Bridging Cognition and Communication: Identifying Opportunities for Cross-Disciplinary Connections Using Scientometric Techniques

Rick Dale, Constance Bainbridge, Yanru Jiang, Lin Lin, Grace Qiyuan Miao, Zachary P. Rosen

Department of Communication, University of California, Los Angeles

Corresponding author:

Rick Dale

Department of Communication

University of California, Los Angeles

90095

rdale@ucla.edu, +1 (310) 794-7193, https://co-mind.org

Conflicts of interest: None.

Acknowledgments: This work was supported in part by the "Mark Allen Itkin Centennial Chair in Communication Honoring Andrea L. Rich" to the Department of Communication at UCLA.

Funding statement: N/A

Ethics statement: Data were based on thousands of published references in research journals. No human participants were recruited for this research.

Data availability: A view-only anonymized OSF link offers a complete work up of our data analysis including all source code needed for reviewers to assess the work:

https://osf.io/4ng5r/?view_only=d7fefc9638e3498e9d399a62d5e48f88

Word count: Approx. 6,000 main text only (no references, figures, etc.)

Figures: 4

Tables: 1

Status and date: Manuscript under review; submitted January, 2025

Bridging Cognition and Communication: Identifying Opportunities for Cross-Disciplinary Connections Using Scientometric Techniques

Abstract

Casual intuition suggests that human communication and cognition would have robust connections across their relevant phenomena: Communication involves minds, and minds are often driven to communicate. Nevertheless, these domains are now represented by very distinct domains of scholarship. This paper explores ways to bridge them. We propose a bidirectional theoretical perspective on the relationship between communication and cognitive science, and support this perspective with an analysis of over 15,000 titles and abstracts in published work in these two disciplines. Using semantic analysis inspired by scientometrics, we argue for a rapprochement between these fields. Specifically, we articulate numerous promising avenues of overlap and mutual influence that may hold between them, such as connecting sociocultural and media issues in communication with core linguistic and mechanistic processes in cognitive science. We conclude with a schema for future theoretical and empirical work aligning communicative and cognitive processes.

Keywords: scientometrics, cognition and communication, interdisciplinarity, processes, semantic analysis, metatheory

Bridging Cognition and Communication: Identifying Opportunities for Cross-Disciplinary Connections Using Scientometric Techniques

1 Introduction

This paper bridges two disciplines: cognitive and communication science. Cognitive science is often defined as the multidisciplinary study of the mind (Nuñez et al., 2019). Communication is a federation of allied research interests, including interpersonal communication, intercultural communication, media studies, and much more (Dance, 1970). They are thriving disciplines. The *Annual Meeting of the Cognitive Science Society*, the main conference of cognitive science, is attended by one-or-two-thousand participants each year. The *International Communication Association* conference, the largest gathering of communication science researchers, is also attended by thousands representing many divisions of its own society. As we show below, the disciplines are quite distinct and can be separated by a quantitative analysis of research topics.

In many ways, this strong separation between disciplines should be surprising. Communication involves cognitive processes (e.g., Scheufele, 2000; Schmälzle & Huskey, 2023a); and human minds are fundamentally social and communicative (e.g., Hermann et al., 2007). The shared conceptual connections between these disciplines are therefore profound. Evidence for this is their shared history. For example, perhaps most prominently, both fields have some identifiable roots in Shannon's midcentury *A Mathematical Theory of Communication* (Shannon, 1948). For cognitive science, these roots were set in part in the early discussions of the Macy Conferences on Cybernetics (Von Foerster, 1949). These meetings are considered an important precursor to cognitive science (Boden, 2008). A reviewer of the conference proceedings incisively commented on the apparently pervasive influence of "communication":

> *The chapter titles [...] sound like someone aspired to cover communication exhaustively: "Communication patterns in groups," [...] "Communication between animals." If the last two chapters on a "Maze-solving machine" and "In search of basic symbols" had been called "Communication between machines," the textbook coverage would have been obvious.* (Miller, 1953, p. 661)

This so-called "transmission model" that Shannon's monograph introduced became an important part of a quantitative toolkit for an emerging communication science (see chapters in Simonson et al., 2013; Littlejohn, 1989) and this model is often described early in communication textbooks as an exemplary (albeit historical) model (Burgoon et al., 1994).[1] Despite the influence of Shannon's monograph on both disciplines, the histories of cognitive and communication science also share the quality that researchers sometimes sharply distinguish their approach from Shannon's one-way sender-receiver model (Burgoon et al., 1994, p. 27).

Craig (1978) identified some contributions cognitive science could make to communication in a book survey in *Quarterly Journal of Speech*. The concerns echo Miller's review over two decades before, but ends on a more positive note:

> *[Re: interdisciplinary research:] After a time, it is difficult not to become inured, to lose either the ability or the will to distinguish jargon, gimmicks, and trendy "hype" from ideas of substance. Cognitive science is not without its elements of self-promotion, but I*

[1] While we focus for illustration on Shannon, for space we do not discuss disciplinary divisions in communication each of which may have a distinctive historical path. As an illustration, Shannon likely offers the strongest relationship historically between various subdisciplines of communication and cognitive science

> *believe many of its claims to be both substantive and genuinely innovative, though as yet unfinished and unproven. … The interests of cognitive science and speech communication closely converge in such areas as discourse production, comprehension, and conversational interaction.* (Craig, 1978, p. 449)

These historical threads would seem to tie the disciplines together, but they are now distinct scholarly communities. Their conferences, mentioned above, have little co-participation.

The goal of the present paper is to rekindle these connections between disciplines. To develop these connections, we take a data-driven approach. We analyze thousands of titles and abstracts from prominent journal outlets representing both disciplines including a subset of "bridge" journals that likely connect communication and mental processes (e.g., *Media Psychology*). Using modeling inspired by scientometrics (Leydesdorff & Milojević, 2015), we statistically infer research domains that bridge cognitive science and communication. We also use these statistical methods to identify research domains that more sharply distinguish them. As we argue below, these more distinctive research areas are suggestive – they are opportunities for a new rapprochement. We are guided by theoretical considerations in both disciplines, and our results are suggestive of what we describe below as a *bidirectional theoretical account* of how communicative and cognitive sciences may inform and innovate with each other.

There are several reasons that this disciplinary rapprochement may be timely. Each discipline may be poised in certain respects to benefit from the discoveries of the other. Cognitive science may benefit from a wider social, political and cultural lens that characterizes a lot of communication research. Many cognitive scientists have recently urged researchers to better understand cognitive agents as parts of wider media, institutional and sociocultural contexts (e.g., Dingemanse et al., 2023; Dubova et al., 2022; Scott-Phillips & Nettle, 2022). On

the other hand, emerging research in communication is integrating diverse methodologies that link to cognitive science, including cognitive modeling, neuroimaging and more (e.g., Gong et al., 2023; Hilbert et al., 2019; Turner et al., 2019). In both cases, what has been learned by one discipline may be highly impactful to the other. This exchange may inform theories in each discipline (Anonymous, 2023) and perhaps even draw out theoretical connections that can facilitate new or more general theories (cf. Schmälzle & Huskey, 2023b).

1.2 Theoretically-Guided Scientometrics

The approach we take in this study is sometimes referred to as "scientometrics," the quantitative study of science (Leydesdorff & Milojević, 2015). Its techniques overlap with information and library science, where similar analyses may be given the label "bibliometrics." Scientometrics often has the quality of combining quantitative techniques with an attention to theoretical issues. Theories and models of science and science communities have been developed in this discipline which sees science as the epistemological subject itself (see, e.g.: Thomas & Zaytseva, 2016; Contreras Kallens & Yoshimi, 2023; Ventura, 2024; Anonymous, 2018).

Many research endeavors in scientometrics visualize, identify and explain the patterns of scientific practices by extracting statistical patterns of published articles and their properties. These statistical patterns may yield overarching trends in human scientific and scholarly culture that are not evident intuitively or by smaller case studies. Some have deployed these tools on massive datasets of all published science (Boyack et al., 2005) while others have carried out focused studies to understand particular disciplines (Chen et al., 2013). A variety of work takes this approach, including recently in communication research (Hu et al., 2024; Song et al., 2020). Scientometric techniques can also involve analysis of the content of articles. Analysis of content may open windows onto the conceptual structure of disciplines under study and relate them even

if they do not share overlaps in other bibliometrics (such as citations). For example, Anonymous (2018) used scientometric techniques to analyze the distribution of theories in published cognitive science research. They focused their analysis on the abstracts of a sample of papers using key terms. Their statistical analysis was able to reconstruct the general disciplinary structure of cognitive science. This content-based approach is the one we take in this paper.

An important question in adopting this approach is what theoretical tradition would inform the bridging between cognitive science and communication. In some recent discussion in communication, Huskey et al. (2020) argue that linkages across subfields of communication can be facilitated by adopting the tri-level framework of cognitive scientist Marr (1983). This framework articulates relations among three levels, from more abstract theories ("computational"), process theories ("algorithmic") and theories that can connect to relevant physical variables such as neuroscience ("implementational"). Marr's tri-level framework is frequently part of early training in cognitive science, appearing in widely used textbooks (e.g., Freidenberg et al., 2021). Huskey et al. (2020) frame a variety of communication phenomena under this lens, such as persuasion. They explain that persuasion research is often at more abstract theoretical levels but could be richly informed by adopting Marr's strategy to integrate process models and neuroscientific research. This multi-level approach may be highly relevant to the current analysis. Indeed, we suspected that one key distinction between communication and cognitive science would align with these arguments from Huskey et al.: That intriguing new bridges may derive from cognitive science and its approach to mental processing and neurocognitive structure and function.

More recently, Schmälzle and Huskey (2023b) discuss Boster's (2023) criticism of proliferating constructs in communication research. A similar argument has taken place in

cognitive science (see Newell, 1973; collection of papers in Gray, 2020). In their commentary, Schmälzle and Huskey again highlight the critical importance of developing multi-level explanations to achieve concrete empirically informed theories. In particular, they argue for integrating methodologies that draw on brain and behavior and reflect on the increasing accessibility of these methods to researchers across communication (cf. Anonymous, 2023).

This suggests that a multi-level theoretical framework may be helpful. We could draw on Marr's levels, but another approach is to think in terms of spatial and temporal scales or structures that compose communicative and cognitive phenomena. A well-known example of this is Newell's (1990) so-called "cognitive bands," which highlights the nested nature of cognitive phenomena including social and communicative phenomena (illustrated in Fig. 1). This framework suggests a spatiotemporal organization: Communication phenomena extend from low-level neural processes all the way to social and institutional constraints on communication, such as media. This highest level of Newell's bands suggests that social phenomena, like media and other institutions, are important for a fuller understanding of cognitive systems. Some cognitive scientists have been urging better integration of theories with social, communicative and institutional processes. Vélez et al. (2023) argue that cognitive science should pursue the puzzle of why humans can form groups that sometimes outperform individuals and solve problems more effectively together (cf. Dingemanse et al., 2023; Dubova et al., 2022; Scott-Phillips & Nettle, 2022).

1.3 Bidirectional Theory of Potential Influence

The prior discussion predicts two main directions of potential influence. These are illustrated in Fig. 1 alongside Newell's bands. One direction of influence is from cognitive science to communication. In this direction, cognitive scientists may help communication researchers

identify mechanisms that underlie our capacity to communicate. These mechanisms may be the particular mental processes and other cognitive ingredients in play to achieve successful communication. The second direction is from communication research to cognitive science. In this "top-down" direction, communication researchers contribute critical context to our understanding of cognition generally. Social, political and other organizational features of communication are the backdrop against which all human cognition and communication occur.

[INSERT FIGURE 1 HERE]

This general bidirectional framework organized the initial plans for the present study. We sought a quantitative approach rooted in scientometrics to consider these questions of bridging cognition and communication. We sampled thousands of abstracts from major journals in both disciplines. We then explored the ways in which these fields intersect. We followed this analysis with a more exploratory and qualitative examination. As detailed further below, we found that cognitive science lacks a robust connection to sociopolitical matters that would seem very important to how humans think and communicate in social and institutional contexts (Scott-Phillips & Nettle, 2023). Communication, on the other hand, may be informed by an examination of cognitive processing that cognitive science offers to help isolate and study core constructs (Schmälzle & Huskey, 2023b), especially psycholinguistics – a critical domain for understanding how and why human minds use certain language in communication.

2 Methods

2.1 Journal Data

We chose 7 major journals each in both communication and cognitive science and 4 journals that would further test our bidirectional hypothesis because they may act as "bridge" journals, linking communication and cognitive science. The co-authors identified these journals because they

were higher among relevant journals in impact metrics and they tend to publish empirical research or theory and review built upon empirical research. In the Supplementary Materials, we offer a survey of the journals chosen for our analysis with direct links to their official aims and scope on publisher websites.

The online interface for Clarivate Web of Knowledge (WoK) was used to extract the most recent 1,000 published articles from each journal. Articles with empty abstracts and repeat listings in WoK were omitted, resulting in 15,470 articles approximately balanced between communication journals (5,684) and cognitive science (6,230) with a smaller subset of the 4 bridge journals (3,556). The 18 journals are listed in Table 1 with descriptive statistics for each.

[INSERT TABLE 1 HERE]

2.2 Analysis

By extracting thousands of titles and abstracts from these journals, we can assess the bridges between these disciplines and new opportunities for connection. Such an investigation requires a set of analytic strategies, and we carried out two stages for this work. First, we use these thousands of abstracts to define a topic space. We both quantify (Analysis 1) and qualitatively assess (Analysis 2) the topic space. This allowed us to test the general bidirectional prediction shared in the prior section. More detail about each analysis stage is offered below.

2.2.1 Analysis 1: Quantitative Modeling with a Topic Space

We built a semantic model known as Latent Dirichlet Allocation (LDA), or "topic model." LDA models characterize the underlying patterns in topic or meaning in a batch of text (see Griffiths & Steyvers, 2004; Mohr & Bogdanov, 2013 for introductions). Because of prior introductions, we will not revisit all the computational details of LDA. Instead, we offer a simple description of what an LDA achieves when we model meaning from a batch of text. We also share the code

needed to reproduce the LDA topic model and analyses, found in the Supplementary Materials. Note that we removed several key terms before building the topic space as these terms could trivially separate communication and cognitive texts.[2]

Our analysis is based on a semantic model that we will refer to as a "topic space." Each journal article can be projected onto the (x, y) plane based on its proximity to other journal articles on the basis of the words used in the title and abstract. To estimate the topic space, we used a mixture of methods described in the Supplementary Materials. Our topic space is displayed in Fig. 2. Each point represents a journal article. The proximity of a journal article to another, in terms of its meaning, can be computed as the Euclidean distance between (x, y) points. As described in Supplementary Materials, we found that 20 topic clusters were sufficient to produce sharp differences between cognitive science and communication and reveal numerous subdisciplines within each. These 20 topic clusters are plotted on Fig. 2 as colors.

[INSERT FIGURE 2 HERE]

2.2.2 Analysis 2: Qualitative Assessment

We developed a qualitative assessment of the topic space generated under Analysis 1. This was meant to be an exploratory investigation into the topic space. The bidirectional theoretical account we described above is only a coarse theoretical perspective – it describes only the broadest themes distinguishing the disciplines, from high-level media matters to lower-level neural processes. Analysis 2 was meant to identify finer-grained themes. To do this, the team built and tested an interactive interface that guided our discussions. The topic space was projected onto a website interface with interactive features so that further development of threads across communication and cognitive science can be identified. The website interface is available

[2] We removed 'communicative, 'communicate', 'communication', 'cognitive', and 'cognition.'

for the reader on a view-only OSF link during review as a downloadable HTML file: https://osf.io/4ng5r/?view_only=d7fefc9638e3498e9d399a62d5e48f88. The team of co-authors identified potential themes and met to discuss them. This provided opportunities for team members to discuss and come to an agreement about the key themes for presentation in the results below. We focused on three primary themes in the topic space: (i) major topics that may be important from cognitive science to influence communication, (ii) major topics from communication that may influence cognition and (iii) research domains that already appear to bridge them.

3 Results

3.1 Analysis 1: Topic Space

First, we can empirically substantiate the claim that began this paper – that these disciplines are sharply distinct. We use the analysis pipeline described in the prior section, permitting visualization of the high-dimensional topic space into two dimensions.

Fig. 2 (left) shows that this two-dimensional representation separates communication (blue) and cognitive science (red) articles. This is primarily true in the y-axis.[3] Discipline accounts for 64% of the variance in y-axis when using a simple OLS regression model to predict y coordinate from a dichotomous discipline variable (1 = communication, 0 = cognitive science;

[3] It is important to note that the distinction on the y-axis is not meaningful in itself – the topic space is stochastic at each run, so it is possible that the distinction in topic space could show up in the x-axis too, or in the diagonal axis (running along x and y axes). In the code in our Supplementary Materials, we seed construction of this topic space so that readers can reconstruct our exact configuration. We chose a seed that produced a clear rotation along the y-axis.

$p < 0.00001$). The x-axis also separates communication and cognitive science but with a smaller effect size ($R^2 = .01$, $p < .00001$). This suggests that the underlying variation in our topic space, captured in two dimensions in Fig. 2, is sufficient to separate the major disciplines under study. With journal as the covariate instead of discipline alone, we obtain an increased 68% and 8% variance in y and x coordinate accounted for, respectively, when predicted by journal identity as a multinomial variable (p's < .00001). This suggests that the journals are also clustering in this space (see Supplementary Materials for some discussion of this).

The articles from bridge journals (purple) appear to be between these two main areas. To test its contribution to this analysis we added articles from bridge journals into our regression by setting the discipline variable for communication to 0 and cognition to 0 (defining bridge journals as the model's intercept). When we add bridge articles into our analysis, the overall model explains 58% of the variance along the y-axis, slightly lower than the prior model but still significant ($p < .00001$). On average, the bridge articles are above (+14.11) the cognitive articles in the topic space y-axis but below communication articles (-22.26). This divergence is predicted by our prior theoretical discussion and is statistically significant (p's < .00001).

Our primary expectation in this topic space analysis was to test a prediction akin to Newell's bands: Communication would have higher social and collective terms and cognitive science would have terms more associated with lower neural and cognitive processes. We annotated some topic clusters in Fig. 2 (right) suggesting this general trend. We also took the words that the LDA model scores highest in those clusters and computed their average x and y coordinates in the topic space by computing over any articles containing those focal words. A plot of these terms as average x and y coordinates on the same space is shown in the Supplementary Materials. The bidirectional theory is largely supported by this finer-grained

analysis. Near the top of the plot, around the topic clusters associated with communication journals, we have terms ‘journalism,’ ‘citizen,’ and ‘media,’ and more. At the bottom, we have terms associated with cognitive processing and brain mechanisms. The difference of these y-axis coordinates of ‘media’ and ‘processing,’ for example, is reliable (y-axis means 12.87 vs. -14.81, Welch’s $t(3,012.4) = 57.57$, $p < .000001$). The same is true for many pairs of these terms across the “high-level” communication topics and the “low-level” cognitive topics at the bottom.

3.2 Analysis 2: Qualitative Assessment

At a glance, the bidirectional account is largely supported by the general trends in our topic space. We observed that the postulated high-level topics that would likely characterize communication are dominant themes in a region of the topic space far from cognitive science: media, news, politics, social and more. This may seem like an intuitive result, but there are many studies in cognition such as on vision and attention that might involve media-related stimuli. Despite that possibility, the high-level media-related concept characterizes several topic clusters on the far end of our space (see Fig. 2).

On the other side, there are topic clusters that seem related to cognitive processing and mechanisms that we proposed in our bidirectional hypothesis. However this trend is a subtler one, as these topics primarily indicate the specific processing relevant to an article. It is not merely that “processing” and “information” would appear among the cognitive science abstracts. Rather the *kind* of processing would be in focus. In the clusters remote from communication, we see collections of abstracts related to language processing, visual attention, learning and motor control and more (see Fig. 2).

Importantly, in between these two groupings is the mass of articles we associated with bridge journals – such as *Media Psychology* and *Discourse Processes*. These generally clump

near the center in such a way that yields a statistically significant deviation from our communication and cognitive science journals separately.

We also aimed to assess potential promising connections between cognitive science and communication using qualitative assessment by canvassing the topic space in Fig. 2 using our online interface (https://osf.io/4ng5r/?view_only=d7fefc9638e3498e9d399a62d5e48f88). We focused on themes that may yield insight from cognitive science to communication, from communication to cognitive science, and which themes they already have in common.

3.3.1 Cognitive Science → Communication

[INSERT FIGURE 3 HERE]

Psycholinguistics. Perhaps the most surprising trend involved the position of language and linguistics in our topic space. In this space, a major domain of cognitive science that seems surprisingly remote from communication is psycholinguistics, the study of the mental processes underlying language. Using search in our interface, we found that "sentence processing" and related phrases are far from the boundary between the disciplines. Some of these cognitive articles are about how experience shapes our processing of language, which would seem critical for an understanding of message processing in general (e.g., Wells et al., 2009). This domain also covers how language is shaped by our understanding of events (e.g., McRae et al., 2021; Ünal et al., 2021). This may also be critical for investigating how media are processed, such as news or cultural events.

Developmental Psychology. The topic of the development of language and cognition seems especially relevant to communication. Communication research has often involved the study of child media exposure and effects related to social identity and more (e.g., Martins & Harrison, 2012). What may be useful by bridging to cognitive research is to gain insight into how

communication emerges early in life. Future work may benefit from deepening links between childhood communication learning and future effects of interpersonal communication and media.

Computational Models. Computation, as a general methodological and theoretical framework, serves as a potential ambassador connecting communication and cognitive science. Both disciplines commonly employ computational methods to advance their respective theories. Cognitive science has done this for many decades; communication is rapidly growing an elaborated toolkit in this regard (Hilbert et al., 2019). Our interface reveals a presence of computation in both fields, although cognitive science demonstrates a more pervasive integration of computation, perhaps because of this early integration of computer science among its stakeholders (Friedenberg et al., 2021). This computational cognitive modeling is evident across numerous papers highlighted by our interface (e.g., Lu et al., 2023; Cohen et al., 2023).

3.3.2 Communication → Cognitive Science

Socio-Politics. Our interface demonstrates that political topics within communication are closely interconnected, spanning a broad swath of the upper section of our topic space, and with several recurring themes. For instance, research has focused on understanding the biases and cues that influence the spread, perception, and consumption of news (Barnidge et al., 2020; Burgers & Brugman, 2022). Additionally, several studies have provided significant insights into the prevalence of misinformation and disinformation (Hameleers et al., 2022) and the factors affecting the credibility and trustworthiness of news (Adam et al., 2023). Because cognitive science has far less overlap with these areas, these insights from communication offer critical empirical and theoretical directions that could inform how humans process information in more natural circumstances, including those that are emotionally charged and socially situated.

Mass Media & Information Contexts. The term "media" encompasses the vast array of mediums used to communicate, ranging from narrative storytelling, to the effects of mass media, to the use of social media to disseminate information across groups. Media studies scholarship can detail the affordances provided by various media as tools for communications practice, as well as the various ways in which they are useful tools for reinforcing audience social expectations (Lotz et al., 2022). Communication research may inform cognitive science by more clearly linking social and other functions of a given message, both in how it is produced and how it is received (cf. Speed et al., 2017).

Identity, Inequality, Justice. An important dimension prominent in communication but relatively absent in cognitive science is bridging to issues of social identity, inequality and so on. Indeed, this issue has been remarked recently as an important direction for cognitive scientists to pursue to expand inclusiveness and relevance of research (e.g., Prather et al., 2022; Goldrick, 2022; Manalini et al., 2023). In communication, there is a significant representation of this across topic clusters, as shown in Fig. 3 (middle). The potential to impact cognitive science would seem to derive from two directions. The first is meta-scientific. There is a well-established literature in communication employing bibliometric techniques to assess inequality across publishing and impact trends in journals. These papers often make recommendations for overcoming inequalities (Chakravartty et al., 2018). The second is in the importance of social identity itself in selecting and understanding messages, such as gender or other demographic factors (e.g., Knobloch-Westerwick et al., 2016).

3.3.3 Communication ↔ Cognitive Science

Moral Cognition & Information. Intriguingly, despite the relative dearth of cognitive science abstracts that mention identity, inequality, justice, there is a growing area of research in cognitive

science on moral cognition. In this area, researchers study what factors underlie moral judgments about individuals or organizations (Yu et al., 2019). This relates to research in communication that assesses the moral judgment of professional journalists in their reporting (Pleisance et al., 2012) or audiences and individuals who are subjected to particular media experiences (Bartsch et al., 2016). The principles discovered in cognitive science may inform underlying processes in communication; and in communication, the critical contexts of investigation offer important and untapped domains of concern.

Music & Intermedia. Media formats may illustrate another potential connection between cognition and communication. The cognitive science community often discusses music on a mechanistic level, such as discussing how rhythm can be interpreted as parsing (Cecchetti et al., 2023) and how listeners can use scales to predict melodies (Verosky & Morgan, 2021). Communication research often assesses the downstream effects of music, with a focus on media effects, or how media content affects viewers. Music-related content is a popular theme discussed in this context, including how viewership of music television may impact cigarette smoking (Slater & Hayes, 2010) or more broadly exposure effects and affective responses of music (Brentar et al., 2009).

Education. Finally, both cognitive science and communication involve several articles that examine educational issues. This again illustrates potential connections to language and learning, such as in how adolescents face psychological challenges in social media use over several years or how media exposure relates to political knowledge among adolescents (e.g., Moeller & de Vreese, 2015). Indeed “adolescent” occurs in communication articles 3 times more than those in cognitive science (approximately 136 vs. 47 in our topic space). Education may bridge early

developmental issues, in focus in cognitive science, to later years in adolescence in critical domains such as news and social media exposure, primarily the domain of communication.

4 Discussion and Conclusion

Analysis of thousands of abstracts in cognitive science and communication shows that (i) the scientometric techniques can clearly separate these scholarly traditions in a semantic topic space, (ii) that there is a bidirectional gradient in the topic space running from low-level cognitive mechanisms to higher-level social topics as generally predicted and (iii) the topic space yields intriguing potential similarities and differences between these disciplines. Across our analyses, the bidirectional account we proposed is largely supported and informed by quantitative and qualitative trends. For example, cognitive science may contribute further insights into mechanisms and mental processing especially in the learning and use of language. Communication provides critical social and institutional functions of language in media and in their impacts across the lifespan. Both disciplines may mutually inform each other on moral and educational implications of communication. Inclusion of "bridge journals" lends further support to the overall thesis as these articles mass in between. The results support prior theoretical discussion in Schmälzle and Huskey (2023b) that a promising way to think about advancing research in communication (and in cognitive science) is to adopt a multi-level framework.

4.1 Theories of Disciplinary Division

There is a potentially rich intellectual interaction implied by this bidirectional account. While we return to this framework again below, it is also valuable to ask why these fields are so sharply separable in the first place. To many readers, these questions may seem intuitive and straightforward – these are distinct disciplines, and readers aware of the disciplines can already intuit a separation. But the strength of this separation, induced by our topic analysis and entirely

by word use in titles and abstracts, suggests that the identity of intellectual traditions in general may be worth considering as a process. (As a reminder, we removed key terms that might separate the disciplines trivially, see footnote 2.)

The disciplinary division observed in the topic space is itself of theoretical significance. It relates to questions about the emergence and evolution of scientific disciplines. This is also studied in a scientometric context (e.g., in the case of communication: Hu et al., 2024; Song et al., 2020). From the vantage point of communication and cognitive science, one candidate to explain this sharp separation is social identity theory. Dougherty et al. (2010) offered a perspective on this that may explain how scientific fields, and scientists themselves, may gradually diverge into distinctive domains. Dougherty et al. take an intercultural approach that highlights that meanings and context both converge to support mutual understanding among individuals of a group. Yet meanings also diverge to sharpen distinctions between members of a group and members of other groups perceived as distinct (cf., Giles et al., 2023). Even a subtle heuristic like this could lead to different topic clusters emerging in each over "academic generational" time. This distinction may emerge despite some shared history and methodologies.

Relatedly, uncertainty reduction theory (URT; Knobloch, 2016; Berger & Calabrese, 1975) suggests that ingroup members building relationships will – especially at the onset of an interaction – seek to reduce uncertainty in their perceptions and behaviors in order to communicate and relate successfully. URT may help to explain collective processes in scientific communities. Disciplines, as they form spontaneous groups, may create convergent linguistic forms that diverge from other groups in such a way that minimizes uncertainty within the group and is neutral to the relation of the outside group. This may explain why cognitive science has been subject to considerable concerns about its coherence (e.g., Nuñez et al., 2018; echoing

Miller, 1953 in cognitive science and Craig, 1978 in communication). As we show in the Supplementary Material, cognitive science topic clusters have higher entropy, while communication may enjoy a more robust set of disciplinary boundaries, ones that are more predictable to understanding ingroup vs. outgroup dynamics. Indeed our general result that communication has lower entropy is consistent with the finding in Song et al. (2020) that communication is less fractured than some have expected (see Supplementary Material for additional entropy analysis).

So scholarly disciplines may form out of what Falandays and Smaldino (2022) refer to as a cultural attractor. This is a collective tendency for individuals in a group to communicate, establish conventions, and generate higher-order cultural trends that are then propagated into convention. Various conditions may drive research fields, as cultural attractors, to deviate from each other and into distinctive disciplines. Coccia (2018) summarizes some of these potential forces, including path dependence from the source discipline, the concentration of research production and more. Such models may speak to the origins of the sharp distinction between communication and cognitive science. They are out of scope here, but nevertheless prompt intriguing potential questions for future analysis of communication and other disciplines.

We could have chosen cognitive psychology as the relevant comparison field (with its potential links to media psychology). Our initial concern was that communication may interface social sciences quite broadly, including sociology and anthropology and so on. Cognitive science fashions itself as a multidisciplinary field (though see Nuñez et al., 2019 and Gray, 2020 for debate). Choosing journals more closely allied to multidisciplinary cognitive science was an opportunity to “sample” multiple disciplines more broadly. Our entropy result in the Supplementary Material, showing that cognitive science requires more topics to approximate its

articles, suggests this intuition holds up in the statistics of our topic space. Still, future work could isolate the subdisciplines of cognitive science and titrate more direct relationships.

4.2 Potential and Challenge of Interdisciplinarity

Our results suggest there may be a very orderly relation between the disciplines, one that echoes long-standing discussions of cognitive systems (Newell, 1990) and recent theoretical discussion in communication (Huskey et al., 2020; Schmälzle & Huskey, 2023b). This orderly relation offers empirical substance for articulating interdisciplinary possibilities. The encouragement to pursue interdisciplinarity has a long-standing history. Scholarly fatigue with interdisciplinarity can be aged to the same degree (see discussion in Van Foerster, 1949; Craig, 1978). This history echoes into the present discussion and so we propose concrete steps forward on building bridges across disciplines.

We suggested three potential influences that cognitive science may have on communication: psycholinguistic research, early communication development, and computational modeling. We offered examples from communication to influence cognition, including political, institutional and social factors that are understudied in cognitive science. Finally, three distinctive areas may serve as interfaces between the disciplines already: music and multimedia, educational applications, and questions of moral judgment and behavior. Each topic of this qualitative assessment has its own unique properties, but the co-authors of the present paper discussed the ways in which we might integrate these into a broader picture. Inspired by the bidirectional account and Newell (1990), we offer an initial framework shown in Fig. 4.

Cognitive science may be especially relevant to the “raw materials” of communication, the mental tools for sending and receiving messages. These cognitive processes may be studied closely in the lab but should also be investigated in their natural environment. To improve our

understanding of natural cognition, it will be critical to embed these questions in their contexts – their social, political or other media functions. And so communication offers the critical contexts of cognitive processing. Our natural inclination to communicate, to connect with other people, means that much of our daily cognition is invested in the domains of the communication discipline. And so the paths of influence are reframed in this way, shown in Fig. 4. We aver that the relationship between communication and cognitive science must be *bidirectional* in all that is implied by this term – gradients flowing between them and without so sharp a division. The communicative contexts shape which tools we use. And the mental tools we use are the raw material building these wider contexts.

[INSERT FIGURE 4 HERE]

The bidirectional theory we frame here offers a scaffold for thinking about this interface between communication and cognitive science. Interdisciplinarity cannot be a goal in itself – it should emerge as a consequence of finding promising connections across intellectual traditions. We offered several domains that represent mutual influence and existing overlap. But a broader theoretical account that describes the bidirectionality may be offered, and we conclude by noting that this may be an especially promising avenue for work in communication – understanding *how* the two fields can intersect offers insights into the nature of communication, its underlying processes, and its psychological, social and institutional effects.

Statements and declarations: As noted in our code (on OSF linked above) some debugging in R was facilitated by large-language models like GPT for ggplot2, dplyr and other data munging. Any such facilitation was integrated and checked by the authors.

References

Adam, S., Urman, A., Arlt, D., Gil-Lopez, T., Makhortykh, M., & Maier, M. (2023). Media Trust and the COVID-19 Pandemic: An Analysis of Short-Term Trust Changes, Their Ideological Drivers and Consequences in Switzerland. Communication Research, 50(2), 205–229.

Austin, J. L. (1962). How To Do Things With Words (2nd ed). Harvard Univ. Press, 1975.

Barnidge, M., Gunther, A. C., Kim, J., Hong, Y., Perryman, M., Tay, S. K., & Knisely, S. (2020). Politically Motivated Selective Exposure and Perceived Media Bias. Communication Research, 47(1), 82–103.

Bartsch, A., Mares, M.-L., Scherr, S., Kloß, A., Keppeler, J., & Posthumus, L. (2016). More Than Shoot-Em-Up and Torture Porn: Reflective Appropriation and Meaning-Making of Violent Media Content: Media Violence and Meaning-Making. Journal of Communication, 66(5), 741–765.

Berger, C. R., & Calabrese, R. J. (1975). Some explorations in initial interaction and beyond: Toward a developmental theory of interpersonal communication. Human Communication Research, 1(2), 99–112.

Boden, M. A. (2006). Mind as machine: A history of cognitive science. Clarendon Press.

Boster, F. J. (2023). Too Many? Too Few? Just Right? Construct Proliferation and Need for a Construct Dump. Asian Communication Research, 20(2), 76–83.

Boyack, K. W., Klavans, R., & Börner, K. (2005). Mapping the backbone of science. Scientometrics, 64(3), 351–374.

Brentar, J. E., Neuendorf, K. A., & Armstrong, G. B. (1994). Exposure effects and affective responses to music. Communication Monographs, 61(2), 161–181.

Burgers, C., & Brugman, B. C. (2022). How Satirical News Impacts Affective Responses, Learning, and Persuasion: A Three-Level Random-Effects Meta-Analysis. Communication Research, 49(7), 966–993.

Burgoon, M., Hunsaker, F. G., & Dawson, E. J. (1994). Human communication (3rd ed). Sage Publications.

Cecchetti, G., Tomasini, C. A., Herff, S. A., & Rohrmeier, M. A. (2023). Interpreting Rhythm as Parsing: Syntactic-Processing Operations Predict the Migration of Visual Flashes as Perceived During Listening to Musical Rhythms. Cognitive Science, 47(12), e13389.

Chakravartty, P., Kuo, R., Grubbs, V., & McIlwain, C. (2018). #CommunicationSoWhite. Journal of Communication, 68(2), 254–266.

Chen, Y., Börner, K., & Fang, S. (2013). Evolving collaboration networks in Scientometrics in 1978–2010: A micro–macro analysis. Scientometrics, 95(3), 1051–1070.

Coccia, M. (2018). General properties of the evolution of research fields: A scientometric study of human microbiome, evolutionary robotics and astrobiology. Scientometrics, 117(2), 1265–1283.

Cohen, D. J., Campbell, M. K., & Quinlan, P. T. (2023). Psychological value theory: A computational cognitive model of charitable giving. Cognitive Psychology, 145, 101593.

Contreras Kallens, P., & Yoshimi, J. (2023). Bibliometric Analysis of the Phenomenology Literature. In J. Yoshimi, P. Walsh, & P. Londen (Eds.), Horizons of Phenomenology (Vol. 122, pp. 17–47). Springer International Publishing.

Craig, R. T. (1978). Cognitive science: A new approach to cognition, language, and communication. Quarterly Journal of Speech, 64(4), 439–450.

Dance, F. E. X. (1970). The “Concept” of Communication. Journal of Communication, 20(2), 201–210.

Dingemanse, M., Liesenfeld, A., Rasenberg, M., Albert, S., Ameka, F. K., Birhane, A., Bolis, D., Cassell, J., Clift, R., Cuffari, E., De Jaegher, H., et al. (2023). Beyond Single-Mindedness: A Figure-Ground Reversal for the Cognitive Sciences. Cognitive Science, 47(1), e13230.

Dougherty, D. S., Mobley, S. K., & Smith, S. E. (2010). Language Convergence and Meaning Divergence: A Theory of Intercultural Communication. Journal of International and Intercultural Communication, 3(2), 164–186.

Dubova, M., Galesic, M., & Goldstone, R. L. (2022). Cognitive Science of Augmented Intelligence. Cognitive Science, 46(12), e13229.

Falandays, J. B., & Smaldino, P. E. (2022). The Emergence of Cultural Attractors: How Dynamic Populations of Learners Achieve Collective Cognitive Alignment. Cognitive Science, 46(8), e13183.

Friedenberg, J., Silverman, G., & Spivey, M. J. (2021). Cognitive science: An introduction to the study of mind (2. ed). SAGE.

Giles, H., Edwards, A. L., & Walther, J. B. (2023). Communication accommodation theory: Past accomplishments, current trends, and future prospects. Language Sciences, *99*, 101571.

Goldrick, M. (2022). An Impoverished Epistemology Holds Back Cognitive Science Research. Cognitive Science, 46(9), e13199.

Gong, X., Huskey, R., Eden, A., & Ulusoy, E. (2023). Computationally modeling mood management theory: A drift-diffusion model of people’s preferential choice for valence and arousal in media. Journal of Communication, 73(5), 476–493.

Gray, W. D. (2020). Introduction to Volume 12, Issue 3 of topiCS. Topics in Cognitive Science, 12(3), 788–789.

Griffiths, T. L., & Steyvers, M. (2004). Finding scientific topics. Proceedings of the National Academy of Sciences, 101, 5228–5235.

Hahn, M., Futrell, R., Levy, R., & Gibson, E. (2022). A resource-rational model of human processing of recursive linguistic structure. Proceedings of the National Academy of Sciences, 119(43), e2122602119.

Hameleers, M., Brosius, A., Marquart, F., Goldberg, A. C., Van Elsas, E., & De Vreese, C. H. (2022). Mistake or Manipulation? Conceptualizing Perceived Mis- and Disinformation among News Consumers in 10 European Countries. Communication Research, 49(7), 919–941.

Herman, E. S., & Chomsky, N. (1988). Manufacturing consent: The political economy of the mass media. Pantheon Books.

Herrmann, E., Call, J., Hernández-Lloreda, M. V., Hare, B., & Tomasello, M. (2007). Humans have evolved specialized skills of social cognition: The cultural intelligence hypothesis. Science, 317(5843), 1360–1366.

Hilbert, M., Barnett, G., Blumenstock, J., Contractor, N., Diesner, J., Frey, S., Gonzalez-Bailon, S., Lamberson, P. J., Pan, J., Tai-Quan Peng, et al. (2019). Computational Communication Science: A Methodological Catalyzer for a Maturing Discipline. International Journal of Communication, 13, 3912–3934.

Hu, J., Oktavianus, J., & Zhu, J. J. H. (2024). Is communication a dependent or involuted discipline? A citation analysis of communication publications from 2010 to 2020. Journal of Communication, 74(1), 77–87.

Huskey, R., Bue, A. C., Eden, A., Grall, C., Meshi, D., Prena, K., Schmälzle, R., Scholz, C., Turner, B. O., & Wilcox, S. (2020). Marr's Tri-Level Framework Integrates Biological Explanation Across Communication Subfields. Journal of Communication, 70(3), 356–378.

Knobloch, L. K. (2016). Uncertainty reduction theory. In Berger et al. (Ed.), The International Encyclopedia of Interpersonal Communication. John Wiley & Sons, Inc.

Knobloch-Westerwick, S., Robinson, M. J., Willis, L. E., & Luong, K. T. (2020). Beauty or Business Queen: How Young Women Select Media to Reinforce Possible Future Selves. Communication Research, 47(3), 323–345.

Krippendorff, K. (2011). Agreement and Information in the Reliability of Coding. Communication Methods and Measures, 5(2), 93–112.

Leydesdorff, L., & Milojević, S. (2013). Scientometrics (arXiv:1208.4566). arXiv. http://arxiv.org/abs/1208.4566

Lieder, F., & Griffiths, T. L. (2020). Resource-rational analysis: Understanding human cognition as the optimal use of limited computational resources. Behavioral and Brain Sciences, 43, e1.

Littlejohn, S. W. (1992). Theories of human communication (3. ed). Wadsworth Publ.

Lotz, A. D., Eklund, O., & Soroka, S. (2022). Netflix, library analysis, and globalization: Rethinking mass media flows. Journal of Communication, 72(4), 511–521.

Lu, Y., Lu, Y., Han, Z. R., Qin, S., Zhang, X., Yi, L., & Zhang, H. (2023). Prediction From Minimal Experience: How People Predict the Duration of an Ongoing Epidemic. Cognitive Science, 47(5), e13294.

Manalili, M. A. R., Pearson, A., Sulik, J., Creechan, L., Elsherif, M., Murkumbi, I., Azevedo, F., Bonnen, K. L., Kim, J. S., et al. (2023). From Puzzle to Progress: How Engaging With Neurodiversity Can Improve Cognitive Science. Cognitive Science, 47(2), e13255.

Marr, D. (1982). Vision: A Computational Investigation into the Human Representation and Processing of Visual Information. New York, NY: W.H. Freeman and Company. http://papers.cumincad.org/cgi-bin/works/Show?fafa

Martins, N., & Harrison, K. (2012). Racial and Gender Differences in the Relationship Between Children's Television Use and Self-Esteem: A Longitudinal Panel Study. Communication Research, 39(3), 338–357.

McRae, K., Brown, K. S., & Elman, J. L. (2021). Prediction-Based Learning and Processing of Event Knowledge. Topics in Cognitive Science, 13(1), 206–223.

Miller, G. A. (1953). [Review of Review of Cybernetics: Circular Causal and Feedback Mechanisms in Biological and Social Systems, Transactions of the Eighth Conference]. The American Journal of Psychology, 66(4), 661–663.

Moeller, J., & De Vreese, C. (2019). Spiral of Political Learning: The Reciprocal Relationship of News Media Use and Political Knowledge Among Adolescents. Communication Research, 46(8), 1078–1094.

Mohr, J. W., & Bogdanov, P. (2013). Introduction—Topic models: What they are and why they matter. Poetics, 41(6), 545–569.

Newell, A. (1973). You can't play 20 questions with nature and win: Projective comments on the papers of this symposium. In Visual Information Processing (pp. 283–308). Academic Press.

Newell, A. (1990). Unified theories of cognition. Harvard University Press.

Núñez, R., Allen, M., Gao, R., Miller Rigoli, C., Relaford-Doyle, J., & Semenuks, A. (2019). What happened to cognitive science? Nature Human Behaviour, 3(8), 782–791.

Prather, R. W., Benitez, V. L., Brooks, L. K., Dancy, C. L., Dilworth-Bart, J., Dutra, N. B., et al. (2022). What Can Cognitive Science Do for People? Cognitive Science, 46(6), e13167.

Scheufele, D. A. (2000). Agenda-setting, priming, and framing revisited: Another look at cognitive effects of political communication. Mass Communication & Society, 3(2–3), 297–316.

Schmälzle, R., & Huskey, R. (2023a). Integrating media content analysis, reception analysis, and media effects studies. Frontiers in Neuroscience, 17, 1155750.

Schmälzle, R., & Huskey, R. (2023b). Skyhooks, Cranes, and the Construct Dump: A Comment on and Extension of Boster (2023). Asian Communication Research, 20(2), 84–94.

Scott-Phillips, T., & Nettle, D. (2022). Cognition and Society: Prolegomenon to a Dialog. Cognitive Science, 46(6), e13162.

Simonson, P., Peck, J., Craig, R. T., & Jackson, J. (Eds.). (2013). The Handbook of Communication History (0 ed.). Routledge.

Slater, M. D., & Hayes, A. F. (2010). The Influence of Youth Music Television Viewership on Changes in Cigarette Use and Association With Smoking Peers: A Social Identity, Reinforcing Spirals Perspective. Communication Research, 37(6), 751–773.

Song, H., Eberl, J.-M., & Eisele, O. (2020). Less Fragmented Than We Thought? Toward Clarification of a Subdisciplinary Linkage in Communication Science, 2010–2019. Journal of Communication, 70(3), 310–334.

Speed, L. J., Wnuk, E., & Majid, A. (2017). Studying Psycholinguistics out of the Lab. In A. De Groot & P. Hagoort (Eds.), Research Methods in Psycholinguistics and the Neurobiology of Language (1st ed., pp. 190–207). Wiley.

Thomas, J., & Zaytseva, A. (2016). Mapping complexity/Human knowledge as a complex adaptive system. Complexity, 21(S2), 207–234.

Thorson, K., & Wells, C. (2016). Curated Flows: A Framework for Mapping Media Exposure in the Digital Age: Curated Flows. Communication Theory, 26(3), 309–328.

Turner, B. O., Huskey, R., & Weber, R. (2019). Charting a Future for fMRI in Communication Science. Communication Methods and Measures, 13(1), 1–18.

Ünal, E., Ji, Y., & Papafragou, A. (2021). From Event Representation to Linguistic Meaning. Topics in Cognitive Science, 13(1), 224–242.

Vélez, N., Christian, B., Hardy, M., Thompson, B. D., & Griffiths, T. L. (2023). How do Humans Overcome Individual Computational Limitations by Working Together? Cognitive Science, 47(1), e13232.

Ventura, R. (2024). The use of scientific methods and models in the philosophy of science. Scientometrics, 129(3), 1255–1276.

Verosky, N. J., & Morgan, E. (2021). Pitches that Wire Together Fire Together: Scale Degree Associations Across Time Predict Melodic Expectations. Cognitive Science, 45(10), e13037.

Von Foerster, H. (1949). Cybernetics: Circular causal, and feedback mechanisms in biological and social systems. Macy Foundation.

Walther, J. B., Kashian, N., Jang, J., & Shin, S. Y. (2016). Overattribution of Liking in Computer-Mediated Communication: Partners Infer the Results of Their Own Influence as Their Partners' Affection. Communication Research, 43(3), 372–390.

Wells, J., Christiansen, M., Race, D., Acheson, D., & Macdonald, M. (2009). Experience and sentence processing: Statistical learning and relative clause comprehension. Cognitive Psychology, 58(2), 250–271.

Yu, H., Siegel, J. Z., & Crockett, M. J. (2019). Modeling Morality in 3-D: Decision-Making, Judgment, and Inference. Topics in Cognitive Science, 11(2), 409–432.

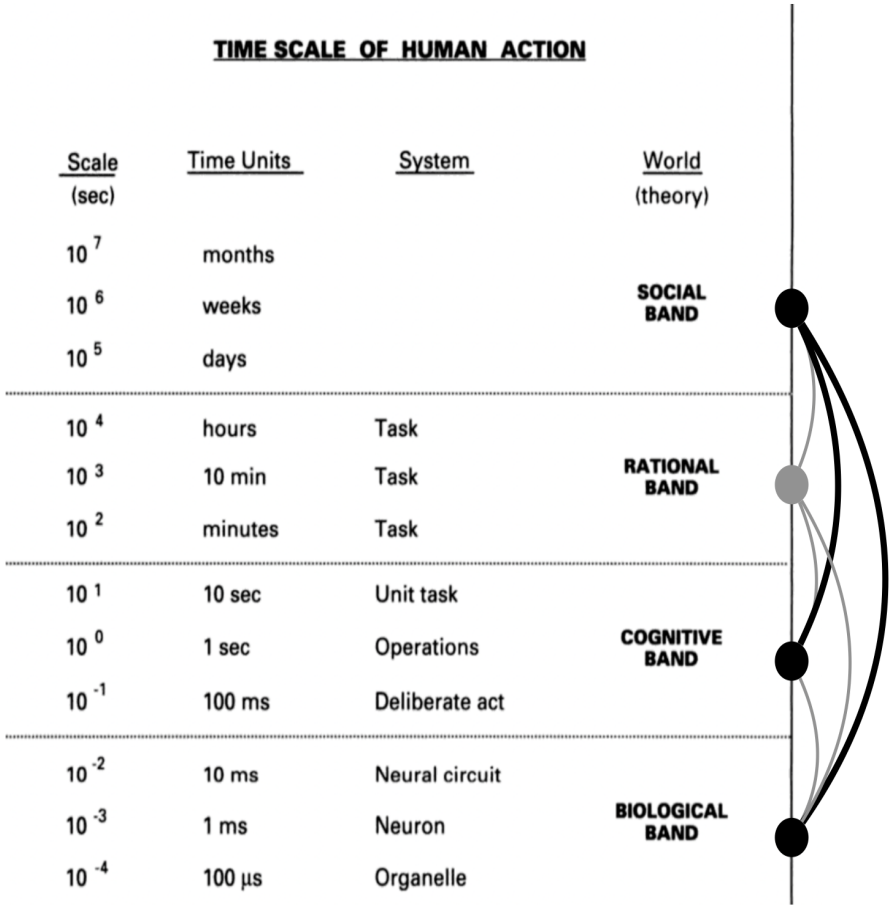

Figure 1: Adapted from Newell (1990, p. 122), multi-level bands of human action reflecting the need to integrate distinct spatial and temporal scales in our studies. His original diagram has been supplemented with lines of proposed bidirectional influence, from the social "band" to the cognitive and vice versa. The rational band is not in focus in the present paper, but many relevant papers are included in our topic space. It is grayed out, and the primary predicted relations are in thicker depicted lines of connection.

Journal	Discipline	N	Date range		N authors	Title (words)	Abstract (words)
Comm. Monographs	Comm.	703	1991	2024	2.52	13.31	136.85
Comm. Research	Comm.	991	1999	2024	2.65	14.49	142.30
Comm. Theory	Comm.	627	1994	2024	1.64	10.94	128.22
Int. J. of Comm.	Comm.	772	2021	2024	2.30	14.13	144.49
J. of Comm.	Comm.	723	2008	2024	2.83	13.27	129.28
New Media & Society	Comm.	882	2021	2024	2.57	13.78	148.18
Social Media + Society	Comm.	986	2017	2024	2.41	13.46	179.64
Comp. in Human Beh.	Bridge	976	2022	2025	3.91	15.25	198.09
Discourse Proc.	Bridge	950	1993	2024	2.50	10.52	155.74
Media Psych.	Bridge	644	2000	2024	2.90	13.81	160.68
Psych. & Marketing	Bridge	986	2017	2024	3.12	13.06	175.30
Cognition	CogSci	986	2020	2024	3.32	11.34	212.76
Cog. Psych.	CogSci	729	1994	2024	2.79	10.45	201.42
CogSci	CogSci	967	2017	2024	3.26	11.26	194.07
JEP: General	CogSci	985	2018	2024	3.59	11.79	212.56
Psych. Rev.	CogSci	933	2004	2024	2.71	10.73	187.17
Topics in CogSci	CogSci	801	2009	2024	2.48	9.63	169.19
Trends in CogSci	CogSci	829	2016	2024	2.84	7.43	98.94

Table 1: Journals and their articles included in sample

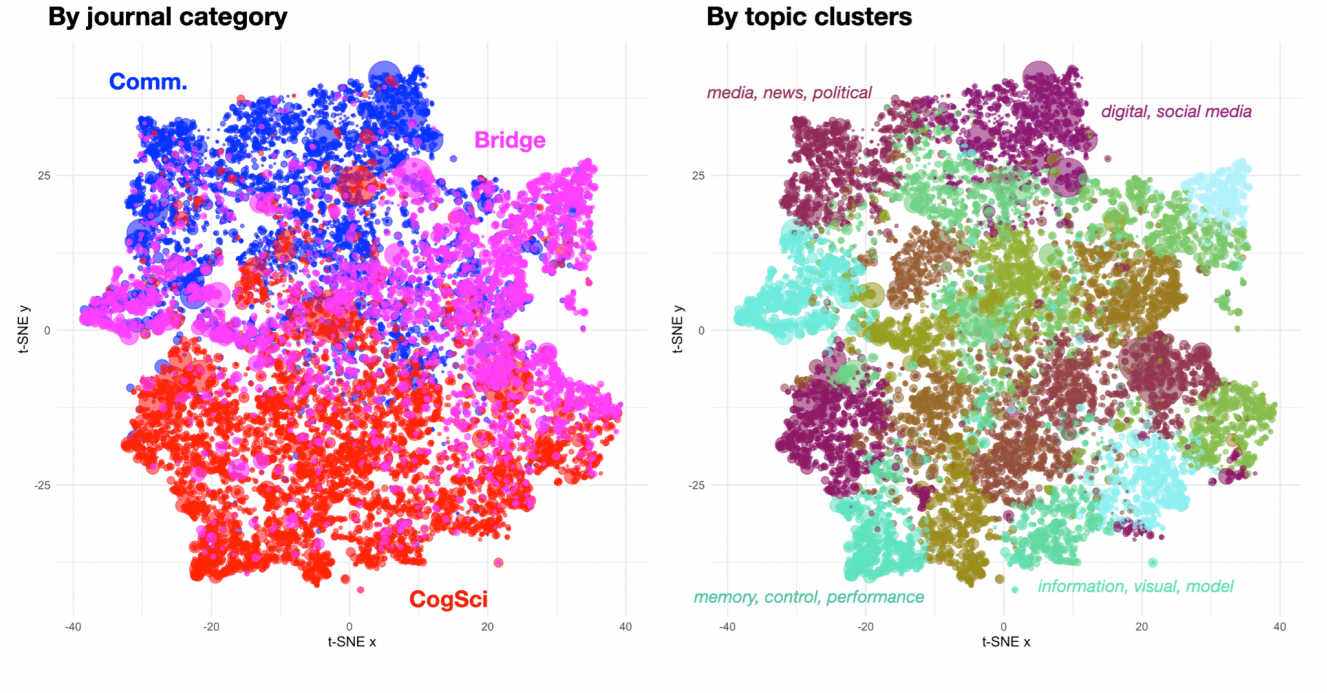

Figure 2: Topic space constructed using LDA analysis pipeline. Each of about 15,000 points is an article, and its proximity in the (x, y) plane indicates similarity in word use. Left, an illustration that the journal discipline is separated in this topic space – cognitive science is in red, communication in blue, bridge journals in purple. On the right, the same space according to topic clusters as inferred. Dot size reflects number of authors and color the topic. The words that appear central to each topic cluster are annotated for some clusters. Readers can peruse the full space in our interactive interface here, a view-only OSF link to anonymize during peer review: https://osf.io/4ng5r/?view_only=d7fefc9638e3498e9d399a62d5e48f88.

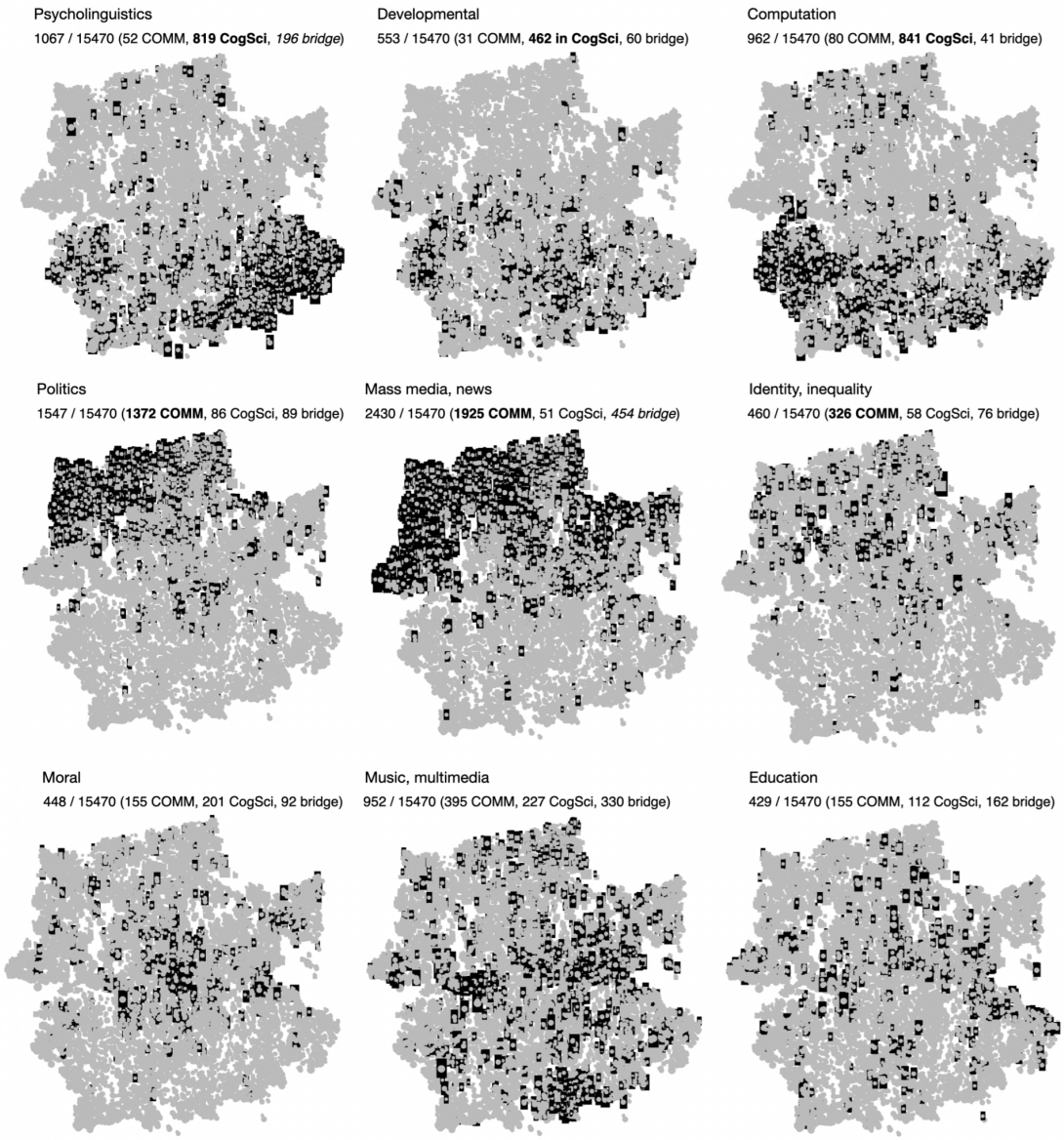

Figure 3: An illustration of the distribution of articles by topics. Top: Psycholinguistics, developmental and computation appear prominently near the bottom of our topic space, a region associated with cognitive science. Middle: Political topics, mass media and identity, inequality terms appear prominently near the top of our topic space, a region associated with communication. Bottom: Moral issues, music, multimedia and education are potential common ground for connecting disciplines. Readers can consult the interface to confirm these search results and investigate other potential topics (see Supplementary Materials).

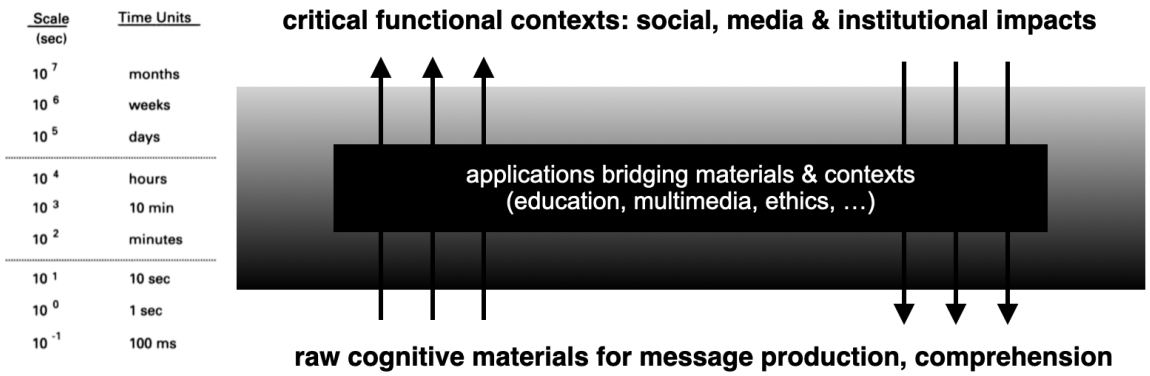

Figure 4: An adaptation of Newell inspired by the main patterns in our Analysis 2 (qualitative). Cognitive raw materials (such as psycholinguistic processes) are throughput for message production and comprehension. These cognitive materials form the basis for an emerging context that is social, media and institution based. But these contexts bidirectionally feedback and influence which of these materials we use. Between these timescales, we have potential applications that can serve as an interface between these levels of analysis, where communication and cognition may be strongly interfaced – such as assessing the educational impacts of communication strategies, how multimedia (or intermedia) is processed and so on.