Guidelines for Reporting About Network Data (GRAND)

The Guidelines for Reporting About Network Data (GRAND) are designed to facilitate clarity and transparency in network research. Although the information reported about a network will typically depend on the research question and other contextual details, these guidelines identify the minimum information that should always be reported. This document contains guidelines for all types of networks, but a custom set of guidelines for a specific type can be generated by answering a few simple questions at `https://www.grand-statement.org`. (COMING SOON, PENDING FINAL GUIDELINES).

GRAND provides reporting guidelines for many different types of network data, but some types have unique reporting guidelines. The figure below describes how GRAND classifies network data into four relatively distinct types, and the names it uses for each one: **Whole**, **Ego**, **Multimode**, or **Hypergraph**. You may use a different term (some common related terms are noted in the figure), but these color-coded terms are used to identify type-specific reporting guidelines. If guidelines are not yet provided for your type of network data, consider adapting the guidelines for the most similar type.

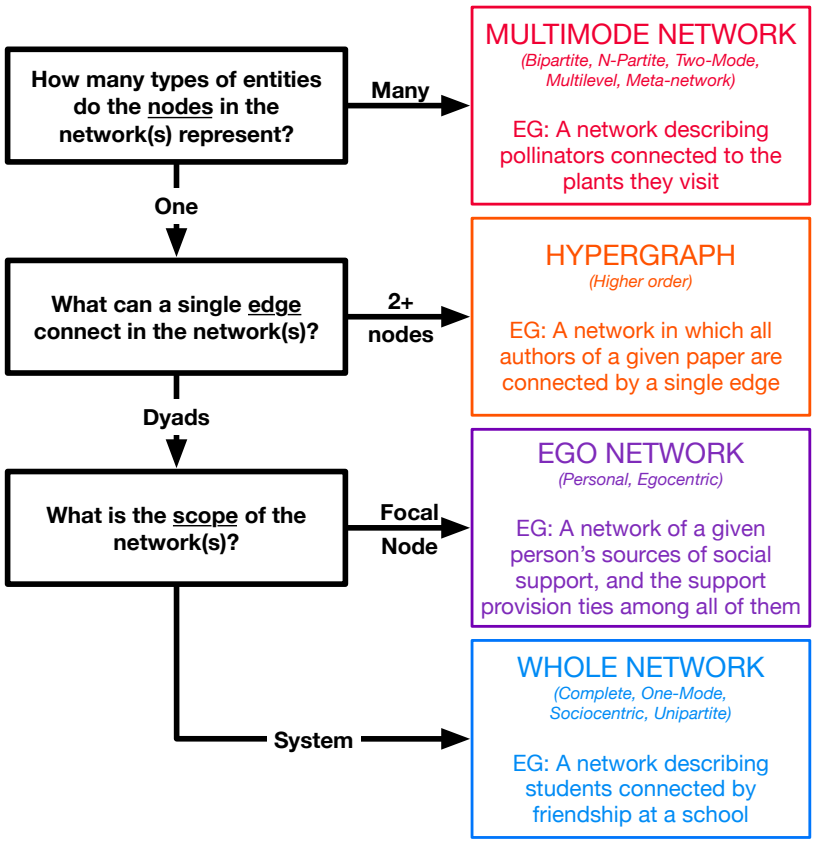
Each of these types of network data can vary in several ways:

- Edges can be directed or undirected
- Edges can be weighted, unweighted, or signed
- Edges can be multiplex or simple
- The data can describe a single static network, multiple networks representing waves over time (e.g., T1, T2), or multiple networks representing similar systems (e.g., Team 1, Team 2; Ego 1, Ego 2)

Variant-specific reporting guidelines are noted in **bold green** text.

Notes –

- Underlined terms are defined in the glossary. The glossary is provided to ensure clarity in the guidelines, however GRAND remains agnostic about terminology.
- *Italicized* guidelines are optional, but describe additional information that may often be useful to report, particularly if the network is not described in more detail elsewhere.
- If a study uses multiple types of network data (e.g., both a whole network, and ego networks), each type should be described separately.
- If a particular piece of information is unknown or unavailable, this should be reported.
- These guidelines should be used to describe the final data, after any pre-analysis transformations have been applied.



1.1 Description: Data

The items in this section are intended to provide a description of the network dataset as a whole.

Item	What to report
Type	Report the type of network(s) described by the data (e.g., Whole, Ego, Multimode, or Hypergraph)
Source	Report the source of the data: Empirical, Generated
Count	If these data contain multiple networks representing the same set of nodes at different temporal waves (e.g., Time 1, Time 2), or multiple networks that each represent the same type of system (e.g., Team 1, Team 2; Ego 1, Ego 2), report the number of waves or systems.
System	Report the system, location, and date that the data represent, at an ethically appropriate level of detail (e.g., an American high school in 2005). **Ego:** Report the population of egos, location, and dates that the data represent, at a ethically appropriate level of detail (e.g., Immigrants in New York in 2005).
Data	Report how and where to obtain the data, or why the data are not available.
Citation	*Provide a citation to a source where the data is more fully described, or that credits those who originally collected/generated the data.*

1.2 Description: Nodes

The items in this section are intended to describe the nodes in the network(s).

Item	What to report
Meaning	Report what the nodes are intended to represent using a word or phrase (e.g., students). **Multimode:** Report what each type of node is intended to represent using words or phrases (e.g., plants and pollinators). **Ego:** Report what the alter nodes are intended to represent using a word or phrase (e.g., close friends).
Count	Report the number of nodes. **Multimode:** Report the number of each type of node. **Ego:** Report the number of alters. **If network count $<$ 5:** Report the number of nodes for each wave or system separately. **If network count $\geq$ 5:** Report the range of the number of nodes across waves or systems.
Attribute	If the nodes have non-structural attributes (e.g., demographic characteristics), report which node attributes are available. *Describe how the attributes were measured, and provide sample descriptive statistics for each.*

1.3 Description: Edges

The items in this section are intended to describe the edges in the network(s).

Item	What to report
Direction	Report whether the edges are directed or undirected.
Weight	Report whether the edges are weighted, unweighted, or signed.
Multiplexity	Report whether the edges are multiplex or simple.
Structural	If the network contains structural edges, report their presence and meaning.
Meaning	Report what the edges are intended to represent using a word or phrase (e.g., friendship). **Multimode:** Report what each type of edge is intended to represent using words or phrases (e.g., pollination), and the types of nodes that each type of edge can connect (e.g., a pollination edge connects a plant node and a pollinator node). *If edges can only exist between different-type nodes, describe the network as N-partite (e.g., bipartite). If edges can also exist between same-type nodes, describe the network as multilevel.* **If directed:** Also report the meaning of the edge direction (e.g., from sender to reciever). **If weighted:** Also report the meaning (e.g., frequency, similarity, intensity), level of measurement (e.g., ordinal, continuous), and range of weights. **If signed:** Report what the positive edges are intended to represent, and what the negative edges are intended to represent, using words or phrases (e.g., collaboration and opposition). **If multiplex:** Report what each type of edge is intended to represent using words or phrases (e.g., friendship, kinship).
Count	Report the number of edges (ignore weights, count directed edges separately). **Multimode:** Report the number of each type of edge. **If multiplex:** Report the number of each type of edge. **If signed:** Report the number of positive edges and the number of negative edges. **If network count $<$ 5:** Report the number of edges for each wave or system separately. **If network count $\geq$ 5:** Report the range of the number of edges across waves or systems.

2.1 Data: Procedure

The items in this section are intended to explain how the network data were obtained.

Item	What to report
Method	**If empirical:** Report the method used to collect the data using a word or phrase (e.g., survey, interview, observation, archival). *Provide a detailed description of the data collection methods, including (as applicable): how the network was bounded, how participants were recruited, the modality and procedures of data collection, and the exact wording of the question(s) used to collect data.* **If generated:** Report the name and citation of the data generating model (e.g., `sample_smallworld()` in `igraph v2.1.4`) and the values of the function parameters. *Provide a detailed description of the data generating model, including its theoretical foundation and the role of each parameter.*
Ethics	**If empirical:** Report whether the data collection received institutional or ethical approval, and if so, the approving entity and approval date. *Provide a detailed description of any approvals, procedures for obtaining informed consent, potential risks, and data security practices such as deidentification.*

2.2 Data: Limitations

The items in this section are intended to describe limitations of the data collection or generation process that could introduce error, bias, or distortion.

Item	What to report
Degree	If a node's minimum or maximum degree is constrained by the data collection or generation design, report the restriction(s) on degree (e.g., respondents could name up to 5 contacts).
Nodes	If the network has a well-defined boundary, report the percent or number of missing nodes. If the network does not have a well-defined boundary, report that it is unbounded. **Multimode:** If the network has a well-defined boundary, report the percent or number of each type of missing node. **Ego:** Not applicable **If network count $<$ 5:** Report the percent or number of missing nodes for each wave or system separately. **If network count $\geq$ 5:** Report the range of the percent of number of missing nodes across waves or systems.

2.3 Data: Transformation

The items in this section are intended to describe transformations that were performed on the raw data to obtain the final analytic data.

Item	What to report
Symmetrizing	If directed edges were transformed into undirected edges, report the transformation method (e.g., confirmed edges, unconfirmed edges), and the percent of connected dyads that had non-reciprocal edges before the transformation. *Provide a detailed description of the transformation method.*
Binarizing	If weighted edges were transformed into unweighted edges, report the transformation method (e.g., threshold, backbone model), and the percent of edges that were deleted as a result of the transformation. *Provide a detailed description of the transformation method.*
Projecting	If the network was generated from two-mode or non-network data such that edges represent similarities, co-occurrences, or statistical associations, report the transformation method (e.g., projection, gaussian graphical model). *Provide a detailed description of the transformation method.*
Excluding	If any nodes have been excluded from the network (e.g., isolates, smaller components), report the exclusion criteria and number of nodes that were removed. *Provide a detailed rationale for the exclusion of these nodes, and the analytic implications of their exclusion.*
Imputing	If any missing nodes or edges have been imputed, report the imputation method, and the percent of nodes or edges in the network that were imputed. *Provide a detailed description of the imputation method.*

3 Structure

The items in this section report basic structural properties of the network. It is intentionally brief because the relevance of most structural properties depends on the research question or analysis.

Item	What to report
Connected	Report whether the network is connected or unconnected. **Ego:** Not applicable **If directed:** Report whether the network is strongly connected, weakly connected, or unconnected. **If multiplex:** Report the number of types of edge for which the network is connected. **If network count $>$ 1:** Report the number of waves or systems in which the network is connected.
Connectivity	Report either the edge density or mean degree (ignore weights). **Multimode:** Report the mean degree for each type of node and each type of edge (ignore weights). **Hypergraph:** Report the mean degree for nodes and the mean size for edges (ignore weights). **Ego:** Also report whether this value is computed with or without ego. **If multiplex:** Report the edge density or mean degree for each type of edge. **If signed:** Report edge density or mean degree separately for positive and negative edges. **If network count $<$ 5:** Report the edge density or mean degree for each wave or system separately. **If network count $\geq$ 5:** Report the range of the edge density or mean degree across waves or systems.

Glossary

Multiple terms often exist for a single network concept. For clarity, this glossary defines the terms as they are used in GRAND. However, GRAND remains agnostic about which term to use when synonyms exist.

Term (*possible synonyms*)	**Definition**
Alter	In an ego network, the alters are the non-ego nodes in the network. Typically they are the individuals identified by ego in response to a name generator. By definition, they are connected to ego, but may or may not be connected to each other.
Boundary	The boundary of a network defines which nodes are part of the system the network is intended to represent, and which are not. The number of nodes missing from a network is only known when a network's boundary is known.
Connected	A network is connected if there exists a path between every pair of nodes, and otherwise is unconnected. A directed network is weakly-connected if there exists a path between every pair of nodes *when ignoring edge direction*, and is strongly connected if such paths exist *when obeying edge direction*.
Edge (*link, tie, arc, connection, relationship*)	The relationships that connect nodes in a network, and whose arrangement gives a network its structure.
Edge density (*Density*)	Number of present edges divided by the number of possible edges, counting each present/possible directed edge separately.
Ego	In an ego network, ego is the focal respondent who provides the data and to whom all other network members are connected.
Empirical	Data that are derived from the real world, directly or indirectly.
Generated	Data that are produced by a model or simulation.
Mean degree	Average degree over all nodes in a network, including any isolates.
Multiplex	A network contains multiplex edges if a single dyad can be connected by more than one type of edge (e.g., two people connected by kinship *and* friendship).
Network	A graph where the nodes and edges are intended to represent something, and are not solely an abstract mathematical object.
Node (*vertex*)	The entities whose relationships are captured by a network.
Isolate	A node with degree of zero.
Structural Edges (*prohibited edges, required edges, structural zeros*)	A structural edge is an edge that either cannot exist (often called a 'structural zero'), or must exist, *in principle*. For example, in a network of students where relationships cannot form across classrooms, the absence of a relationship between two students in different classrooms can be represented by a structural zero in an adjacency matrix.