

Cognitive Representations of Social Structure in a Tongan Village

C. Cappell

G. Bennardo

Conference draft last updated 3/24/2009

(Not for Quotation without permission of the authors)

Abstract

This paper examines the correlation between measures of cognitive saliency of villagers held in memory with measures of centrality of network positions. Using data collected during extensive field work in Tonga, we show that the cognitive saliency of any villager for other villagers is correlated with centrality aspects derived from four villager networks: social support, political influence, dispute resolution influence, and daily activity patterns. Cognitive saliency measures were obtained by asking villagers to perceive associations of other villagers, to recall all villagers from memory, and to construct narratives about village life. Indegree measures across all three activities give indicators of each villager's cognitive saliency in the mental representations of other villagers. A regression analysis shows that the varying level of cognitive saliency is associated more strongly with a villager's centrality in influence and dispute resolution networks than in support networks, net of age and sex effects. The results support a conclusion that social networks are cross-represented in the mental salience of actors embedded in those networks. The findings also lend support to Bennardo's concept of 'cognitive radiality' proposed as a cognitive mental form of representation in Tongan culture that orients attention to external referential nodes rather than to oneself. We acknowledge research support from NSF # 0349011 and NSF # 0650458.

Keywords: social cognition, network centrality, mental representations of social structure.

1. Introduction

This paper examines the correlation between measures of cognitive saliency of villagers held in memory with measures of centrality of network positions. We extend Bennardo's study of the cognitive structure of several domains of Tongan knowledge and structure to include network positions. We are interested in testing hypotheses about the extent to which a villager's network position or characteristics influences the extent to which that villager has cognitive salience in the minds of other villagers. In a sense, this examines the degree of cognitive 'radiality' present in representations of village life and structure. The general thesis of 'radiality' involves the preeminence of other focal points, objects or persons, which orient mental representations – apart from using oneself as the primary reference object or point (see Bennardo 2009, 2002, 2001; Bennardo and Cappell, 2008). This radial structure appears as a characteristic in a number of Tongan mental representations: as grammatical structure, spatial and temporal representations, kinship terminology, and may be implicated in the more collective rather than individualistic social orientations.

On a more general track, our research addresses the issue of social cognition, the extent to which and processes by which awareness of others and social structure are represented in mental states. Fisk (1991) presumes that awareness of the four elemental forms of social relations: equality matching, communal sharing, authority ranking, and market pricing orient action (see especially, Ch. 9). Burt (1982) distinguished action based on structural location and awareness from that based on individualistic and normative rules.

More specifically, Krackhardt (1990) found at least one setting in which one's centrality as well as the accuracy of one's perception of the overall network correlated with one's power in that organization. In an earlier study, Krackhardt and Porter (1985) related changed levels of job satisfaction with the perceived structural relations concerning workers who left a workplace. And most recently, the dependence of cognition on social structure has been extended to emotional contagion; one's level of reported happiness is a function of the level of centrality one has in the context of happy friends (Fowler and Christakis (2008).

We examine the significance of networks, as well as ascriptive characteristics, on the cognitive saliency of Tongan villagers. During Bennardo's field work in Tonga during 2004, 2005, and 2007, he collected and elicited both complete network data on several social relations as well as information relevant to the cognitive representations of village structure and life, using both structured and semi-structured methods. In this analysis, we focus on relating network positions – measures of centrality - to the saliency villagers awarded to other villagers in other cognitive tasks, such as telling a story about the village. Our major research question involves the extent to which the more objective derived network positions from complete network data are associated with more subjective attributed indicators of 'Cognitive Saliency' possessed by each villager in his or her cognitive representations of village structure and life.

We refer the reader to Bennardo (2009) for a detailed description of the Tongan research site. We note briefly that the South Pacific village is on one of several islands comprising the archipelago Kingdom of Tonga. Bennardo has studied this small village (172 residents, 95 adults over age 18) for more than 15 years. The small size made feasible the collection of complete network data for several relations.

We next describe the data collected and then formulate the substantive hypotheses examined in this paper. One can refer to the Appendix for a table showing all of the design and data collection efforts related to this project.

2. Description of Social Networks: Support, Influence, Dispute Resolution, and Daily Interactions

All of the complete network survey information was collected in the summer of 2004. Our operationalization of social support addressed the following questions to all available adult

members in the village.

Social Support Network Questions

S1a) If you must give a fakaafe, who could you count on for help? (*show list*)

S1b) If X (*show list*) gives a fakaafe, could s/he count on your help? (*show list*)

S2a) A typhoon has damaged your house/property. Who will you ask for help to repair/fix/get place back in shape? (*show list*)

S2b) A typhoon has damaged X's (*show list*) house/property. Can s/he count on you for help to repair/fix/get place back in shape? (*show list*)

Below are the questions used to operationalize the measurement of the village influence structure.

Influence Network Questions

P1a) I have donated \$1,000.00 to spend for Houma. If you propose to buy oil for the water pump, who could you persuade to vote for/support you? (*show list*)

P1b) The town officer assigned you to prepare two polas for the next King visit. You said yes at first, but now realize that you cannot afford to prepare two, but only one. Who do you think you can persuade to support your change. (*show list*)

Related to the influence domain, we also asked two questions about dispute-resolution, namely who has the influence as a dispute mediator, separately for disputes involving kin and then non-kin.

Dispute Mediator Network Questions

P2a) You are having a dispute with a kin member about a border of a lot (or about some crop use, or about the assignment of fahu for a funeral). Who can come in and make you change your mind/convince/persuade you to compromise? (*show list*)

P2b) You are having a dispute with a non-kin member about a border of a lot (or about some crop use, or about the assignment of fahu for a funeral). Who can come in and make you change your mind/convince/persuade you to compromise? (*show list*)

The above network measures were collected in the usual survey manner, asking each villager to nominate other villagers in response to the query.

In addition, in a separate field interview and setting a year later, in 2005, villagers were asked to discuss their previous day's activities, thereby enumerating other villagers with whom they came into contact.

Daily Interaction Pattern Network (SNIO)

Tell me all of the people with whom you talked yesterday, how long did you see that person, what was the nature of the interaction, and was the interaction planned or unplanned?

All but six villagers completed the network questionnaires, thus giving us a nearly complete network graph. All of the social, influence, and dispute resolution network measures were collected during Bennardo's field research in the summer, 2004; the daily interaction data in 2005. (See the Appendix.)

In the analysis presented here, we restrict our attention to the two support network questions: S1a: whom one could count on for help in giving a fakaafe; and S2a: whom one could ask for help to make repairs due to typhoon damage. Each of these questions measures the extent of social support each villager believes is available to them. The measure of indegree on these questions indicates one measure of centrality: as a source of support, possessed by each villager in the collective representations of the entire village. The outdegree indicates the extent of social capital each villager possesses, i.e., the extent to which the villager has social support in the village.

We also restrict our attention to two influence questions: P1a: who one could influence to vote in a particular way; and P1b: who one could influence to support a change in plans for *polas* for the

next King visit. In these questions, the outdegree of a villager indicates the degree of aggregate influence the villager has over other villagers; and the indegree indicates the salience each villager has as a political ally.

The third network relation questions used relates to dispute resolution influence: P2a: influence to settle a dispute with a kin villager; and P2b: influence to settle dispute with a non-kin villager.

In addition to the indegree and outdegree measures of centrality on these network relations, we also computed the betweenness measure of centrality for each network relation. The betweenness measure indicates the importance or salience of a villager as a bridge to other villagers.

We also examine the network centrality derived from recalled daily pattern interviews conducted with villagers. In this design, villagers were asked to reconstruct a previous day's activity, and their network relations were coded. The indegree from these networks indicates the centrality each villager has in the Daily Interaction patterns of village life.

3. Cognitive Saliency

In addition to the complete network measures obtained by asking villagers to nominate members of their network, Cappell and Bennardo designed additional procedures to collect information about the saliency of villagers in the cognitive structure. Two of these tasks (memory and narrative) were administered at separate times under separate conditions during Bennardo's field research a year after (2005) the social network data were collected (2004).

Interview Protocol

In 2004, an interview was conducted in which each villager was instructed to organize the villagers into groups with whom each of the villagers were routinely affiliated. The total number of times a villager was mentioned as a member of a group was coded and used as an indicator of Cognitive Saliency. The total indegree, i.e. nominations, of how often other villagers were listed as part of interactions with others produced a measure of 'Interview Saliency'.

Memory Protocol

In 2005, villagers were asked to list (without form) the members of the village by name. The order in which members were retrieved from memory was recorded as well as whether the villager was remembered. In this analysis, we use the simple number of times a villager was remembered by other villagers.

The indegree for each villager's nominations on the list measured 'Memory Saliency'. We take this to indicate the extent to which a villager is prominent in the memory of other villagers and is used in memory tasks to recall other members.

Narrative Protocol

In 2005, we asked each villager to construct a story about the village, something that could describe village life. Instructions were left vague to give the villager an opportunity to construct nearly any type of narrative about life in the village. We take the number of times a villager appears in these stories as an indicator of that villager's 'Narrative Saliency'. High frequencies indicate a villager who more likely serves as a 'referential node' in village life, one who is more central to describing and interpreting the cognitive structures the villagers have of their social environment.

Cognitive Saliency

We use the concept of Cognitive Saliency to refer to the set of interview, memory, and narrative saliency measures.

Referential Nodes

Measures of Cognitive Saliency are associated with each villager, each node in the network. In our discussion to follow, we will use the concept of a 'referential node' to capture the idea that

villagers can have different salience in organizing these cognitive representations of village structure and life. To the extent a villager uses other villagers, not oneself, as the major referential nodes in depicting village structure and life, we think we have some evidence of 'radiality' in the social cognition of villagers. Reference points apart from oneself are used to orient the cognitive representations of the village.

The overall frequency with which villagers were mentioned in the 3 tasks gives some indication of the extent to which each villager has salience as a referential node in the cognitive scheme of the informant. The frequency of mentions elicited by each protocol indicates the salience or primacy of that villager in the aggregated representations of the village structure. The variety of tasks used to collect measures of 'Cognitive Saliency' should increase the reliability of our findings; some tasks were structured, e.g. memory listing of villagers, while another was unstructured, the narrative task.

4. Hypotheses Regarding Cognitive Salience

We hypothesize that the derived network centrality of a villager, as measured by the indegree, outdegree, and betweenness, in reported social, influence, and dispute resolution networks will be correlated with the other measures of Cognitive Saliency for each villager collected through the interview, memory task, and narrative construction protocols. In an explanatory mode, we hypothesize that level of Cognitive Saliency attributed to a villager will be a function of the derived network centrality of the villager, controlling for other personal characteristics such as age, sex, income, and official village status.

We posit a construct – the referential node – corresponding to the idea that a villager (a node in the cognitive network representing village structure) serves as a variable anchor or orienting point. Thus our hypotheses tests to what extent derived network centrality generates (or more meekly, is correlated with) the level at which a villager serves as a 'referential node' in the collective cognitive representations of the village.

The models below examine whether the extent to which a villager possesses Cognitive Saliency as a Referential Node in the cognitive representation of village life and structure can be explained by their derived network centrality in social support, influence, and dispute resolution networks.

5. Correlation of Network Centrality Measures

Table 1 below gives the simple correlations between the pairs of indegree and outdegree for the six network questions. We leave out the set of correlations with betweenness measures.

Table 1: Correlations of Indegree and Outdegree Measures of Social and Influence Structure

	S1a ID	S1a OD	S2a ID	S2a OD	P1a ID	P1a OD	P1b ID	P1b OD	P2a ID	P2a OD	P2b ID	P2b OD
S1a-ID	1.00											
S1a-OD	0.09	1.00										
S2a-ID	0.71*	0.17	1.00									
S2a-OD	0.02	0.56*	-0.07	1.00								
P1a-ID	0.61*	0.13	0.46*	0.05	1.00							
P1a-OD	0.46*	0.13	0.48*	-0.20	0.30*	1.00						
P1b-ID	-0.03	0.09	0.01	0.08	0.10	0.03	1.00					
P1b-OD	-0.19	0.04	-0.18	0.12	-0.29*	-0.29*	0.26*	1.00				
P2a-ID	0.28*	-0.00	0.34*	-0.17	0.58*	0.20	-0.07	-0.23*	1.00			
P2a-OD	0.17	0.01	0.43*	-0.19	0.18	0.25*	0.01	-0.13	0.10	1.00		
P2b-ID	0.30*	-0.06	0.39*	-0.20	0.51*	0.25*	-0.03	-0.20	0.88*	0.21	1.00	
P2b-OD	0.21	0.11	0.38*	-0.10	0.16	0.33*	0.02	-0.19	0.16	0.78*	0.24	1.00

*Indicates significance level is $\leq .05$; significant correlations also in bold face font.

We can see that structural location, centrality, is variably correlated across the different relations

and measures. Indegree measures for the various relations are correlated around an average of .34. The highest correlation occurs between the indegree of kin and non-kin dispute resolution nominations. Since these measures are nearly redundant, in further analysis, we will focus on non-kin dispute resolution centrality.

6. Correlation of Cognitive Saliency Measures

Table 2 presents the correlations of the three measures of cognitive saliency of each villager in the minds of fellow villagers. These measures are derived from three tasks designed to elicit the cognitive images villagers have of their village social structure. We were particularly interested to be able to discriminate among villagers along a dimension we term 'cognitive saliency'. The more prominent a villager appears along this measure, the more likely that villager is able to serve as a 'referential node' in the village, aggregating across all villagers. High 'saliency' makes it more likely that such a villager can serve as a locus for a radial network structure. Hence, three tasks/interviews were conducted to tap the memory and cognitive structure to elicit these measures.

Interview regarding group structure: First, an interview was conducted in which each villager was instructed to organize the villagers into groups with whom each of the villagers were routinely affiliated. The total number of times a villager was mentioned as a member of a group was coded and used as an indicator of cognitive saliency.

Memory listing: Villagers were asked to list the members of the village by name. The order in which members were retrieved from memory was recorded as well as whether the villager was recorded. In this analysis, we use the simple number of times a villager was remembered by other villagers.

Narrative Construction: We asked each villager to construct a story about the village, something that could describe village life. Instructions were left vague to give the villager an opportunity to construct nearly any type of narrative about life in the village. We take the number of times a villager appears in these stories as an indicator of that villager's saliency. High frequencies indicate a villager who more likely serves as a 'referential node' in village life, one who is more central to describing and interpreting the cognitive structures the villagers have of their social environment.

Two of these measures (memory and narrative) were obtained during the summer, 2005, one year after the measures obtained about the complete network structure of social support, influence, and dispute resolution. The third set of data (interviews) were obtained in 2004.

Table 2: Correlations of Villager Cognitive Saliency

	Interview re Groups	Memory Listing	Narrative
Interview re Groups	1.00		
Memory Listing	0.34	1.00	
Narrative	0.61	0.37	1.00

Note: all correlations are significantly different from zero at p-values <.001.

These correlations indicate that there is significant overlap in the level of a villager's saliency elicited from the different techniques. But we note that at most two measures apparently share about 36% of their variance (memory listing and narrative), and that therefore it is advisable to study all three indicators of cognitive saliency. The correlations among these dependent variables indicate the possibility of 'seemingly unrelated' regression bias, so alternative specifications, simultaneous equations with correlated error, will be considered in the regression analysis discussed later.

7. Correlation of Derived Network Centrality and Cognitive Saliency

One of the guiding research questions behind the network portion of the study of this Tongan village examines the extent to which measures of centrality in the social and influence networks correlate with more direct measures of the level of saliency and centrality villagers have in the minds of other villagers. If actual measures of network centrality derived from social network analysis questions about the relationships of support and influence are positively correlated with the prominence of villagers as measured by tasks evoking the cognitive image villagers have of the village, some additional support is obtained for the 'radial' cultural model organizing Tongan cognitive structures. Villagers' mental images of village life are anchored by referential nodes in their cognitive structure that correspond to their centrality in the network structure.

To test this broad research question, we first generated the correlations between the network derived measures of social support, influence, and dispute resolution centrality with the saliency of the villager evoked through three cognitive protocols: an interview regarding group structure that coded the villagers that were mentioned; a memory task that asked the villagers to list other members of the village; and a series of narrative protocols that asked villagers to generate a story (narrative) that describes some aspect of village life. The overall frequency with which villagers are mentioned in the 3 protocols gives some indication of the extent to which each villager is a referential node in the cognitive scheme of the informant. The results are presented in Tables 3 and 4.

When we inspect the bivariate correlations between all of our Cognitive Saliency measures and the derived network centrality measures in Table 3, we note first that no measures of outdegree centrality are associated with Cognitive Saliency; only several indegree measures show an association with Cognitive Saliency. The more a villager is nominated by others in influence and dispute resolution relations, the more cognitive saliency they have.

Social support centrality, for the most part, is uncorrelated with Cognitive Saliency, except for the association between the centrality derived from the 'asking for repairs' relation and Narrative Saliency. This undermines our main, general hypothesis. We find the most support for our general research hypothesis in the correlations between dispute resolution centrality and Cognitive Saliency. Being nominated as someone who can be influenced to vote in a certain way also is correlated with Cognitive Saliency, but outdegree voting influence is not associated with Cognitive Saliency. The only social support measure of centrality associated with any Cognitive Saliency measure is the modest (.23) correlation between being a resource for helping with repairs and Narrative Saliency.

The level of Daily Interaction indegree is associated with Memory and Narrative Saliency to some degree. Thus, the association between a wide range of centrality measures and Cognitive Saliency is not uniformly large. Indegree nominations are more important than outdegree nominations; and social support centrality seems less important than dispute resolution centrality in the generation of Cognitive Saliency.

|

Table 3: Correlations of Cognitive Saliency with Support, Influence, and Dispute Degree Measures.

	Interview	Memory	Narrative
InDegree_SNS1a	0.1292	0.17237	0.14955
(Ask help <i>fakaafe</i>)	0.233 (87)	0.1104 (87)	0.1668 (87)
OutDegree_SNS1a	-0.11401	0.06693	0.00328
(Ask help <i>fakaafe</i>)	0.2931 (87)	0.5379 (87)	0.9760 (87)
InDegree_SNS2a	0.10256	0.12349	0.23213
(Ask help repairs)	0.3445 (87)	0.2545 (87)	0.0305 (87)
OutDegree_SNS2a	-0.15578	0.06334	0.00247
(Ask help repairs)	0.1496 (87)	0.5600 (87)	0.9819 (87)
InDegree_SNP1a	0.32171	0.33563	0.27398
(Voting Influence)	0.0021 (89)	0.0013 (89)	0.0094 (89)
OutDegree_SNP1a	0.07359	0.06767	0.05463
(Voting Influence)	0.4931 (89)	0.5287 (89)	0.6111 (89)
InDegree_SNP1b	-0.04642	0.00397	0.00145
(Influence Decision)	0.6658 (89)	0.9705 (89)	0.9892 (89)
OutDegree_SNP1b	-0.14353	-0.02799	-0.05002
(Influence Decision)	0.1797 (89)	0.7946 (89)	0.6416 (89)
InDegree_SNP2a	0.69344	0.31116	0.61015
(Kin Dispute Mediator)	<.0001 (89)	0.0030 (89)	<.0001 (89)
OutDegree_SNP2a	0.01759	0.18091	0.08118
(Kin Dispute Mediator)	0.8701 (89)	0.0898 (89)	0.08118 (89)
InDegree_SNP2b	0.77161	0.34190	0.62760
(Non-Kin Dispute Mediator)	<.0001 (89)	0.0010 (89)	<.0001 (89)
OutDegree_SNP2b	0.10893	0.07702	0.04460
(Non-Kin Dispute Mediator)	0.3096 (89)	0.4731 (89)	0.6782 (89)
Daily Interaction - Indegree	-0.01428	0.22078	0.18964
	0.8907 (95)	0.0316 (95)	0.0657 (95)

Note: entries are row 1: Pearson correlation, row 2: p-value for H_0 that $\rho=0$ and (analytical sample size). Daily Interaction measures the indegree obtained from a query regarding with whom the villager interacted in the previous day.

Table 4: Correlations of Cognitive Saliency with Support, Influence, and Dispute Normed Betweenness Scores

	Interview	Memory	Narrative
nBetweeness_sns1a	0.05957	0.24771	0.11294
(Ask help <i>fakaafe</i>)	0.5837 (87)	0.0207(87)	0.2976(87)
nBetweeness_sns2a	-0.09144	0.18504	0.05937
(Ask help repairs)	0.3996 (87)	0.0862 (87)	0.5849 (87)
nBetwnSNP1a	0.04749	0.10555	-0.03147
(Voting Influence)	0.6585 (89)	0.3249 (89)	0.7697 (89)
nBetwnSNP1b	0.11251	0.04093	0.08046
(Influence Decision)	0.2938 (89)	0.7033 (89)	0.4535 (89)
nBetwnSNP2a	0.40377	0.30296	0.29230
(Kin Dispute Mediator)	<.0001 (89)	0.0039 (89)	0.0054 (89)
nBetwnSNP2b	0.40293	0.11528	0.24914
(Non-Kin-Dispute Mediator)	<.0001 (89)	0.2820 (89)	0.0186 (89)

Note: entries are row 1: Pearson correlation, row 2: p-value for H_0 that $\rho=0$, and (analytical sample size).

We note interestingly that the Cognitive Saliency measures are correlated fairly consistently with the betweenness measure for the dispute resolution centrality (see Table 4). This is consistent with the notion of the betweenness measure of centrality, as bridge between otherwise isolated or less connected portions of a network. It is also consistent with the interpretation that in the context of dispute resolution, a villager's betweenness centrality is aligned with the cognitive saliency that villager has in the minds of fellow villagers. In the subsequent analysis, we focus only on the centrality measures of indegree and outdegree, more direct operationalizations of centrality, and their role as explanations of cognitive saliency.

8. Regression Analysis of Cognitive Saliency on Network Centrality

In order to adjust for overlapping sources of variation, we regressed each measure of cognitive saliency on the set of network centrality measures. Since the saliency measures are correlated, we estimated 'seemingly unrelated regression' models to adjust the standard errors for these correlations (see below, Table 7).

These regression models explicitly test for the affect that network positions, measured a year earlier during the previous year's field work, have on the Cognitive Saliency of a villager in the mental representations of other villagers. The models examine whether the extent to which a villager possesses Cognitive Saliency as a 'Referential Node' in the cognitive representation of village life and structure can be explained by their network centrality as measured by both indegree and outdegree across the different relations.

The most robust indicators of Cognitive Saliency in Table 5 are the dispute resolution based measures of centrality and the Daily Interaction centrality measures. Substantial portions of Cognitive Saliency are explained by network centrality measures. The greatest overlap is between the explanatory power of non-kin dispute resolution centrality and Interview Saliency ($b = .83$; $R^2 = .66$).

Table 5: OLS Regression Results Predicting Cognitive Saliency

Centrality Measure	Interview		Memory		Narrative	
	<i>b</i>	P-value	<i>b</i>	P-value	<i>b</i>	P-value
InDegree_SNS1a - Ask help <i>fakaafe</i>	0.10187	0.4249	-0.00082	0.9966	-0.03746	0.8097
OutDegree_SNS1a - Ask help <i>fakaafe</i>	-0.01690	0.8535	0.03317	0.8082	-0.05568	0.6187
InDegree_SNS2a - Ask help repairs	-0.20594	0.0980	-0.14533	0.4306	0.13282	0.3789
OutDegree_SNS2a - Ask help repairs	-0.02318	0.8093	-0.02479	0.8627	0.10486	0.3724
InDegree_SNP1a - Voting Influence	-0.07426	0.5229	0.29557	0.0912	-0.13563	0.3402
OutDegree_SNP1a - Voting Influence	-0.09096	0.3122	0.01437	0.9145	-0.02465	0.8219
InDegree_SNP1b - Influence decision	-0.00108	0.9886	-0.02783	0.8058	0.05065	0.5847
OutDegree_SNP1b - Influence decision	-0.01494	0.8524	0.08408	0.4836	0.00851	0.9308
InDegree_SNP2a - Kin dispute med.	0.06276	0.7129	-0.02455	0.9232	0.38473	0.0679
OutDegree_SNP2a - Kin dispute med.	-0.10872	0.4101	0.31230	0.1152	0.10806	0.5023
InDegree_SNP2b - Nonkin dispute med.	0.82789	<.0001	0.26803	0.2614	0.38048	0.0534
OutDegree_SNP2b-Nonkin dispute med.	0.07894	0.5135	-0.20721	0.2520	-0.18231	0.2183
Tot_Indeg_SNIO_Daily Interaction	0.01521	0.8484	0.16639	0.1642	0.20427	0.0385
R ²	.66		.24		.49	

b is the standardized beta.

We find little support for our hypothesis that social support centrality affects Cognitive Saliency, the only substantial effect is from Repair Support on Interview Saliency and it is a negative effect, reflecting a compensatory adjustment from the effect of non-kin dispute resolution. Memory Saliency seems conditioned upon the indegree of being influenceable about voting, the outdegree of kin based dispute resolution (inexplicably), and Daily Interaction indegree. Kin and non-kin based dispute resolution centrality along with Daily Interaction centrality affect Narrative Saliency ($R^2 = .49$). With so many insignificant, collinear independent variables, we need to trim the models and estimate more robust standard errors to verify our findings. The results from these simplified and more robust models are presented in Tables 6 and 7.

Table 6: Summary Table of Significant Standardized Regression Coefficients of Cognitive Saliency Regressed on Support, Influence, and Dispute Centrality (Degree) Measures (Trimmed Models).

	Interview		Memory		Narrative	
	r	b	r	b	r	b
InDegree_SNS1a (Ask help <i>fakaafe</i>)						
OutDegree_SNS1a (Ask help <i>fakaafe</i>)						
InDegree_SNS2a (Ask help repairs)	0.10256	-0.20616*			0.23213	0.06659
OutDegree_SNS2a (Ask help repairs)						
InDegree_SNP1a (Voting Influence)	0.32171	-0.04868	0.33563	0.23163*	0.27398	-0.11988
OutDegree_SNP1a (Voting Influence)						
InDegree_SNP1b (Influence Decision)						
OutDegree_SNP1b (Influence Decision)						
InDegree_SNP2a (Kin Dispute Mediator)	0.69344	0.08007	0.31116	-0.04966	0.61015	0.35630*
OutDegree_SNP2a (Kin Dispute Mediator)			0.18091	0.07665		
InDegree_SNP2b (Non-Kin Dispute Mediator)	0.77161	0.81081*	0.34190	0.26967	0.62760	0.36647*
OutDegree_SNP2b (Non-Kin Dispute Mediator)						
Daily Interaction - Indegree			0.22078	0.21071*	0.18964	0.23472*
R^2		.65		.21		.47

Note: * indicates coefficient significant at a level $\leq .05$.

Since we are analyzing three indicators of Cognitive Saliency elicited by different protocols and that we observed a correlation of these indicators, the appropriate method of regression analysis requires that one take into account the correlation of the error terms across equations. This is achieved by using a generalized least squares approach that adjusts the coefficient estimates and their standard errors appropriately due to any remaining correlation of the residuals across equations, a method termed – seemingly unrelated regression. We also deleted one source of collinearity discovered in the earlier analysis between kin and non-kin dispute centrality. Since the centrality of non-kin dispute resolvers was more robust, we retained that measure and deleted the centrality measure for kin-dispute centrality in any models where it had previously appeared. These results are presented in Table 7.

Table 7: Summary Table of Significant SUR Metric Regression Coefficients of Cognitive Saliency Regressed on Support, Influence, and Dispute Centrality (Degree) Measures (Trimmed Models with Age and Gender).

	Interview		Memory		Narrative	
	b	p-value	b	p-value	b	p-value
InDegree_SNS1a (Ask help fakaafe)						
OutDegree_SNS1a (Ask help fakaafe)						
InDegree_SNS2a (Ask help repairs)	-.05748	.050			.05277	.078
OutDegree_SNS2a (Ask help repairs)						
InDegree_SNP1a (Voting Influence)	.04329	.399	.73959	.018	.01966	.700
OutDegree_SNP1a (Voting Influence)						
InDegree_SNP1b (Influence Decision)						
OutDegree_SNP1b (Influence Decision)						
InDegree_SNP2a (Kin Dispute Mediator)						
OutDegree_SNP2a (Kin Dispute Mediator)			.08929	.110		
InDegree_SNP2b (Non-Kin Dispute Mediator)	.21992	<.000	.09897	.663	.09105	.015
OutDegree_SNP2b (Non-Kin Dispute Mediator)						
Daily Interaction – Indegree			.23869	.041	.06316	.001
Age	.05720	<.001	.13830	.139	.05240	.001
Sex (F=0; M=1)	1.4192	<.001	-2.50702	.288	.38014	.317
R ²		.73		.24		.51
Residual Correlations	Interview		Memory		Narrative	
Interview						
Memory	.21					
Narrative	.18		.16			

Note: Daily Interaction measures the indegree obtained from a query regarding with whom the villager interacted in the previous day. R^2 is the GLS based percent of variance explained by the model. The residuals for Interview and Narrative are normally distributed, but the residual for Memory does violate the assumption, it has a modest kurtosis reflecting an overconcentration of values tightly clustered around zero.

In addition to age and gender, the above basic models shown in Table 7 were respecified adding

several additional respondent characteristics, namely the villager's income, the size of the *kainga* in which the villager was affiliated, and whether the villager was a notable, i.e. the chief, village officer, etc. None of these characteristics of a villager were significant, indicating that these characteristics played minimal roles in allocating cognitive saliency in the minds of other villagers. Referential node status was not determined by these individual characteristics.

The villager's age is a fairly consistent predictor of the cognitive saliency that villager has in the cognitive representations of village life in the minds of other villagers. Age also mediates some of the previously significant network centrality measures influences on cognitive saliency. We note in particular that the effect of centrality as a dispute settler is rendered insignificant by age. Clearly, the association of age and centrality as a dispute settler are at play in the cognitive representations, and it is futile to assign causal priority to either. The veneration awarded elders in the Tongan village is manifested in their status as advisors and dispute resolvers and thereby enhancing their cognitive saliency. Gender only plays a part in the interview recall protocol designed to tap memory recall.

Interview Cognitive Saliency

For the interview task used to capture the cognitive saliency of each villager in the mental model of other villagers, age, gender (males positive), and dispute resolution centrality contribute significantly to explaining the distribution of cognitive saliency. The negative coefficient for social support is an artifact of some remaining collinearity; in fact, when dispute resolution centrality is deleted from the model, the coefficient for social support becomes positive, although statistically insignificant. This anomaly aside, cognitive saliency of referential nodes as recovered in this task is related to dispute resolution centrality, apart from age and gender. Consistent with earlier results, a large percentage of the variation in cognitive saliency is captured by this model ($R^2 = .73$).

Memory Cognitive Saliency

Analysis of the free form memory task reveals that cognitive saliency can be understood as a function of the centrality with which one is perceived as being influenceable, daily interaction centrality, and to a lesser extent, age and gender (females more saliency). In this protocol, cognitive saliency was more importantly associated with daily interaction centrality and location as a villager one could influence than age and gender, although less of the variance in this indicator of cognitive saliency was explained ($R^2 = .24$).

Narrative Cognitive Saliency

Perhaps the most robust elicitation of cognitive saliency is measured by the centrality villagers have in the open-ended narratives villagers constructed about village life. This protocol did not emphasize memory tasks nor explicitly ask for villager's names or roles. We note with some satisfaction that a substantial portion of the variance ($R^2 = .51$) in the narrative saliency of villagers is explained by three network centrality indicators: influence centrality, daily interaction centrality, and dispute resolution centrality, along with age.

We summarize the consistent and non-spurious effects of individual characteristics and network positions on Cognitive Saliency in Figure 1.

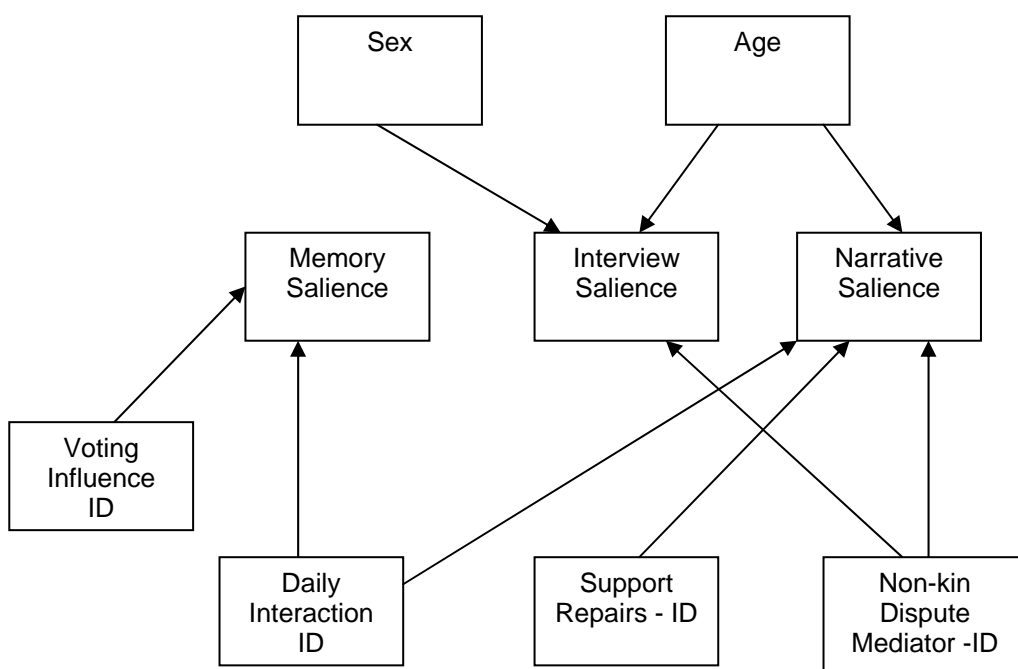


Figure 1: Network Influences on Cognitive Salience as Referential Node

9. Conclusion

These results indicate that the ‘unobservable’ network centrality properties of individual villagers derived from their overall village network position are associated with the salience each villager is awarded in the cognitive representations of other villagers as they reflect on village structure and life, even after one takes into account individual level characteristics like age, sex, official status, and income. Age increases Cognitive Salience. Sex has marginal influences, most prominently in predicting Interview Salience.

In particular, from the final results presented in Table 7, we note that daily interaction centrality is a robust predictor of Cognitive Salience, influencing both Memory and Narrative Salience. Dispute Resolution centrality influences two of the Cognitive Salience measures: Interview and Narrative Salience. The centrality of a villager in the social support network does not consistently affect the Cognitive Salience reflected in the cognitive representations of the villagers. A small positive affect of Social Support (InDegree_SNS2a: help with repairs) is found for Narrative Salience; but a slight negative affect is found for Interview Salience (likely a spurious effect).

Since these questions pertain to extensive support regarding the exchange of material and labor to repair damaged property, the centrality of villagers with regard to dependence involving these resources does apparently correlate with the cognitive salience of the villager in the cognitive scheme a villager has of the notables, or villagers who serve as referential nodes. Thus, these modest, yet non-random correlations, suggest some connection between a villager’s centrality in the social support network we uncovered and the cognitive salience of that villager.

No outdegree measures of any relation show a significant affect on Cognitive Salience. This finding indicates that only the nominations from other villagers received when queried about a variety of social relationships affect the level with which that same villager is salient as a referential node in the minds of other villagers.

While we did not include betweenness measures in the regression analysis, there is a correlation of betweenness measures and Cognitive Saliency (see Table 4). Betweenness is interpreted as a potential for mediation or influence since it highlights the bridging ability of a network member. The betweenness measures for the kin and non-kin mediation correlate significantly with the Cognitive Saliency of villagers. Thus, the referential nodes, in memory and narrative form, are those that are structurally located between other villagers, an even more subtle network attribute than indegree (for example, which could be perceived as popularity).

The consistent findings regarding the importance of dispute resolution network position suggests that these networks may be more important in allocating cognitive salience than support or other forms of influence. This brings to mind the classic anthropological studies on dispute resolution that implemented the methodology of 'trouble cases' to illicit the law-like functional equivalents used to generate dispute resolution structures and the distribution of influence and control (Llewellyn & Hoebel, 1941). Using trouble case narratives could lead to networks of influence structure more informative than the quicker network interview question used in this project.

These findings indicate that cognitive representations of networks in the mind can be invoked by different methods; and importantly that the network derived network positions are associated with attributed cognitive salience. We take these findings to be consistent with the more general thesis articulated by Bennardo's study of Tongan language and other cultural domains. The cognitive salience of a villager, i.e. the level at which a villager serves as a 'referential node' to orient representations of village life and structure, is a function of network position as much as the personal characteristics of age and sex. A form of 'radiality' is at work in the Tongan villager mind, where spontaneously generated narratives and memories are oriented around other, referential nodes.

Appendix: Data Collection Protocols

The following is a table giving a brief description of the protocol used to collect the major indicators of cognitive representations and network attributes along with the dates this information was collected.

Protocol	Date	Description
Complete Network Survey: SNI-Influence SNS-Support	July 2004 July 2004	Complete network survey on 8 different relationships (support, influence, dispute resolution) whole village whole village
Interviews about Social Relationships (SN): 'Personal' Relationships 'Perceived' Relationships 'Narrative' (Indirect) Relationships 'View from Above' Relationships	June 2002 June 2004 June 2005 July 2007	18 subjects 18 subjects 24 subjects 9 subjects
Indirect Observations (Daily Interactions - SNIO)	June 2005	Whole village
Cognitive Task1 – Memory/Free Listing	June 2005	Whole village
Cognitive Task2 – Grouping Interview	June 2005	24 subjects
Cognitive Task 3- Drawing	June 2005	24 subjects

References

- Bennardo, Giovanni. 2009. *Language, Space, and Social Relationships: A Foundational Cultural Model in Polynesia*. New York: Cambridge University Press.
- Bennardo, Giovanni. 2004. Linguistic Untranslatability vs. Conceptual Nesting of Frames of Reference. In Kenneth Forbus, Dedre Gentner, and Terry Regier. Eds. *Proceedings of the Twenty-Sixth Annual Conference of the Cognitive Science Society*. pp. 102-107. (New York: Lawrence Erlbaum).
- Bennardo, Giovanni. 2002. Map Drawing in Tonga, Polynesia: Accessing Mental Representations of Space. *Field Methods*, 14:390-417.
- Bennardo, Giovanni. 2001. A Possible Tongan Cultural Model: Radiality. Paper read at The 100th Annual Meetings of the American Anthropological Association, Washington, DC. November 28, 2001.
- Bennardo, Giovanni. 2000a. A Conceptual Analysis of Tongan Spatial Nouns: From Grammar to Mind. *Languages of the World*, 12. München, Germany: Lincom Europa.
- Bennardo, Giovanni. 2000b. Language and Space in Tonga: 'The Front of the House is Where the chief Sits!' *Anthropological Linguistics*, 42:499-544.
- Bennardo, Giovanni. 1999. The Conceptual Content of Tongan Directionals: Mental Representations of Space in Tongan. *Rongorongo Studies*, 9:39-61. Auckland, New Zealand: The Institute of Polynesian Languages and Literatures.
- Bennardo, Giovanni. 1996. *A Computational Approach to Spatial Cognition: Representing Spatial Relationships in Tongan Language and Culture*. Unpublished doctoral dissertation, University of Illinois at Urbana-Champaign, Urbana, Illinois.
- Bennardo, G. and Dwight Read. 2005. The Tongan Kinship Terminology and Culture: Insights from an Algebraic Analysis. *Mathematical Anthropology and Cultural Theory*, 2:1-51. <http://www.mathematicalanthropology.org>
- Bennardo, G., and C. Cappell. 2008. "Influence Structures in a Tongan Village: 'Every Villager is not the Same!'" *Structure and Dynamics: eJournal of Anthropological and Related Sciences*: Vol. 3: No. 1, Article 2. (2008). <http://repositories.cdlib.org/imbs/socdyn/sdeas/vol3/iss1/art2>.
- Burt, Ronald. S. 1982. *Toward a Structural Theory of Action*. New York: Academic Press.
- Fiske, Alan Page. 1991. *Structures of Social Life*. New York: The Free Press.
- Fowler, James, H. and Nicolas A. Christakis. 2008. "Dynamic spread of happiness in a large social network: Longitudinal analysis over 20 years in the Framingham Heart Study. *BMJ* 2008;337:a2338. Retrieved Dec. 5, 2008.
- Freeman, L.S., S.C. Freeman, and A.G. Michaelson. 1988. "On human social intelligence." *Journal of Social and Biological Structures* 11:415-425.
- Freeman, L.S., S.C. Freeman, and A.G. Michaelson. 1989. "How humans see social groups: A test of the Sailer-Gaulin models." *Journal of Quantitative Anthropology* 1:229-238.
- Krackhardt, D. 1987. "Cognitive social structures. *Social Networks* 9:109-134.
- Krackhardt, D. 1990. "Assessing the political landscape; Structure, cognition, and power in organizations." *Administrative Science Quarterly* 35:342-369.
- Krackhardt, D., and L.W. Porter. 1985. "When friends leave: A structural analysis of the relationship between turnover and stayers' attitudes." *Administrative Science Quarterly* 30:242-261.
- Llewellyn, Karl, N., and e. Adamson Hoebel. 1941. *The Cheyenne Way*. Norman, OK: Oklahoma University Press.
- Wasserman, Stanley, and Katherine Faust. 1994. *Social Network Analysis: Methods and Applications*. Cambridge: CUP.