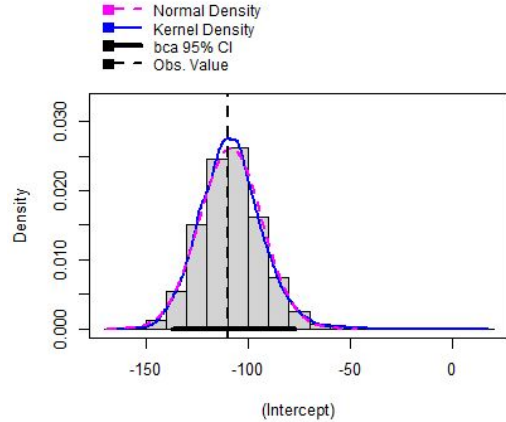
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Results: **Collaboration**


```
Call:
lm(formula = Unique_Affiliations_mean ~ Year + SR_normalized,
    data = srq_filled)

Residuals:
    Min      1Q  Median      3Q     Max
-0.9282 -0.4213 -0.0112  0.3853  1.2933

Coefficients:
                 Estimate Std. Error t value Pr(>|t|)
(Intercept)    -1.095e+02  1.984e+01  -5.518 2.83e-06 ***
Year            5.537e-02  9.954e-03   5.562 2.46e-06 ***
SR_normalized   9.991e-02  1.735e-01   0.576    0.568
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.5497 on 37 degrees of freedom
Multiple R-squared:  0.6262,    Adjusted R-squared:  0.606
F-statistic: 30.99 on 2 and 37 DF,  p-value: 1.243e-08
```

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Limitations

- Other **predictors**?
  - social media following, shared affiliation, social interactions, …

- Other **outcomes**?
  - citations, altmetrics, interdisciplinary collaboration, …

- Other emerging fields of research?
- How to interpret self-referentiality, when the theoretical maximum is practically impossible? (every paper cites every other paper in the field)

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Discussion

- We used citation-based self-awareness as an indicator of citational fragmentation.

- The extent to which a field cites studies from the same field was positively related to publication output.

➜ Indication that **high citational fragmentation** relates to **lower productivity**

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Conclusion

- Importance of analysing self-awareness of research fields

- Promising approach to assess (thematic) fragmentation

- Call for further research to address the evolving landscape of scientific publications

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