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Eliciting and Representing the Causal Understanding of a Social Concept: a Methodological and Statistical Comparison of Two Methods

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We contrast, for the first time, two existing network methods for eliciting the causal understanding of a social psychological concept. Our exemplar was loneliness. In the diagram method individuals draw paths in a diagram to indicate their perceptions of how different presented causal factors interconnect both amongst themselves and to the target factor of loneliness. They then rate the causal strength of these paths. In the grid method they indicate the perceived strength of connection between each and every cause and between each cause and the target factor by choosing one number on a Likert scale. Potentially, these methods might elicit different mental, and hence aggregated, representations of the causes of loneliness because they impose different task demands. We analysed the data from each method in two different ways (factor analysis and inductive eliminative analysis) that have previously been associated with just one method. Factor analysis of the data from the diagram method indicated that different individual diagrams derived from a single common representation. Data from the grid method showed the same outcome when we controlled for response artefacts. Both methods also revealed similar but sparser representations using inductive eliminative analysis. We make certain methodological suggestions in the light of our data and consider theoretically the relationship between lay explanation research and research on social representations.

Introduction

The discipline of psychology can inform public debate on social issues. But a key concern is to determine, and to represent, the mental representations of such issues and concepts that range from the perennial (loneliness; unemployment, poverty) to the current and controversial (AIDS, GM foods). Two traditions converge on the question of how social concepts are represented. One tradition, the lay explanation of social concepts (e.g., Furnham, 1982; 1992; Lunt, 1991) has focussed exclusively on the mental representations of phenomena. The second tradition, the European continental tradition of social representations (e.g., Bauer & Gaskell, 1999; Jodelet, 1991; Joffe, 1999a; Moscovici, 1963, 1981, 1984) has also sought to identify the representations and images used in public media. Both traditions have used a variety of methods for eliciting views and beliefs. These methods of elicitation include questionnaires and focus groups (see, for example, Bauer & Gaskell, 1999), interviews (Joffe, 1999a), word association tasks (Wagner, Valencia & Elejabarrieta, 1996) and the observation of both verbal and non-verbal behaviour (Jodelet, 1991).

Methods of elicitation are not neutral with respect to their objects of enquiry and there is a wide recognition of the need for converging evidence or "triangulation" (e.g., Bauer & Gaskell, 1999; Flick, 1992; Joffe, 1999b;). However, there has been little effort to identify the constraints and limitations of different methods of elicitation. For instance, verbal methods of elicitation (e.g., interviews, focus groups, questionnaires) are limited in the extent to which they can explore the interrelationships of factors. Nor, as yet, has there been any effort to contrast results from methods that do allow the representation of interrelations such as the methods we discuss next.

In this paper we contrast two methods for eliciting people's views on the possible causes of loneliness and consider whether or not they elicit different representations of this phenomenon. We term these methods, network methods, as they allow individuals to express their views on the interrelationship of different (causal) factors. We also consider two different ways of analysing such data and propose that each analytic technique in fact delivers a different but complementary representation of consensus. We chose the concept of loneliness because there is extensive prior research on it (Lunt, 1991; Muncer & Gillen, 1997) that allows us to draw out a number of methodological points. Although we report the results based on a single concept our theoretical goal is wider: to forge a closer integration between the two traditions (lay explanation and research on social representations). We defer discussion of this theoretical matter until after the presentation of our empirical data.

Methods of network elicitation

There are two different methods of eliciting networks: the grid method and the diagram method each with its own method of analysis. One of the questions we consider is the extent to which the composite representations that can be formed from these methods are consensual and represent a shared view of some social object. We discuss the grid method first.

The grid method of elicitation. The grid method has been used to examine what has been referred to as the lay explanations of phenomena and the perceived causal structure of such phenomena (Lunt, 1988; Lunt, 1991; Heaven, 1994). This work has generally emphasised its relationship to attribution research and particularly to the work of Kelley (1983). In the grid method, individuals are presented with a grid in which the probable causes of a social phenomenon (such as unemployment, loneliness or poverty) are printed along the top and down the sides of the grid. Individuals complete the grid by entering a "1" if they perceive a link and a "0" if they do not. A network is constructed from an aggregated grid with causes being entered according to the number of individuals endorsing a link. Construction of the network stops when

either all the causes had been entered at least once (the minimum systems criterion, Lunt, 1988; Knoke & Kuklinksi, 1982) or when the number of links necessary to add a cause was too great (cause-to-link ratio). Networks for the perceived causes of personal debt (Lunt & Livingstone, 1991), crime (Campbell & Muncer, 1990) and drug use (Muncer, Sidorowicz, Epro & Campbell, 1992) have been produced using this method.

More recent studies have tended to replace the binary form of endorsement with a Likert scale, in which individuals rate the strength of the causal link on a scale from 1 to 5. The lay interpretations of loneliness (Lunt, 1991) and poverty (Heaven, 1994) have been investigated using this approach and networks constructed according to a cause-to-link ratio calculation.

Muncer and Gillen (1992, 1997) criticised this method of aggregation as it produced networks that were not produced by any one participant. They suggested an alternative form of network construction that used a form of inductive eliminative analysis (De Waele & Harré, 1976), in which causes were added to the network until the level of endorsement of the whole network reached a criterion of 50 per cent. The network of loneliness produced in this way was substantially smaller than that produced by Lunt (1991) with just 5 causal links as opposed to 48 links. The final network was endorsed by 58% of the sample. While Lunt's method indicates an aggregate representation held by no one individual, the network produced by inductive eliminative analysis may be too restricted. Muncer and Gillen's insistence on a specific notion of a consensual network may have revealed something which is more like a stereotypical explanation, and produced an extreme reduction of the variability that exists in people's theories of the causes of loneliness.

A very serious omission of the original grid network method is that it ignored the direct links between potential causes and the social phenomena under study. This is particularly important if one is taking a social representations approach to explanation in which the target phenomenon takes a central role with images and possible causes and effects attached to it. The original network method looks at the relationships between possible causes and tells us nothing of the direct links between these possible explanations and the phenomenon being examined. It is entirely possible that these links amongst causes have nothing to do with loneliness at all. Green and McManus (1995) were the first to point out this weakness and overcame it in their study of individuals' conception of the causes of coronary heart disease.

The diagram method of elicitation. Green and McManus (1995) required individuals to draw a network diagram of the risk factors for a target factor, coronary heart disease. The elicited diagram combines verbal, visuo-spatial and numerical information. Unlike previous network elicitation studies, individuals were not forced to consider each and every connection amongst the factors but were free to sample as they wished. Individuals represented a causal relationship between two factors by drawing a line connecting them and indicated the direction of the causal influence using an arrow-head. Also in contrast to previous studies, the target factor (coronary heart disease) was explicitly represented. In the diagrams created a possible causal factor may be connected to the target factor in a variety of ways. A causal factor may have a direct path to the target factor, or it may have an indirect path to it via some other factor, or it may have both a direct path and an indirect path to the target factor. The diagram represents what individuals spontaneously consider the critical pathways.

In addition to representing a path individuals were required to rate the strength of each causal path on a scale from zero to one hundred. A composite diagram was constructed that indicated both the percentage of individuals including each causal path and the mean strength of those causal paths. Green and McManus (1995) showed that the total path strength of a factor (the strength of both direct paths and all indirect paths) predicted participants' ratings of the effectiveness of different actions based on each of the risk factors in reducing the risk of coronary heart disease.

In a subsequent study that examined perceptions of the factors increasing a person's prospects of employment, Green, McManus and Derrick (1998) confirmed the importance of path strengths in predicting the ratings of the effectiveness of different actions designed to increase a person's employment prospects and explored two statistical ways of determining whether or not the composite network reflected a single consensual representation of the phenomenon.

They proposed that if there is a single consensual representation then a factor analysis of the correlations between the presence of paths should show a single underlying factor. If, instead, the factor structure suggests two or more factors, then individuals could be seen as sampling from different representations, and there would not be a single representation of the domain. They used a suitable computer program to carry out a principal factor analysis of the path correlation matrix and this showed clear evidence of a single factor. Converging evidence for the unifactorial nature of the representation was obtained using Item Response Theory, IRT (Hambleton, Swaminathan, & Rogers, 1991; Weiss & Yoes, 1991 - see Appendix 1 for a brief description and usage in the present study). Hence, analysis of the employment data suggested that there is a unifactorial model underlying the different individual diagrams produced by participants for this domain. Accordingly, Green *et al.* concluded that the composite diagram reflected a representation that was shared amongst participants even though the diagrams of different individuals were non-identical.

The two elicitation methods and the nature of consensus. We stipulate that any attempt to uncover a mental representation of a social concept requires the phenomena under study to be included as a target along with the possible causes of it. It may be that the most salient paths are, in fact, direct paths, i.e., paths that directly connect a possible cause to the target. Heffernan *et al.* (1998) provided preliminary evidence that these direct paths are very important in understanding loneliness. Furthermore, a target factor may have reciprocal causal links with the nominated causes. In a recent network study of the causes of health and illness, participants' representations suggested that stress was an important cause of illness and that illness was an important cause of stress (Muncer, Taylor & Ling, 2001). Preventing individuals from representing direct paths (as in the earlier grid method) may yield an over complex representation on the one hand (see, for instance, the representation elicited in Lunt, 1991), as individuals seek to encode their perceptions within the constraints of proposed causes, and, on the other hand, it may limit the subtlety of the representation by precluding the representation of connections to the target factor that are both direct and indirect from a given causal factor.

Consider next the process of constructing a diagram or completing a grid. In the case of the diagram method, individuals elect to include a path and for any included path they go on to assess its strength. The initial representation of a path reflects a sampling process. Conceivably then path inclusion and path strength tap different aspects of a latent underlying representation. In contrast, the grid method requires individuals to consider all possible paths and so even though a sampling process may also be involved, judgements of causal likelihood may function as a proxy for the inclusion of paths.

The methods differ most obviously in their response constraints. The diagram method may restrict the complexity of depicted representations because individuals avoid multiple criss-crossing paths. The grid method imposes no such constraints but is open to response artefacts of another type. Repeated probing may lead individuals to adopt specific response strategies (e.g., preferring a certain range of options on the Likert scale) and this will affect the nature of the consensus revealed. Clearly if the elicitation methods are to "triangulate" on a given phenomenon it is important to understand the effect of different response constraints. Otherwise, theoretical effort will be devoted to understanding what is merely artefactual rather than a

genuine difference in representation elicited by different methods that may point to multiple, and perhaps, inconsistent representations of a phenomenon.

The diagram method leads naturally to a probabilistic view of diagram construction and to a probabilistic view of consensus. Individuals differ in their propensity to include paths in their diagrams (perhaps as a function of personality), and each group of individuals samples randomly from the paths in their mental representation, but with a higher probability of sampling from those paths that are more salient. On this view, a consensual representation may be conceptualised as consisting of a series of paths between various factors, some of which are more salient than others, and hence more likely to be included in any individual diagram. To the extent that there is a single consensual representation, despite differences in the overt diagrams, this will be revealed by a single factor in a factor analysis (or in an IRT analysis) of the data. We may speak of the composite representation created from individual diagrams as a probabilistic or P-consensual representation. Such a view is close to the notion of a "shared" representation espoused by Harré (1984; see also Bauer & Gaskell, 1999, p. 167).

In the grid method, where individuals are required to consider all possible paths, completed grids may differ both because of differences in the perceived salience of paths and because the repeated nature of such judgements leads individuals to adopt different response strategies. The inductive eliminative analysis of such data (Muncer & Gillen,1997) can show whether or not there is a determinate core of connected, highly salient causal beliefs. Operationally, it provides a view of endorsed or E-consensus. Precisely, what we treat as the mental representation of loneliness, for instance, will depend on our criterion (e.g., the 50% criterion) for including paths and this will surely depend on the aims and purposes of the investigation. In certain circumstances, it may be important to determine if a specific subset of paths is jointly endorsed (for instance, an intervention might be able to affect one path with consequences for interconnected paths). In other circumstances, the critical question might be whether there is a single model or a multiple model. For instance, do lonely people have a different representation of loneliness compared to people who are not lonely?

The present study

So far in the literature, the diagram method has been tied to one form of analysis and the grid method to another. Of course, methods of elicitation and methods of analysis are separate. One aim of the present studies is to investigate lay interpretations of loneliness using both the diagram method and the grid method and both methods of analysis. In each case, and in contrast to prior studies using the grid method, we include the target factor. A comparison of these two methods has not been attempted before and is of both theoretical and practical importance. If these different methods elicit different representations of loneliness, it would incorrect to speak of *the* representation of loneliness or perhaps of *the* representation of any social-psychological phenomenon: representations would in all cases be contingent on the method of elicitation. Practically, it would imply that one would need to motivate quite carefully the selection of even closely related methods and appreciate their limitations.

We compare the elicited representations in two ways: If the diagram and grid methods elicit comparable data then there will be significant correlation between the paths elicited in the diagram method and those elicited in the grid method. Further, the results of the factor analysis and inductive eliminative analysis will be the same for the two methods.

We also examined whether the diagrams and grids of loneliness are influenced by individuals' experience of loneliness and by personality factors (see Wittenberg & Reis, 1986; Brown & Muncer, 1995). In point of fact, we found no evidence that the representations were markedly affected by personality factors, or by the experience of loneliness, and so, for brevity's

sake, we consider the personality data only where they help us understand how individuals perform the tasks.

Method

Participants

Diagram method. One hundred and sixty undergraduate psychology students at the University of Teeside carried out the diagram task. One hundred and fifty completed the task satisfactorily - 10 failed to provide a complete set of responses to one or other of the questionnaires. Of the 150 participants, 95 were females and 55 were males, with an age range of 18 - 48 years (mean age 28 years).

Grid method. One hundred and thirty eight undergraduate psychology students at the University of Northumbria completed the grid method. All participants completed the task satisfactorily. Of the 138 participants, 102 were females and 36 were males, with an age range of 18 -50 years (mean age 22 years).

Procedure and materials

Participants were informed in advance that the study was both voluntary and anonymous. All participants completed the elicitation phase before completing the questionnaires.

Elicitation phase: Diagram method. Individuals were run in three groups and were asked to draw a diagram indicating how, in their view, a set of factors caused loneliness. They were instructed as follows:

> People give a number of causes as explanations of loneliness. Your task is to diagram how these causes (listed below) are interrelated and affect loneliness in your view. For example, is it possible that *others' group relationships* cause an *unpleasant personality*? Does being *physically unattractive* cause *impersonal situations*? Does *shyness* cause *pessimism*? Please indicate the direction of the effect of one cause on another using an arrowed line.
>
> *Causes*: The names of the thirteen causes of loneliness are in bold with a short description in brackets: *pessimism* (the person believes there is little chance of finding someone), *fear of rejection* (the person is afraid of being rejected if he or she tries to start a relationship), *lack of trying* (the person does not try hard enough to meet someone), *unlucky* (the person has not had any luck meeting people), *lack of knowledge* (the person does not know what to do to start a friendship), *shyness* (the person is too shy), *physically unattractive* (the person is physically unattractive), *others' group relationships* (other people have their own groupings and are not interested in the person), *others' fear* (other people are afraid of making friends), *impersonal situations* (the person is always in impersonal situations with too many people), *lack of opportunity* (there are not enough opportunities to meet people), *other's lack of trying* (other people do not try to make friends), *unpleasant personality* (the person has an unpleasant personality). NB: Please indicate the connection of these causes which can either be direct or indirect to loneliness on your diagram.

Where necessary these instructions were repeated and simplified for the participants. A schematic overhead slide of a network was shown to the participants, using factors not included

in the study. The participants were reminded to include the target factor of loneliness in their diagrams and were also asked to list which factors (from those listed above) they believed bore no relation to loneliness on a separate sheet.

After approximately 5 minutes participants were asked to check that they had represented each factor they considered important on their diagram, listed those factors that they believed were unrelated to loneliness, and labelled each path. They were then asked to assess the strength of the paths connecting one factor to another by choosing a number between 0 and 100 (where 0 equals no relation and 100 equals an invariable relation, e.g., factor "X" always causes loneliness). Participants were told to place a number on each path representing the strength of relationship between the two factors.

Elicitation phase: Grid method. Individuals were presented with a grid with the causes of loneliness and the target loneliness down the side and along the top of it. They were instructed as follows:

> Over the page you will find a grid with 14 causes and effects printed. I want you to think about these as explanations of loneliness. Your task is to judge how likely the causes are to bring about the effects. For example, how likely is it that pessimism will cause *lack of knowledge*? If you think it is highly likely then put a "5" in the box. Choose whichever answer best represents your opinion and put the corresponding number in the appropriate box. At the top of the page three is a scale of numbers from 1 to 5. Each represents one possible answer. Please make sure you fill in all the open boxes.

As above, the names of the thirteen causes of loneliness were displayed in bold type with the same short description in brackets e.g. *pessimism* - the person believes there is little chance of finding someone. *Loneliness* was described as "being lonely.

Questionnaires

After the elicitation phase, participants completed the UCLA Loneliness Scale and the Eysenck Personality Questionnaire (revised version, short version - EPQR)[1]. The instructions for these questionnaires were provided on the scales themselves and, again, the experimenter was on hand to answer any queries. Following participation in the study, the participants were thanked for their co-operation and offered a debriefing session.

Results and discussion

We first report our analyses of the data elicited under the diagram and grid methods examining the overall pattern of representation and then compare the present findings with those reported previously.

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[1] The UCLA Loneliness Scale is a valid and reliable measure of loneliness (Russell, 1996). The 20 item scale covers the two fundamental aspects of loneliness: social loneliness and emotional loneliness (Russell, Peplau & Cutrona, 1980). On the scale, the person is required to indicate how often each statement applies to him/her. The participants use a four point rating scale ranging from "never" to "often" to respond to questions such as: "I lack companionship", or "I am an outgoing person". A total score is calculated: a higher score indicating greater loneliness. The EPQR-short questionnaire is a 48 item self-report personality scale which was used to assess the introversion-extroversion dimension of personality. This scale has been developed from over forty years of research, and is a valid and reliable psychometric measure of personality dimensions (Eysenck and Eysenck, 1991).

P-consensual representations of loneliness for the diagram and grid methods

In the diagram method individuals elect to include a path. 20 subjects did not put a strength figure on all their perceived links and so their data were omitted from the analyses. Table 1 displays the paths and paths strength for all factors represented by 10% or more of the sample (N =130). The same data are displayed graphically in Figure 1. The factors of physical unattractiveness, rejection, pessimism, shyness and lack of trying show the greatest degree of interconnectedness. Other factors generally show a single direct path to the target factor of loneliness.

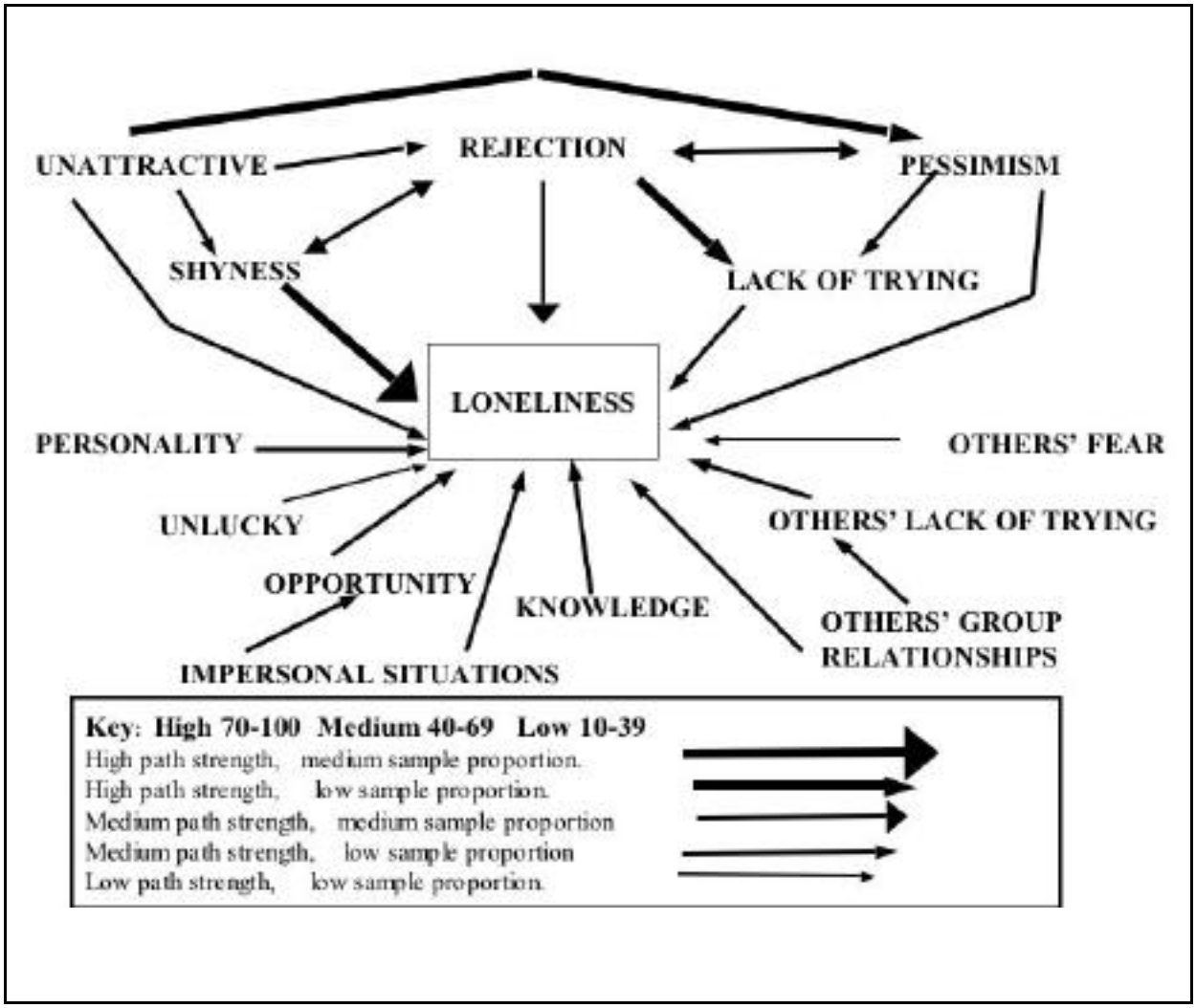

Figure 1
Composite network derived from the diagram method.

In the grid method, individuals are required to consider all possible paths explicitly. Presentation of the entire data matrix would be unilluminating but we can assess the overall commonality of the two elicited representations either by exploring the correlation between the paths elicited in the diagram method and those elicited under the grid method or by means of factor analysis. We report these two types of analyses below.

Table 1

The number and percentage of participants representing each path together with their path strengths (standard deviations in brackets) for paths represented by 10% or more of the sample (N= 130) using the diagram method.

Factor paths		Path strength	Number with path
Source factors	Target factors		
Others' group relationships	Loneliness	54.5 (21.9)	36 (28%)
	Others' lack of trying	54.2 (23.8)	13 (10%)
Impersonal situations	Loneliness	44.0 (22.3)	31 (24%)
	Lack of opportunity	52.3 (26.8)	13 (10%)
Lack of knowledge	Loneliness	44.8 (30.4)	27 (21%)
Lack of opportunity	Loneliness	52.2 (29.8)	50 (38%)
Others' fear	Loneliness	36.2 (25.3)	17 (13%)
Others' lack of trying	Loneliness	48.5 (22.4)	24 (18%)
Unpleasant personality	Loneliness	66.1 (26.6)	64 (49%)
Pessimism	Loneliness	56.6 (26.5)	48 (37%)
	Fear of rejection	58.4 (20.7)	22 (17%)
	Lack of trying	62.4 (23.0)	21 (16%)
Fear of rejection	Loneliness	69.1 (22.0)	58 (45%)
	Pessimism	53.2 (30.8)	17 (13%)
	Shyness	61.5 (25.5)	27 (21%)
	Lack of trying	70.3 (20.5)	17 (13%)
Shyness	Loneliness	72.2 (20.4)	68 (52%)
	Fear of rejection	63.0 (25.2)	27 (21%)
Lack of trying	Loneliness	53.6 (26.7)	45 (35%)
Physically unattractive	Loneliness	47.9 (27.8)	35 (27%)
	Pessimism	74.6 (16.6)	13 (10%)
	Fear of rejection	54.7 (25.1)	16 (12%)
	Shyness	63.5 (25.9)	26 (20%)
Unlucky	Loneliness	24.6 (23.1)	22 (17%)

Correlation of paths. We correlated the percentage of individuals representing a path in the diagram method with the average rating of causal likelihood of the paths in the grid method. There was a strong and highly significant correlation (Pearson = 0.85; Spearman = 0.75) indicating a substantial degree of overlap in the representations of loneliness elicited by the two methods. The grid method did, however, elicit backward paths from the target (loneliness to shyness; loneliness to pessimism; loneliness to lack of trying; and loneliness to lack of opportunity. These backward paths were rarely elicited in the diagram method (but actually present at about 6% i.e. below our 10% threshold) presumably because participants are not directly informed that they can have backward paths and therefore fewer do. Nevertheless on a scattergram these four are clear outliers. We can therefore reach the provisional conclusion that the two methods elicit broadly similar representations of loneliness.

Factor analysis of the diagram data. Paths were included in the factor analysis if at least 5% of the 130 participants had included that path in their individual diagrams. These 50 paths, which were scored as present or absent (1 or 0), were factor analysed by the program MicroFact 1.1 (Waller, 1995) that is specifically designed for use with dichotomous data. This is necessary since standard factor analytic programs (e.g., SPSS FACTOR) assume multivariate normality and inevitably produce artefactual 'difficulty factors', which have been well described in the literature (Carroll, 1945; Gorsuch, 1983; Maxwell, 1977). Technically, MicroFact1.1 calculates a

matrix of tetrachoric correlations which is then smoothed by removing negative eigenvalues so that the matrix is positive definite.

Examination of the scree-plot of the eigen values of the first 20 factors extracted shows that there is a very clear first factor and little evidence of a second or higher order factors in the plot. That a single factor is an adequate fit to the data is shown by the mean residual being - 0.0024 and the mean squared residual being 0.0179 (standard deviation of residuals 0.1338), with the interquartile range of residuals being -0.0909 to 0.0914. The mean factor loadings of the 50 items was 0.56 (SD = 0.16, range 0.21 to 0.85), showing that all of the 50 paths loaded well on the single factor.

Analysis of the data using Item Response Theory (IRT) analysis (see Introduction and Appendix 1) provided reasonable confirmation that the P-consensual representation elicited by the diagram method was unifactorial.

Bidirectional paths. A feature of the composite network is that two of the paths, Rejection with Shyness, and Pessimism with Rejection, have participants who represent bi-directional paths. Each of these appears once in the list of paths that under the IRT analysis possibly do not fit the concept of a single P-consensual representation. We explored them a little more carefully. Theoretically, it is important to distinguish two different cases:

i. The situation in which there are two different theoretical models, (A causes B, or B causes A), with each participant espousing either one model or the other, and:

ii. The case in which there is a genuine reciprocity of causation and the composite diagram contains both paths (A causes B, and B causes A) but since each path is relatively unlikely to occur it is statistically quite rare for diagrams to contain both paths, although that situation can and should occur at a predictable rate.

Tables 2a and 2b below show the numbers of participants producing each of the various combinations of paths. For Rejection with Shyness it can be seen that 6 participants included both paths. In addition, it can be seen that since 20.8% of participants included Shyness to Rejection and 20.8% included Rejection to Shyness, by chance alone one would expect that 0.208 x 0.208 = 0.043 = 4.3% of participants should include both. With an N of 130 the expected value of 5.6 is very close to the observed value of 6. Likewise for Rejection and Pessimism, 2 participants included both paths (i.e. the consensual reciprocal model), and given that 16.9% of participants included Pessimism to Rejection, and 13.1% included Rejection to Pessimism, then .169 x .131 = .022 = 2.2% by chance should have included both paths, which with 130 participants is an expected value of 2.9, which is very close to the observed value of 2.

The bidirectional paths in the composite network therefore provide a useful test of the assumptions behind the idea of P-consensus. The number of participants including bidirectional paths is almost identical to the number expected if participants are sampling probabilistically from a single consensual model, some including a path in one direction and others including a path in the reverse direction, rather than from two conceptually distinct models.

Table 2a

The number of participants including paths from rejection to shyness and vice versa in the diagram method

		Rejection to Shyness		
		Absent	Present	Total
Shyness to Rejection	Absent	82	21	103 (79.2%)
	Present	21	6	27 (20.8%)
	Total	103 (79.2%)	27 (20.8%)	130

Table 2b

The number of participants including a path from pessimism to rejection and vice versa in the diagram method

		Rejection to Pessimism		
		Absent	Present	Total
Pessimism to Rejection	Absent	93	15	108 (83.1%)
	Present	20	2	22 (16.9%)
	Total	113 (86.9%)	17 (13.1%)	130

We also examined whether diagram complexity (indexed by the number of paths in the diagram) and the mean rated strength of paths was affected by the peronality variables. Only one correlation reached a nominal alpha of 0.05. There was a correlation of –0.193 ($p = 0.028$) between the number of paths and Psychoticism but this is not significant at a Bonferroni corrected alpha level of $0.028/7 = 0.004$. We conclude that the diagram method yields a unifactorial model of loneliness with no evidence of response artefacts attributable to personality variables (see Appendix 2 for details of other analyses).

Factor analysis of grid data (1). Factor analysis of the diagram data (see above) revealed a single underlying factor. To what extent do the grid data reveal the same structure? In order to achieve an effective comparison we factor analysed those grid method variables that were included in the composite diagram using the SPSS FACTOR procedure. In apparent contrast to our earlier analyses, factor analysis of these data suggested three factors: The first factor was all of the backwards variables from loneliness (i.e., the ones not picked up by our diagram instructions), plus the interconnections between variables (i.e., excluding the target factor); a second factor loaded mainly on external variables (e.g., luck, opportunity, impersonal situations), and a third factor loaded on internal variables (e.g., shyness, rejection).

We explored this apparent factor structure in more detail. Neuroticism loaded on two of the factors and extraversion on one of the factors, suggesting that neurotics in particular should have different diagrams. However, inspection of the diagram data showed no evidence at all that neurotics had different diagrams, either when we factor analysed their data or when we looked at the detailed paths where the effect seemed to be on the grid data. Does the grid method then elicit a different consensual representation from the diagram method? We believe not and detail our reasons below.

The distribution of responses in the Likert categories. Examination of the grid data showed that participants differed dramatically in how much they used the 1,2,3,4,5 response categories on the Likert scale. Indeed cluster analysis showed three very different clusters according to how often individuals used the five categories of the Likert scale (see Table 3).

Table 3

The distribution of responses in the five Likert categories for the three clusters of participants in the grid method together with the proportion of female participants in each cluster and the mean neuroticism scores.

		Likert categories						
							Neuroticism	Female
Cluster	n	1	2	3	4	5	(mean)	(prop)
1	80	160	4	6	7	3	5.9	0.68
2	40	109	17	14	22	12	6.9	0.77
3	18	37	39	39	40	25	7.7	0.94

Descriptively, cluster1 are least neurotic, more male (they also had lowest lie scales) and basically answer 1 to most paths. Cluster3 are most neurotic, predominantly female and include lots of responses in Likert categories 2,3,4,5. Participants in cluster 2 are intermediate. In brief then responses using Likert scales appear to reflect strategic or personality factors.

From the statistical point of view the most relevant feature is that these distributions are non-normal: indeed in cluster 1 they tend to be binary. As noted in connection with the analysis of the diagram data, factor analysis of binary items using conventional Pearsonian correlations (as in SPSS FACTOR) typically results in spurious factors related to the difficulty of items (Carroll, 1945; Gorsuch, 1983; Maxwell, 1977). Indeed, examination of the mean ratings in cluster 1 showed that paths relating to internal factors had higher scores than paths relating to external factors suggesting that "difficulty" factors could well underlie the factor structure. Tetrachoric or polychoric correlations get round the problem by ensuring that the calculated correlations are independent of the marginal proportions present on each item. We report the results of a factor analysis of such correlations in the next section using MicroFact 1.1.

Factor analysis of the grid data (2): using polychoric correlations. We factor analysed the ordinal grid data by calculating polychoric correlations (using MicroFACT 1.1) amongst the ratings of each of the paths. MicroFACT 1.1 calculates a smoothed polychoric correlation matrix between items and then carries out a principal factor analysis of this matrix. Our first analysis included all 138 participants and all 182 paths. The eigen values clearly suggested a single underlying factor using the scree-slope method (all eigen values after the first one (153.6) were less than one) with all loadings on the single factor being in the same direction (minimum value .878). A second analysis was carried out for the 80 subjects in cluster 1 (those whose Likert responses were essentially binary), but using only 172 of the paths (the remaining 10 being omitted due to having zero variance). Again, the eigen values clearly suggested a single factor on a scree-slope criterion (all eigen values after the first one (145.0) were less than one with all loadings on the single factor being in the same direction (minimum value .886). It can therefore be concluded that the ratings using the grid method are unidimensional, both overall and in cluster 1, and that the apparent finding of three factors using the SPSS FACTOR procedure is due to erroneous difficulty factors, reflecting the non-normal nature of the distributions, particularly in cluster 1.

Comparison of the P-consensual representations. The grid method generates many more factors in a standard factor analytic treatment but these seem to come from a) differences in strategy used by participants and b) difficulty factors not being accounted for. Nonetheless we have shown that when suitably analysed statistically the grid method reveals the same P-consensual representation as that deriving from the diagram method: the P-consensual representation of loneliness is unifactorial.

E-consensual representation of the diagram data and the grid data

In order to compare the endorsed, E-consensual representation of the diagram data and grid data, the diagram data were recoded into binary form. If there was a path between any two causes or between causes and the target phenomenon then a 1 was entered and, if there was no path, a 0. The data of all 150 diagram participants could therefore be included. In the case of the grid data the data were retained in the Likert format.

We explored the E-consensual representation of loneliness under the two elicitation methods using inductive eliminative analysis. When constructing a network using inductive eliminative analysis, the first causal path to be entered has the highest endorsement level. Causal paths are added according to the number of participants endorsing each, while noting the number of

participants endorsing the total network of causal paths (Muncer & Gillen, 1992; Gillen & Muncer, 1995, Muncer & Gillen, 1997).

Diagram data. The first causal path entered was *shyness* to *loneliness* which was endorsed by 80 (53.3%) of the participants and the second causal path was *unpleasant personality* to *loneliness* which was endorsed by 72 (48%) of the participants. This network of two causes was endorsed by 49 (32.7%) of the participants. Muncer and Gillen (1997) have suggested that for a network to be regarded as a lay interpretation it should be endorsed by at least 50 per cent of participants. This suggestion, however, was made for network studies in which participants were specifically asked to consider the connection between each and every cause, rather than those in which they produce their own network. Given that this latter method is likely to lead to a lower endorsement of any given cause (as participants would have to nominate it rather than evaluate it), the endorsement criterion for the overall network was lowered. The third causal path added to the network was *fear of rejection* to *loneliness* which was endorsed by 66 (44%) of the participants and the whole network of three casual paths was endorsed by 24 (16%) of the participants. The fourth causal path added to the network was *lack of opportunity* to *loneliness* which was endorsed by 56 (37.3%), and the whole network was endorsed by 13 (8.7%) of the participants. The fifth causal path added to the network was *pessimism* to *loneliness* which was endorsed by 53 (35.3%) of the participants, and the whole network by 8 (5.3%) of the participants. The sixth, and final, causal path added to the network (see Table 4a) was *lack of trying* to *loneliness*. This causal path was endorsed by 53 (35.3%) of participants and the whole network was endorsed by just 4 (2.7%) of the participants. Network construction was concluded at this point as endorsement of the entire network had reached a very low level.

Table 4a

Causal paths entered into the network of loneliness from the diagram method constructed by inductive eliminative analysis.

Causal path	Endorsement of path	Endorsement of network
1. Shyness to loneliness	53.3%	-
2. Unpleasant personality to loneliness	48%	32.7%
3. Fear of rejection to loneliness	44%	16%
4. Lack of opportunity to loneliness	37.3%	8.7%
5. Pessimism to loneliness	35.3%	5.3%
6. Lack of trying to loneliness	35.3%	2.7%

This network contains only *direct* paths between a cause and loneliness and appears to tell us very little of interest, as the candidate causes were initially selected because they had previously been nominated as having a direct effect on loneliness (Michela, Peplau & Weeks, 1982). It is possible, however, that previous network studies of loneliness have placed too much emphasis on the connections between perceived causes (Lunt, 1991; Muncer & Gillen, 1997) rather than direct paths with loneliness, which are more often nominated graphically by the participants.

Having entered all the direct paths, we can construct a network of the indirect paths. *Fear of rejection* to *shyness*, endorsed by 31 (20.7%) of participants, was the first path to be entered. S*hyness* to *fear of rejection* (endorsed by 30; 20%) of the participants was the second path entered and the whole network of two causes was endorsed by 7 (4.7%) of participants. The third causal path entered to the network was *pessimism* to *fear of rejection* (endorsed by 30 (20%) of the participants). This whole network was endorsed by just 2 of them (1.3% of the sample).

Grid data. When a Likert scale grid is used, endorsement of a causal path is usually done by calculating the mean for each causal path (i.e., the mean rating of the likelihood that a given causal factor causes some effect) and identifying those with the highest means. In this case the ten causal paths with the highest means were *shyness* to *loneliness* (3.69), *fear of rejection* to *loneliness* (3.42), *unpleasant personality* to *loneliness* (3.09), *pessimism* to *loneliness* (3.06), *lack of trying* to *loneliness* (3.01), *fear of rejection* to *shyness* (2.96), *loneliness* to *shyness* (2.94), *shyness* to *fear of rejection* (2.77), *loneliness* to *fear of rejection* (2.74) and *lack of opportunity* to *loneliness* (2.74).

The network was then developed by taking the two causal paths with the highest means, checking this network for endorsement by each and every participant, and then adding causal paths in order of mean rating. In the case of a Likert scale, grid endorsement has different levels: a path could be endorsed at the level of 2 which means it is not impossible but is not very likely to be a causal factor, to 5 in which case it will be highly likely to be causal factor. Muncer and Gillen (1997) suggested using two endorsement criterion, a level of 2 and a level of 3. The order of addition of paths and endorsement level of the entire network is presented in Table 4b (see also Fig. 2).

Table 4b

Order of inclusion of the paths of the causes of loneliness in the grid method and endorsement level for each network.

Network	Causes	Endorsement	
		at level 2	at level 3
1.	Shyness to loneliness Fear of rejection to loneliness	80.4%	68%
2.	Unpleasant personality to loneliness	65.2%	50%
3.	Pessimism to loneliness	61.6%	39.9%
4.	Lack of trying to loneliness	55.1%	29.7%
5.	Fear of rejection to shyness	40.6%	21.7%
6.	Loneliness to shyness	31%	17.4%
7.	Shyness to fear of rejection	28%	15.9%

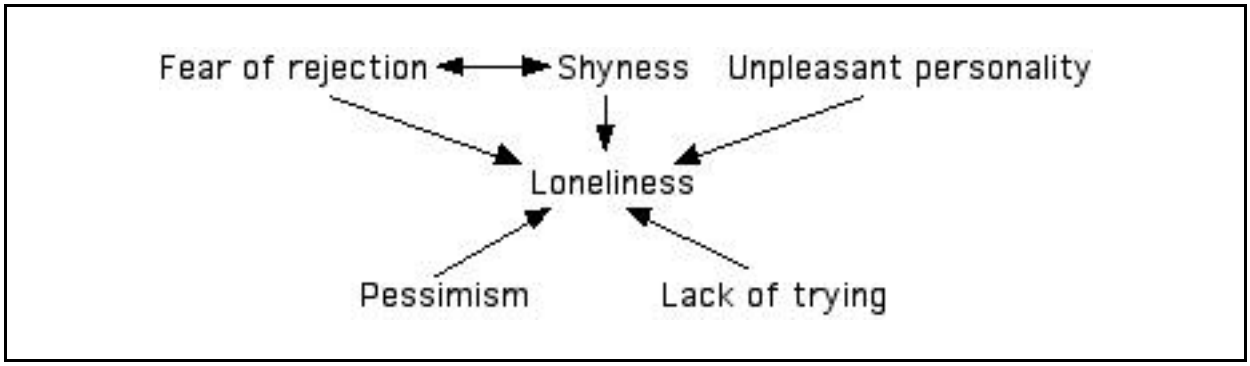

Figure 2

Network of the causes of loneliness from the grid method, produced by inductive eliminative analysis. The entire network was endorsed by 28% at level 2 and 15.9% at level 3.

Comparison of the E-consensual representations. Overall the networks produced by inductive eliminative analysis of the grid data are similar to those produced from inductive eliminative analysis of the data from the diagram method - *lack of opportunity* to *loneliness*

being the only causal path not featured on the network produced from the grid data. The major difference is in the level of endorsement of paths on the network. Only one of the paths *shyness* to *loneliness* is endorsed by over 50% of participants in the diagram method whereas in the grid method five causal paths appear in the network endorsed by over 50% of the sample at the lower criterion (level 2). It is also important to note that the indirect causal path between *fear of rejection* and *shyness* appears in the grid network. Furthermore all four of the causes identified in previous research as appearing on a network endorsed by at least fifty per cent of individuals (Muncer & Gillen, 1997) appear on the grid network. The grid method makes individuals consider each and every possible path and in doing so produces greater E-consensus.

Comparison with prior research. When comparing the networks produced using the diagram method, and analysed either by factor analysis or by inductive eliminative analysis, with previous network studies of loneliness (Lunt, 1991; Muncer & Gillen, 1997), it is important to remember that both previous studies ruled out any direct path with loneliness and both studies asked participants to systematically rate the likelihood of a causal path between all possible pairs of causes. The paths between *shyness* and *fear of rejection* and *pessimism* and *fear of rejection* appear on Muncer and Gillen's (1997) first network of loneliness which was endorsed by 58 per cent of their participants, and included five causal paths. They also appear on the composite network here (Figure 1) which includes 13 direct paths and 11 indirect paths. The other causal paths in the Muncer and Gillen (1997) network are between *pessimism* and *lack of trying* and *lack of trying* and *fear of rejection*. These paths both appear in the eight most frequently endorsed paths in the present study, when direct paths are excluded.

In contrast to a prior study using the grid method in which introverts produced different networks of loneliness than extroverts (Brown & Muncer, 1995), there were no personality effects on the representations. It is possible that the results attributed to personality factors in the earlier study were in fact response effects. The lay representation of the causes of loneliness appears to be a "rather simple dispositional and psychologically based" one (Muncer & Gillen, 1997) placing emphasis on shyness, an unpleasant personality, pessimism and fear of rejection both in terms of direct paths with loneliness and also in terms of paths between causes.

General discussion

In this paper we have contrasted for the first time two methods whose main purpose is to elicit individuals' sense of how different causal factors are interrelated. The diagram method and the grid method impose different response constraints and so, in principle, might elicit different representations of the causal understanding of a social-psychological phenomenon such as loneliness.

Overview of findings

In the diagram method, individuals elect to represent specific paths and having done so rate their causal strength. In the grid method, individuals must consider each and every possible path and reach a judgement about it. In the grid method, individuals did in fact show different response patterns. However, a major finding of the present study is that these two different methods do yield similar outcomes when the data are suitably analysed.

Factor analysis of the data elicited by the diagram method and by the grid method indicate a common, unifactorial solution when response artefacts associated with the use of the Likert scale in the grid method are suitably controlled. Inductive eliminative analyses of the two data sets also indicated substantial overlap. The main difference lay in the level of endorsement of the causal paths. The casual paths endorsed, however were similar. We can therefore conclude that the

elicited representations are not unduly determined by the method of elicitation when suitably analysed.

Methodological implications

We note two methodological cautions: the grid method encourages less sparsely endorsed networks than the diagram method but also elicits many paths with very low ratings on the Likert scale. We have shown that individuals differ on how they complete these scales and this might be relatively independent of what they are asked to consider. Methodologically then, it is important to examine the response patterns of different groups of individuals before concluding that it is the representation itself that differs across such groups. A second caution is that inductive eliminative analysis is less well suited to analysing data from the diagram method where individuals selectively represent paths in any case.

A second innovation also proved important – we included the target factor of loneliness. The resulting representation is relatively simple with the most important causal paths connecting directly to the target factor of loneliness. The causal paths reflect what has previously been described as a dispositional basis that is shyness, pessimism, fear of rejection and an unpleasant personality. The relative simplicity of our data, obtained by including the target factor, contrasts strikingly with the complexity of earlier data on loneliness (e.g., Lunt, 1991) obtained without including the target factor. Such complexity, we suggest, may be a consequence of requiring individuals to encode their perceptions within the constraints of proposed causes without the opportunity to indicate any direct pathways between these causes and the target factor. Whether such simplicity would be retained if individuals were asked to represent a model of their own loneliness is moot but, methodologically, our study shows how it important is to include the target factor and so allow direct paths to be represented if one is to gauge accurately the complexity and subtlety of lay thinking on a topic.

Procedurally, we propose a methodology in which relevant potential causes are elicited using a grid method and then the diagram method is used to elicit a relatively spontaneous representation of their interrelationships. The composite network derived from the diagram method provides an estimate of the complexity and interconnectedness of the mental representation of the concept.

The concept of consensus

The wider goal of this research was to contribute to an understanding of composite representations and, in so doing, to help integrate the individualistic research on lay understanding of social concepts with research on social representations. We first consider the concept of consensus and then briefly address the integration of the two research areas.

Our data are consistent with a process of diagram production in which individuals access a common shared representation of loneliness in which the paths vary in their salience. Probabilistic statistical sampling, coupled with a differential propensity between participants to include more or less paths yields different overt diagrams. This interpretation is particularly supported by a detailed analysis of two cases in the present situation in which bidirectional paths were present in the composite diagram. We have termed the composite representation produced (see, for instance Fig. 1) probabilistic or P-consensus. We assume that a sampling process also occurs in the case of responding under the grid method but that this is also modulated by a response strategy designed to minimise task demands. In contrast to this type of consensus, endorsed or E-consensus indicates agreement on a specific set of paths and potentially allows specific differences in the network representations of different groups to be identified.

As we noted in the Introduction, the idea of probabilistic consensus is close to the notion of a "shared" representation espoused by Harré (1984; see also Bauer & Gaskell, 1999). In the context of social representations research we agree with Rose et al. (1995) that what is widely shared need not be agreed. The social representations of controversial social issues (e.g., AIDS, GM foods) involve conflicting elements. Even within individuals, distinct concepts may mediate action in different contexts. Jodelet (1991), for instance, found that villagers in France washed the eating utensils and clothes of their mentally ill lodgers separately from their own implicitly expressing the idea of mental illness as a form of contagion but did not mention this idea when interviewed about their role as hosts.

Theoretical integration

How might we then build connections between the research on lay thinking and the research on social representations with its focus on controversial issues and their representation over time both in the minds of individuals and in the media? We note some preliminary points. First, everyday interactions rely on suppositions about common ground (i.e., what can be assumed with some degree of certainty to be mutually known or believed). It follows that mental representations of some phenomena will contribute to the kinds of causal attribution that individuals make and the nature of the communicative exchanges between individuals. Current theories of causal attribution and inference in the cognitive literature (e.g., Cheng, 1997) tend to concern only how individuals induce causal relations rather than how pre-existing causal beliefs enter causal judgements. The context (topic, occasion and interlocutors) must affect not only which representations are activated but also which paths in a representation (on loneliness, for instance) are probabilistically relevant and so which inferences and attributions may follow. For instance, if you are told that someone is shy you might infer they may be lonely when they visit a foreign country.

A second point to note is that the form and distribution of ideas in human groups derives from causal chains (Sperber, 1996) in which mental representations give rise to public representations (e.g., conversations, print or film) that in turn elicit further mental representation and so on. Moscovici's (1984) notions of anchoring (categorising new issues in terms of old concepts) and objectification (transforming abstract ideas to concrete realties) that are key to the formation of a social representation may then be understood as cognitive responses that are both consequent on public representations and formative of such representations.

A third point to note is that much social thinking has an argumentative quality (Billig, 1993). We seek to persuade others and be persuaded by them. The argumentative quality of social thinking provides a critical link between individual mental representations and the notion of a social representation. The notion of argument allows us to complete the linking of the domain of individual cognition to the domain of social action.

Individual cognitive networks, as revealed here, can be interpreted as networks of arguments (Green, 1998, 2000) comprising a claim that a certain relation holds (e.g., that shyness is a cause of loneliness) together with an implicit reason that may either be broadly cognitive (e.g., "Individuals who are shy avoid other people") or broadly affective (e.g., "Shy people don't like meeting new people"). Affective information is an important source of information for deriving decisions (see Oatley, 1996; Damasio,1994) and may just be intuited and reported as a particular kind of affective reason - a "gut feeling". Judgements of the strength of a path (and perhaps judgements on the Likert scale with the proviso noted earlier) can therefore incorporate both verbalisable knowledge and knowledge that is not readily verbalisable but merely felt. Our position contrasts with one which sees a cognitive approach as being incapable, *in principle*, of

recognising the important role of emotional and symbolic factors in social thinking (e.g., Joffe, 1999b).

Reasons then for particular claims can be cognitive or affective and they can derive not only from personal experience but also from the media (its imagery and claims) and from conversations with others in a social group. Cognitive networks ("cognitive matrices", Moscovici & Hewstone, 1985) provide a source of arguments and will change as a function of the extent to which these arguments are accepted or challenged within the social group.

Decisions and actions (including conversational actions) can emerge computationally from cognitive networks by a process of constraint satisfaction that seeks to maximise the coherence of the network (e.g., Kunda & Thagard, 1996; Spellman, Ullman & Holyoak, 1993) in a way compatible with earlier consistency theories (e.g., Heider, 1958; Festinger, 1957). Which actions or attributions become dominant will reflect the relative strength of the arguments and this will reflect the nature of the arguments in a social group.

The notion of argument therefore also points to a way in which collective action can emerge through "distributed cognition" via the conversational and media practices of the group. The elicitation methods discussed in this paper provide practical ways in which to elicit such networks of arguments without recourse to the syntactic complexities of discourse. The diagram method, in particular, allows individuals to express the perceived interconnectedness of arguments in a relatively spontaneous and natural fashion.

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Appendix 1

Item Response Theory (IRT) analysis of the diagram data

IRT was originally described for modelling the performance of examination candidates in situations in which it can be assumed that there is a single underlying dimension of ability but it has been shown to be suitable for analysing a much wider range of psychological data (Thissen & Steinberg, 1988). In the present case the items on the test can be considered to be the *paths* in the network diagrams. If the paths are unifactorial then an IRT model should provide an adequate fit to the data: or to put it another way, if the data are not unifactorial then an IRT model should show significant residuals, and hence a poor fit. The 50 most common paths of the 130 participants were included in an IRT analysis using the program XCALIBRE for Windows, version 1.0 (Anonymous, 1995). Of the 50 paths included in the model, 10 (20%) had residuals greater than 2, the largest being 2.86. The residuals can be regarded approximately as normally distributed with a mean of zero and a standard deviation of one (although they must always be positive). Values of greater than 2 are likely to occur about 5% of the time by chance, and hence finding 10 in 50 that are greater than 2 is somewhat unlikely. The largest residual had a value of 2.86 (p=.002), and that is within acceptable limits for 50 repeated tests (Bonferroni expectation = 0.5/50 = .001). It is probable therefore that the data can be regarded as adequately fit by an IRT model.

For the record, the largest residuals (and hence the paths most likely to be problematic) are, in descending order of residuals: Rejection to Loneliness (2.86);Rejection to Shyness (2.68); Shyness to Loneliness (2.35) ; Pessimism to Loneliness (2.24); Opportunity to Shyness (2.24); Loneliness to Shyness (2.21); Unattractive to Loneliness (2.16); Others Group Relationships to Shyness (2.15); Pessimism to Rejection (2.09); Loneliness to Rejection (2.08). If there is evidence of individual differences in the diagrams then it is most likely to be found in these particular paths.

Appendix 2

Presence or absence of paths. We restricted the analysis to those 24 paths which were included by at least 10% of the participants (since it was unlikely that differences would be found if less than 13 participants had included a path). We computed the correlations between the presence or absence of these 24 paths and the seven individual difference measures, a total of 24 x 7 = 168 correlations, of which 7 (4.2%) were significant at the 0.05 level, 2 (1.2%) at the 0.01 level, and one (0.6%) at the 0.001 level. Using a Bonferroni correction we considered as significant only those correlations which reached a nominal alpha level of 0.05/168 = 0.0003. In fact none of the correlations reached this level and indeed only one reached a nominal 0.001 level, which is as would be expected by chance alone. For the record, those correlations reaching an uncorrected 0.05 significance level were: the path from pessimism to lack of trying correlated .461 ($p<.05$; N=21) with the UCLA loneliness scale and -.456 ($p<.05$; N=21) with age; the path from others lack of try to loneliness correlated -.493 ($p<.05$; N=24) with the UCLA loneliness scale and -.486 ($p<.05$; N=24) with age; the path from impersonal situations to lack of opportunity correlated -.571 ($p<.05$; N=13) with the UCLA loneliness scale; the path from lack of knowledge to loneliness correlated -.497 ($p<.01$; N=27) with sex (i..e the path is stronger in males than females); and the path from fear of rejection to shyness correlated .624 (p=.00055) with neuroticism.