Collocations and Network Structure as Insights to Functional Elements of Building Adaptive Capacity

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Introduction

Decades of field research have identified numerous characteristics and conditions, so-called "determinants," such as education, wealth, social networks, government transparency, gender, and risk-communication (Brooks et al. 2005; Smit & Wandel 2006; Tol & Yohe 2007), that affect the ability of individuals and groups to prepare for and respond to the effects of climate change. But why these particular determinants and how do they affect our capacity to adapt?

We apply methods from computational text analysis (Sinclair 1991) and network analysis (Brandes 2001; Blondel et al. 2008) to offer an innovative approach to understanding the concept of adaptive capacity. Computational analyses allow us to reveal the unconscious rhetoric of adaptive capacity that illuminates how determinants are interconnected and how they might work to build adaptive capacity. These patterns are not stated or visible in a single study but emerge from a field-wide analysis. Results depict a concept map of adaptive capacity that operationalize the academic discourse and highlights points of convergence and divergence to inform future research.

Corpus and Methods

A Web of Science search for title = "adaptive capacity", years 1800-2015, returned 448 non-duplicate English language academic articles. Based on title, journal, and abstract, we categorized papers as focused on social (e.g., community, organization, government; n=295) or non-social systems (e.g., biological, engineering; n= 153). Of 295 social papers, 261 full length texts (88%) were accessible. Most (91%) were published post-2001, when the Intergovernmental Panel on Climate Change (IPCC) first recognized adaptive capacity as a major element of vulnerability to climate change (IPCC 2001), signaling the concept's rise to the forefront of climate and sustainability research.

We used collocation analysis to develop a network of determinants that visualizes inter-connections and may be interrogated. Based on a close reading, we identified 164 determinants of adaptive capacity and 351 related terms (to account for regional spelling variations, synonyms, gerunds, etc.). Collocation analysis was used under the theory that two concepts whose terms frequently co-locate have a conceptual relationship. Collocates were identified in symmetric 15 word distance with significance of 0.01 using a Fisher's Exact Test.

Measures of network structure, such as centrality and modularity, have been found in other fields to provide insights into functionality (Krackhardt 1990; Danon et al. 2005). Collocations between determinants were visualized as a network (149 nodes, 1877 edges, network density 0.09). Both degree and betweeness centrality (Brandes 2001) were calculated. The centrality of a determinant may provide insight as to its role and sphere of influence. Community detection (Blondel et al., 2008), which has been shown in other cases to reveal functional groups (Danon et al. 2005), was performed 10 times each at three resolutions (0.4, 0.7, 1.1) (Lambiotte et al. 2008).

Results

Results provide substantial insight into potential roles for determinants. In many cases, results confirm expectations and establish consensus. In others, results raise new research questions and may provide an impetus to test assumptions currently held within the field. Results further suggest determinants group into hierarchical functional modules, which could provide a function-based framework to assess adaptive capacity. These patterns may also reconcile competing theories in adaptive capacity literature as to whether all determinants are critical or some may compensate for weaknesses in others (Tol & Yohe 2007).

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