Full ALAAM Models

TABLE S1. ALAAM: Depression. Full model

Effects	MPNET label	θ	SE	Sig.
Sex (F)		.40	0.21	
Age		.00	0.01	
Tertiary education		-.15	0.22	
Fear for life		.51	0.22	+
Interpersonal loss		.49	0.23	+
Property loss		.19	0.11	
Employment/financial stressors		.46	0.11	+
Other traumatic events		1.19	0.30	+
Relocation		-.76	0.38	
Tie to someone who relocated		1.42	0.56	+
Network effects				
Density (Constant)	Density	-1.52	0.52	+
Sender	SenderAttr	-.69	0.34	+
Receiver	ReceiverAttr	-.42	0.31	
Reciprocity	ReciprocityAttr	.54	0.49	
Co-occurrence	ContagionArc	.91	0.37	+
Co-occurrence X Reciprocity	ContagionReciprocity	-1.29	0.84	
Popularity effects				
Popularity	EgoIn2Srar	.16	0.45	
Popularity X co-occurrence	AlterIn2Star1	-.01	0.34	
Popularity among outcome	AlterIn2Star2	-.25	0.61	
Activity effects				
Activity	EgoOut2Srar	-.05	0.34	
Activity X co-occurrence	AlterOut2Star1	-.06	0.42	
Activity among outcome	AlterOut2Star2	-.46	0.75	
Brokerage effects				
Brokerage (broker position)	Mixed2Srar	.27	0.33	
Brokerage (broker + source positions)	Mixed2StarSource	.31	0.35	
Brokerage (broker + sink positions)	Mixed2StarSink	.03	0.39	
Brokerage (broker + source + sink positions)	Mixed2Star2	-.14	0.62	
Triangle effects				
Transitive closure (repeater position)	T1T	.34	0.82	
Transitive closure (source position)	T1D	.43	0.76	
Transitive closure (sink position)	T1U	.25	0.75	
Cyclic closure	T1C	-1.70	1.28	
Transitive closure (repeater position) X co-occurrence	T2T	-.53	1.15	
Transitive closure (source position) X co-occurrence	T2D	-.61	0.90	
Transitive closure (sink position) X co-occurrence	T2U	.10	0.90	
Cyclic closure X co-occurrence	T2C	1.29	1.26	

+ Wald ≥ 2

TABLE S2. ALAAM: PTSD. Full model

Effects	MPNET label	θ	SE	Sig.
Sex (F)		.29	.29	
Age		.00	.01	
Tertiary education		-.31	.33	
Fear for life		.77	.32	+
Interpersonal loss		.94	.30	+
Employment/financial stressors		.51	.13	+
Other traumatic events		1.17	.34	+
Relocation		-.52	.46	
Property loss		.37	.16	+
Sender X property loss (alter)		.25	.37	
Receiver X property loss (alter)		.79	.34	+
Reciprocity X property loss (alter)		-1.17	.61	
Network effects				
Density (Constant)	Density	-2.90	.82	+
Sender	SenderAttr	-1.05	.75	
Receiver	ReceiverAttr	-1.99	.75	+
Reciprocity	ReciprocityAttr	2.29	1.18	
Co-occurrence	ContagionArc	-.66	.58	
Popularity effects				
Popularity	EgoIn2Star	.06	.65	
Popularity X co-occurrence	AlterIn2Star1	.64	.41	
Popularity among outcome	AlterIn2Star2	-1.58	1.39	
Activity effects				
Activity	EgoOut2Star	-.43	.69	
Activity X co-occurrence	AlterOut2Star1	-.33	.56	
Activity among outcome	AlterOut2Star2	-9.01	23.17	
Brokerage effects				
Brokerage (broker position)	Mixed2Star	.99	.62	
Brokerage (broker + source positions)	Mixed2StarSource	-.14	.50	
Brokerage (broker + sink positions)	Mixed2StarSink	-.63	.56	
Brokerage (broker + source + sink positions)	Mixed2Star2	.08	1.77	
Triangle effects				
Transitive closure (repeater position)	T1T	-1.82	1.60	
Transitive closure (source position)	T1D	1.92	1.59	
Transitive closure (sink position)	T1U	.62	.99	
Cyclic closure	T1C	-2.99	2.14	
Transitive closure (repeater position) X co-occurrence	T2T	2.92	2.76	
Transitive closure (sink position) X co-occurrence	T2U	.81	2.58	

+ Wald ≥ 2

The following effects were not specified in the ALAAM for depression because the configuration was not observed within the dataset: Cyclic closure among outcome (T3C), Transitive closure among outcome (T3T). The following effects were not specified in the ALAAM for PTSD because the configuration was not observed within the dataset: Co-occurrence X reciprocity (ContagionReciprocity), Transitive closure (source position) X co-occurrence (T2D), Cyclic closure X co-occurrence (T2C), cyclic closure among outcome (T3C), Transitive closure among outcome (T3T). Both models demonstrated excellent goodness of fit.

Representativeness Analysis

In conventional epidemiological research, in order to ascertain the generalizability of results, it is necessary that the sample is representative of the wider population of interest on the basis of various attributes, such as gender and age. Random sampling techniques are used to obtain a representative sample, although in practice in community-based research, samples may still be biased depending on the response rate of particular groups within the community (e.g. it is often difficult to get a high proportion of young males to participate). In such cases, when the sample can be compared to census data for the community, under-represented cases may be weighted in the subsequent analysis to draw more robust inferences that might generalize to the population (e.g., Kish, 1990; Pfeffermann, 1993).

There are two issues here for network research. First, conventional random sampling is inappropriate to capture network connectivity (Robins, 2015). By design, random sampling largely pre-empts the selection of participants who are interdependent with one another in various ways (e.g., friends, family, colleagues). This runs directly counter to the aims of social network research, in which social interdependence among observations is of central theoretical and empirical interest. Therefore, in order to adequately capture network structure and treat it as the object of enquiry, it is desirable to attempt comprehensive, census-like survey methods, as seen in the current study (Gibbs et al, 2013). So, in relatively small-scale sociocentric network studies (i.e., research on whole networks) which are typical of

social network research, networks are surveyed in their entirety. The issue of generalizability is therefore largely sidestepped: one has the "population," rather than a sample.

Nevertheless, complete network data is impractical in larger scale social surveys: it is often difficult to identify the entire population of interest, much less gain the cooperation of, and interview, every member of that population. It is well-known that the snowball sampling methods employed in this study are better at capturing network connectivity, even when some data is missing and an entire census of the population proves impractical (Pattison et al., 2013). Even so, the resulting sample may still have a bias against certain categories of community members (such as young males).

The second issue for network methods in this context is that there is no established network method to weight the sample to correct for this bias. The difficulty is that we may know that some categories of respondents are not well-represented, it is not obvious how we could "weight" network structure that surrounds missing network nodes to correct the network structure.

These issues leave open the extent to which our results can generalize. The comprehensive sampling methods employed in this study resulted in a sample which – as a whole – was not representative of the selected communities on the basis of age and gender: initial chi-square tests showed that the individuals in the network were both disproportionately older and contained more females than the general population, in comparison to census data (Australian Bureau of Statistics (ABS) 2011).

So, we attempted to assess the robustness of the results reported in the main text for more representative samples in two ways. Both procedures rely on the observation that while we cannot "weight up" a network by introducing new cases, we can extract from the network subsamples (possibly many) that are representative in terms of age and gender.

Both of our two procedures used the following methods:

- Thirty random subsamples were drawn from the network dataset, stratified on the basis of gender and age proportions representative of the population. Participants were randomly

selected from each gender-by-age subgroup, proportionate to the census data for communities selected for this study (Australian Bureau of Statistics (ABS) 2011). Each subsample had 112 participants (subsamples did overlap). This may be regarded as analogous to a stratified bootstrap procedure (e.g., Sitter, 1992). As with standard bootstrap methods, some subsamples did overlap, but this is not problematic.

- The same ALAAMs as reported in the main study were rerun for each subsample, for both depression and PTSD as outcomes. Participants who were not selected as part of this subsample remained in the analysis in a strictly exogenous manner: this means that their data were used not as a dependent variable, but rather only served as an independent variable to contribute to predicting the outcomes for their network partners.
- Cyclic triads were not numerous enough to be found within every subsample, leading to difficulties in model estimation (i.e., model degeneracy). Therefore, they were left out from the sampling and estimation procedure altogether. This will limit the generalizability of this particular effect, but this is not central to our conclusions.
- The 30 different sets of ALAAM results were combined in two ways. First, for each parameter in the model, a 95% bias-corrected and accelerated confidence interval of the 30 parameter estimates was constructed based on 10,000 bootstrap samples with replacement. Secondly, parameter estimates and their standard errors were pooled using the Weighted Least Squares (WLS) estimator, as described by Snijders and Baerveldt (2003), to test effects across multiple network samples. The test that the pooled WLS estimated effect is zero can be tested by dividing the parameter estimate by the standard error (Snijders & Baerveldt, 2003). By convention, values greater than 2 may be considered significant. This method has been used previously to pool network results drawn from multiple subsamples (Stivala et al., in press).
- We used two different methods to test robustness of our results with representative subsamples in order to compare each approach. This reflects the fact established methods for weighting network structure do not exist to date.

Results

The results of the subsampling procedure for the ALAAM as applied to depression are presented in Table S1. These indicate that the effects of main interest within the main study (i.e., sender effect and co-occurrence) are generalizable to the population of residents of disaster affected communities as a whole. For the sender effect and the co-occurrence effect, the 95% confidence interval for the parameter estimates included the original estimate, and excluded 0. Furthermore, the pooled WLS estimates for these effects were likewise significant, with the ratio of the parameter estimate to the standard error exceeding 2. A further effect – having a tie to a relocated individual – had a similar pattern, except that the original parameter estimate was less than the lower bound of the 95%CI, indicating that the true effect for the parameter may be larger than the original model.

TABLE S3. ALAAM results: Depression. Based on 30 representative subsamples (n = 112). Weighted Least Squares combined estimates and standard errors, with bootstrap estimates.

	Original model[a]		WLS pooled estimates			BCa 95% CI	
Effect	$\theta_{original}$		θ_{wls}	SE_{wls}	$\lvert\theta_{wls} / SE_{wls}\rvert$	Lower	Upper
Density (constant)	-1.62	+	-2.31	.33	7.00	-2.86	-2.01
Sender	-.49	+	-.62	.13	4.93	-.89	-.46
Receiver	-.27		-.22	.13	1.62	-.45	-.03
Reciprocity	.40		.43	.30	1.43	.05	.80
Co-occurrence	.69	+	.64	.20	3.18	.40	.95
Co-occurrence × Reciprocity	-1.04		-.99	.60	1.65	-1.60	-.39
Sex (F)	.42		.49	.10	4.67	.36	.68
Age	-.002		.01	.003	2.01	.00	.01
Tertiary education	-.14		-.53	.13	4.18	-.81	-.35
Fear for life	.54	+	.77	.14	5.65	.60	1.06
Interpersonal loss	.48	+	.76	.12	6.28	.57	.93
Employment stressors	.46	+	.68	.05	12.81	.62	.80
Traumatic events	1.18	+	1.56	.21	7.58	1.35	1.93

Relocation	-.71		-.96	.23	4.12	-1.41	-.77
Tie to relocated person	1.29	+	2.13	.58	3.70	1.91	2.94
Property Loss	.17		.07	.05	1.30	-.02	.15

+ *Wald ≥2; a* as reported in the main text.

The results of the subsampling procedure for the ALAAM as applied to PTSD are presented in Table S2. These results are mixed. The bootstrap estimates reflect the original model: the parameters of interest (receiver effect, brokerage effect) lie within the 95%CI, which also excludes 0. Also, importantly the 95%CI for the co-occurrence effect excludes positive numbers, as well as zero. This reaffirms the assertion that PTSD does not co-occur across social ties. However, for the interaction effect between the receiver effect and a network alter's property loss, the 95%CI included 0, suggesting no general effect for the population as a whole. Furthermore, the pooled WLS estimates for these effects are not significant. Therefore, we are less confident that the key findings of the main analyses are representative of the larger population of bushfire-affected community residents.

In order to further investigate whether the results are generalizable to an important subset of individuals, the resampling procedure was repeated once more, with a specific focus on middle aged individuals (ages 45-75), the most numerous age group within the sample. This yielded subsamples with a size of n = 293. Ten random subsamples were drawn. ALAAMs were combined in the same way as previous analyses. The results are presented in Table S3. These indicate that the parameters of primary interest (receiver effect, brokerage effect, and the interaction effect between the receiver effect and property damage) are significant. While the original parameter estimates lie outside of the 95%CI, they are lower than the lower bound, indicating that these effects may be stronger among middle-aged individuals than what was found within the model. We therefore conclude that these effects are generalizable to middle-aged individuals affected by the bushfires.

TABLE S4. ALAAM results: PTSD. Based on 30 representative subsamples (n = 112). Weighted Least Squares combined estimates and standard errors, with bootstrap estimates.

	Original model[a]		WLS pooled estimates			BCa 95% CI	
Effect	$\theta_{original}$		θ_{wls}	SE_{wls}	$\lvert\theta_{wls} / SE_{wls}\rvert$	Lower	Upper
Density (Constant)	-2.58	+	-3.18	1.42	2.23	-4.39	-2.42
Sender	-1.03		-2.26	.90	2.50	-3.33	-1.88
Receiver	-1.41	+	-.96	.98	.98	-2.07	-.48
Reciprocity	1.65		1.98	2.60	.76	.78	3.32
Co-occurrence	-.61		-.50	.38	1.29	-1.26	-.34
Brokerage	.67	+	1.36	.90	1.52	.19	1.76
Cyclic closure	-2.96	+	*b*				
Sex (F)	.25		.41	.31	1.29	.12	.66
Age	-.01		.81	.09	9.32	-.03	-.008
Tertiary Education	-.29		.35	.19	1.85	-.95	-.22
Fear for life	.76	+	1.92	.40	4.75	.04	.89
Interpersonal loss	.91	+	-.02	.01	3.48	1.65	2.60
Employment stressors	.48	+	1.58	.22	7.26	.72	1.06
Traumatic events	1.06	+	-.60	.20	3.00	1.37	2.22
Relocation	-.42		-.81	.26	3.16	-1.17	-.58
Property loss	.32	+	.50	.10	4.87	.35	.77
Sender × property loss (alter)	.18		.52	.25	2.04	.42	1.01
Receiver × property loss (alter)	.63	+	.37	.40	.91	-.12	.90
Reciprocity × property loss (alter)	-.88		-1.23	.89	1.38	-1.95	-.49

+ *Wald ≥2;* *a* as reported in the main text.; *b* excluded from estimation due to model degeneracy.

TABLE S5. ALAAM results: PTSD. Based on 10 partially representative subsamples, ages 45-75 (n =293).

Weighted Least Squares combined estimates and standard errors, with bootstrap estimates.

	Original model[a]		WLS pooled estimates			BCa 95% CI	
Effect	$\theta_{original}$		θ_{wls}	SE_{wls}	$\lvert\theta_{wls} / SE_{wls}\rvert$	Lower	Upper
Density (Constant)	-2.58	+	-2.53	.47	5.35	-2.92	-2.25
Sender	-1.03		-.73	.24	3.03	-.89	-.61
Receiver	-1.41	+	-2.27	.38	5.93	-2.80	-1.97
Reciprocity	1.65		1.52	.58	2.61	1.04	1.99
Co-occurrence	-.61		-.40	.18	2.25	-.58	-.25
Brokerage	.67	+	.89	.15	5.84	.72	1.06
Cyclic closure	-2.96	+	*a*				
Sex (F)	.25		-.24	.14	1.75	-.08	.06
Age	-.01		-.01	.01	1.78	-.02	-.01
Tertiary Education	-.29		.55	.06	9.12	-.38	-.11
Fear for life	.76	+	-.02	.13	.14	.92	1.13
Interpersonal loss	.91	+	1.01	.13	7.63	.91	1.06
Employment stressors	.48	+	.98	.13	7.68	.51	.60
Traumatic events	1.06	+	1.02	.15	6.97	.87	1.14
Relocation	-.42		-.69	.21	3.28	-1.08	-.42
Property loss	.32	+	.37	.07	4.94	.25	.44
Sender × property loss (alter)	.18		-.16	.14	1.16	-.24	-.06
Receiver × property loss (alter)	.63	+	.98	.17	5.92	.82	1.26
Reciprocity × property loss (alter)	-.88		-.42	.30	1.40	-.77	-.05

+ Wald ≥2; a as reported in the main text.; *b* excluded from estimation due to model degeneracy.

Summary

For depression, the key findings of the ALAAM, as seen within the main text, are likely to be representative of the larger population of bushfire-affected community residents: moderate depression co-occurs across emotionally close social ties, individuals with close social ties are less likely to be depressed, and individuals with close ties to other individuals who have relocated are more likely to be depressed. For PTSD, the key findings of the ALAAM are likely to be representative of the middle-aged (ages 45-75) population of bushfire-affected community residents: being nominated by someone else as being a close social ties is associated with less risk of PTSD; one's own property damage increases the likelihood of PTSD for those to whom one feels close; and being in a brokerage position is a risk factor for PTSD. Also, there is no evidence that PTSD co-occurs across social ties. The generalizability of the results for PTSD to other age groups is less certain. This may be due to diminished statistical power due to the small sample sizes needed to construct a representative sample. Also, due to the relative scarcity of PTSD, we were unable to include the cyclic closure effect in our analyses.

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