Chapter 1

Introducing Epinets: Why do we need an Epistemic Model of Social Networks?

Using examples and unstructured intuitions that highlight the importance of knowledge, beliefs, and mutual beliefs to the outcomes of social situations and interpersonal relations, we argue for the usefulness of explicit epistemic models of human interactions and networks. We introduce the notion of an epistemic state – a link between individuals and propositions they may know or believe – and an epistemic tie among individuals – connecting individuals epistemic states to one another: if Alpha knows Beta knows Gamma knows that the garden is closed after dark, then there is a set of ties connecting Alpha, Beta, Gamma and the proposition the garden is closed after dark, which is part of the epistemic structure of the situation. We show how the structure of epistemic networks formed by such links among individuals and their beliefs are relevant to the dynamics of human interactions, and how the dynamics of these networks are critical elements of complex interpersonal narratives.

What must human agents know about what other humans – with whom they are connected – know, in order for the resulting patchwork of ties among them to function as a social network? Suppose a study of the friendship network of a seven person executive team reveals that Beth, Harry and Martha form a clique: each describes both of the others as ‘friends’ in an anonymous survey. We describe the triad as a clique, rather than as a patchwork of ties, because we expect these three to exhibit some special forms of cohesion that may be evidenced by, for example, an above-average ability to coordinate, collaborate, communicate, and collude. That is, we expect triad to function as a clique: we may expect each of them to know – and know that the other two know – sensitive information about an event of mutual importance; or that such sensitive information will quickly propagate within the triad.
What each knows of and about the others and their knowledge is the ‘epistemic glue’ of the clique; it is what allows Beth to react to an unforeseen disaster in ways she knows Harry and Martha would find justifiable, and to make sense of their intentions based on observing their reactions and knowing what they think about what she knows. The grammar is somewhat complicated, but its complexity closely tracks that of the phenomena we would expect a clique to exhibit. This epistemic superstructure is what makes the clique a clique – an identifiable network substructure with very specific expected properties – rather than a patchwork of ties and connections that can offer no further insight or predictive value.

At a more fundamental level still, what must human agents know or believe about what others know or believe in order for their interactions to have joint or shared sense and meaning and to lead to stable patterns of interpersonal behavior? Game theory has contributed a basic canon of coordination, cooperation, and collaboration ‘games’ that require coherent mutual beliefs (players’ beliefs about other players’ beliefs’, about other players’ beliefs about their own beliefs, and so on) whose ‘epistemic structures’ can be analyzed to arrive at the pre-conditions for coordination, cooperation, collaboration, and even coherent communication. However, these neat analytical structures come at the cost of an over-simplification of what and how humans believe what they believe and know what they know. States of knowing like ‘oblivion’ (not knowing and not knowing you do not know) or ‘forgetting’ (knowing but not recalling the what you know) are ruled out by assumptions such as those of ‘common priors’ and ‘common knowledge’, even though they are all-important to the unfolding of real human interactions. Moreover, because the event spaces of game theory do not admit interpretations and shadings, the resulting analyses lack the subtlety required to understand that humans interpret ‘Can I pray while I smoke?’ very differently from the way in which they interpret ‘Can I smoke while I pray?’ The conjunctive ‘while’ functions very differently in first-order logic from the way it functions in plain English.
The contemporary importance of epistemic moves and epistemic games to understanding social interactions is clear in the direction of technological progress and innovation. *Homo sapiens* is *homo communicans*, and makes use of the full range of means for passing information-bearing signals to shape, control, and predict the social milieu of being in the world. The ‘cc’ (carbon copy) and ‘bcc’ (blind carbon copy) functions of everyday e-mail, for example, are levers for shaping the informational structure of the interaction: ‘Cc’ creates pools of mutual knowledge about the contents of a message, and is an aggregation tool; ‘Bcc’ oppositely brackets cliques that are ‘in the know’ from individuals outside of a circle of trust or power. But these are just the rudiments: new technologies allow senders to control a message after they have sent it – and possibly to delete it – making it possible for them to deny ever having sent it, even as they know the recipients know their contents; to ‘hack’ into each other’s e-mail servers to access the contents of critical messages without their authors knowing the hacker knows it; to encrypt messages so that only intended recipients can decode them on the basis of knowing which recipients know the public or private key that has been used to encode them. The complexity of ‘interactive epistemology’ has multiplied over the past few decades, and continues to do so. A new language and new models are needed to understand the epistemic glue of human social interactions.

We are interested in building intuitive, yet precise, models of the epistemic glue of social structures. We are assuredly not pioneers of the epistemic dimension of social interactions. Nuanced treatments of epistemic structures and effects have previously appeared in the fields of artificial intelligence [Halpern, Fagin and Vardi 1995], epistemic game theory [Aumann 1989] and analytic philosophy [Kripke 2011]. Nor nearly are we first to point out that social networks (and social structures more generally) require descriptions sensitive to differences between what social agents think and what we think social agents think about such structures [Krackhardt 1987]. What we are after is a toolkit for modeling, measuring, and manipulating the *epistemic glue* of human interactions.
and networks in ways that are as accessible to social network analysts as they are engaging to logicians, epistemic game theorists, and artificial intelligence researchers. We are ‘building an app’ as much as we are theorizing, modeling, or philosophizing.

**The Epistemic Structure of a ‘Friendship Tie’**

Because we are building an application as much as a theory, we need to become intimate with ‘user requirements’ – the kinds of uses to which our modeling toolkit may be put. To that end, consider the friendship tie between Beth and Harry in our example above. Beth ‘knows’ Harry; she sees him daily, is familiar with his latest setbacks and successes, works with him on a joint project, and sees him socially on average every other week. That is her longhand unpacking of the shorthand answer ‘Harry is my friend’, which she responded on our questionnaire. Now, what we want to know is this: when Beth needs Harry to convey to her, quickly and covertly, a sensitive piece of information she believes he has received from one of his acquaintances with whom Beth has no connection, what must Beth know about Harry for her to have good reason to believe that he will come through?

The minimal set of beliefs Beth would have to hold about Harry to rationalize her expectations might include: She believes that Harry knows the information is useful to her, that it is important to her that their office mate, Martha, does not know Beth has come to know it, and perhaps that Harry knows that Beth will not divulge her source after he has passed along the information. Complications can arise: If Beth knows Harry’s boss knows of Harry’s ties to Beth and is monitoring Beth’s actions in order to detect any sign that Harry has leaked to Beth information Harry was entrusted with in confidence, then Beth may have to believe Harry knows of this threat and trusts in Beth’s integrity and competence to not ‘blow his cover’, or that Harry does not know about this threat (in which case, she may choose to inform him of it, as would befit the level of trust she assumes they share).
In each case, there is a structure to the knowledge that the social agents ‘share’ that both is intelligible and intuitive, although it grows quickly in logical complexity with the addition of new information and people. The structure of this ‘epistemic glue’ is rendered intuitive and intelligible by the recursive and interactive nature of what should be properly called ‘social knowledge’ it relates to, which is often knowledge about knowledge: Beth’s knowledge about Harry’s knowledge, which includes knowledge about Beth’s knowledge about Harry’s knowledge, and so on. The structure of the epistemic glue is ‘interactive’: it does not only link a agent’s mind to a proposition, but also one agent’s mind to a proposition via at another agent’s mind: Beth knows Harry knows that Harry’s boss is monitoring Beth’s actions for any sign of information leaked by Harry.

Of course, it is not only knowledge, but also beliefs, conjectures, and even barely articulated hunches that we want to be able to capture and address with our language. Beth may not know – by any acceptable use of ‘knowing’ – that Harry knows that the piece of information he possesses should be transmitted to Beth in a way that guards against eavesdropping – but may simply believe it for reasons having to do with a complex of other prior beliefs. Harry may merely ‘sense’ that Beth needs him to transmit the information covertly, without really having fully articulated that hunch as a proposition. All of these are legitimate objects of modeling, measurement and manipulation for our app. We need a comprehensive conceptual framework to engage the range of states in which humans find themselves in vis-à-vis propositions about the world. To study the gamut of mental objects playing pivotal roles in the relationships that form the fabric of human networks we will use the covering term epistemic states, and represent them as directed ties between social agents and propositions, which are grammatically correct sentences in natural language or well formed formulas in propositional logic. And, we will refer to the networks that comprise a group of social agents, potentially true or possibly true propositions, and the interactive (‘I think that you think…’) and recursive (‘I know that I know…’) relationships among them as epistemic networks or epinets.
Let us give meaning to these words through usage: if Beth knows that Harry knows that Beth needs Harry to convey a piece of sensitive information to her quickly and covertly, there is a path connecting Beth to Harry to the fact that Beth needs Harry to act in such and such a way: an agent to another agent to a proposition. If Harry knows that Beth knows this, then there is a path that connects Harry to Beth to Harry to the proposition in question; if Beth knows Harry knows Beth knows this, then there is a further path making the correspondent connections, and so on. One can add agents (Martha, Harry’s boss) and beliefs (the boss’s vigilance) to the epistemic network, as well as additional interactive loops involving one (‘Beth knows that she knows what she knows’), two (‘Beth knows Harry knows Beth knows…’) or more (‘Beth believes Harry believes his boss believes that Beth believes…’) agents.

**Epinets in Shakespeare, Kesselring, and Durrenmatt: That upon which the Plot Turns**

Epinets evolve, and as they do ‘things happen’, socially speaking. Far from being epiphenomenal – appearances *sine* consequences – changes in epistemic networks are that upon which ‘plots turn.’

In Shakespeare’s *Othello* (ed. 1963), epinets formed by epistemic states of Othello, Desdemona, Iago and the audience are essential to the interpretive schemata that allow us (the audience) to understand what the play is all about. The play can be understood as the evolution of the epistemic states of its lead protagonist, Othello, from a state of oblivion and trust, through states of doubt and suspicion, to a state of certainty about a false belief regarding the infidelity of his wife, Desdemona. The epistemic state changes can be traced to a set of manipulations by his lieutenant, Iago, that make careful use of the structure of interactive epistemic states – what Othello thinks Desdemona thinks when she says what she says, what he thinks she thinks he thinks,…).

At the beginning of the play, Othello believes unconditionally in Desdemona’s loyalty and faithfulness to him. He trusts her, in the sense of believing that she would not be able to evince
fidelity and love if she did not feel it. Othello is also oblivious of the possibility that Desdemona is attracted to the young Cassio – one of his lieutenants, and rival to his chief lieutenant and schemer Iago – in the sense that he gives this possibility no thought. It is not that he, if asked about Desdemona’s putative relationship with Cassio, would say, ‘I do not know’, or, ‘I do not believe it is true’, but rather, that he would be shocked by the presumption and by the suggestion of the possibility. At the same time, he is jealous of Desdemona, yet not aware of this jealousy, which makes this feeling an easy target for Iago to play with. Iago seeds doubt in Othello’s mind regarding Desdemona’s fidelity and manages to augment this doubt by playing with what Othello thinks Desdemona thinks, and what Othello thinks Desdemona thinks he thinks: When Desdemona realizes that Othello is both jealous and, now, suspicious, she attempts to endear herself with loving entreaties. However, Iago has also managed to plant in Othello’s mind the thought that Desdemona is a masterful dissembler, and therefore Othello interprets these entreaties as masterful dissimulations of faithlessness rather than avowals of love.

Some outright lying and other trickery is required on Iago’s part to wean Othello from his trusting mood, but the deceit succeeds because of the prior work Iago has done in setting up the right epistemic states among Othello, Desdemona, Cassio, and himself. In particular: Othello believes that Desdemona is unfaithful, knows she does not know whom he suspects her of being adulterous on him with, believes she knows he is suspicious, and therefore thinks she is likely to ‘protest’ her love of him exaggeratedly so as to lay his suspicions to sleep. When Desdemona – oblivious of much of this epistemic structure – intervenes in favor of her presumed lover Cassio (who has in the meantime fallen from Othello’s grace after a conflagration into which he is cunningly pulled by Iago), the epistemic trap Iago has set for Othello works exactly planned. Othello sees the situation as one of figuring out with who his wife is cheating on him, rather than whether or not she is cheating on him. Iago’s soliloquies keep the viewer informed of the dynamics of Othello’s
epistemic states, contributing to the indignation the audience feels witnessing the epistemically-trapped Othello smother Desdemona a fit of jealous rage; an indignation that is assuaged, though perhaps only partly, when a finally awakened Othello finally sees Iago for the vile manipulator he has turned out to be and attempts, unsuccessfully, to kill him.

In Joseph Kesselring’s *Arsenic and Old Lace* (1942) the central character, Mortimer Brewster, is deciding whether or not to fulfill his promise to marry the woman he loves, on the complicated emotional landscape of his family, which includes two elderly spinsters – Abby and Martha – who, while passing off as ‘good Christians’, specialize in poisoning lonely old men with a home brew of cyanide-and-arsenic-laced elderberry wine, a brother – Teddy – who believes he is Teddy Roosevelt and digs graves for the spinsters’ murder victims in the cellar of Mortimer’s home thinking he is digging locks for the Panama Canal, and a murderous brother, Jonathan. The characters are oblivious of each others’ beliefs and intentions – they do not know and do not know they do not know – and the only bits of information that are common knowledge are either false (‘the spinsters are good Christians’) or relatively useless (‘Teddy thinks he is Roosevelt’). It is this oblivion – of which the audience is aware – that creates the tension between what the characters say, do and cause one another to think, and what the audience knows they know, as illustrated in Figure 1.1.

Friedrich Durrenmatt takes the strategy of building dramatic tension based on interactive epistemic knots and tangles to a higher level in *The Physicists* (*Die Physiker*; 1961; English translation by James Kirkup 1991). The play is set in a sanatorium for the mentally ill run by Dr. Mathilde von Zandt, a famed psychiatrist, and features three patients – Beutler (who ‘believes’ he is Sir Isaac Newton), Ernesti (who ‘believes’ he is Albert Einstein) and Moebius (who ‘believes’ he is visited regularly by King Solomon). Einstein has just murdered one of his nurses and the ensuing police investigation turns up the fact that Newton had also earlier murdered a nurse. ‘Believes’ is in
quotation marks above because it represents a far more complex interactive epistemic state, which the second act elucidates. Specifically, it refers to the fact each inmate *pretends* to believe in a false identity for the benefit of the asylum staff and of Mathilde von Zandt in order to more convincingly feign the madness required to cover up his true identity and allow him to reside in the asylum. Mobius *is* in fact a renowned physicist who has checked into the asylum to protect his inventions from government exploitation, and is tracked by two foreign spies – Newton and Einstein – who are interested in appropriating one of his inventions to their etatist ends. Meanwhile, Mathilde von Zandt *pretends* to believe that Newton and Einstein are who they say they are and that Mobius is deranged in order to appropriate Mobius’ invention for herself.

As illustrated in Figures 1.2 and 1.3, that on which the plot turns in *The Physicists* is not only an epistemic network that includes states of knowledge, uncertainty, and oblivion regarding both facts and intentions, but an evolution of that network – between the two acts – that remains consistent with regard to facts – the murders of the nurses, the fact that the action unfolds in an asylum – but upends the viewer’s interpretation of those facts (e.g., that Einstein and Newton are mad, and that Dr. von Zandt is their mental health care-giver).

‘Everyday’ Epistemic State Tangles

If we are correct that interactive and reflective epistemic states make a very large difference to explaining and understanding human-social behavior, then we should be able to show how epistemic states and the epistemic links that connect them produce insight into common interactive situations and predicaments. For instance:

**Vignette 1.** Alice is seeking a job in Bob’s firm. She is being interviewed by Bob for this purpose. Alice made some false statements on resume sitting before Bob while the interview is
Vignette 2. Alan sends an electronic message to Belinda and, without specifying in his letter to Belinda that he is sending it anywhere else, also sends the message to Charles, who is Belinda’s boss, via a ‘bcc’ message. So, Alan thinks Belinda knows its contents, Belinda thinks Alan thinks Belinda knows it (absent any other considerations), Alan thinks Charles knows its contents and Charles thinks Alan knows its contents (absent any other considerations). However, Belinda does not think that Charles knows it – otherwise the ‘cc’ sign would have appeared in the message, even though Charles thinks Belinda knows it and also thinks that Belinda does not think that Charles knows it. Charles can therefore ‘play’ with Belinda, assuming that Belinda does not think that Charles knows it. Charles also knows that Alan thinks that Belinda does not think that Charles knows it, and therefore can also wield some power over Alan, by credibly threatening to respond to
Alan’s message and sending a ‘cc’ copy of the response to Belinda, on which Belinda’s original ‘bcc’ will appear as a sub-header.

**Vignette 3.** The CEOs of three large consumer goods firms selling undifferentiated products to a homogeneous market decide to coordinate their pricing of a particular product in order to prevent a new competitor from entering their market space. Because they do not want to get together and explicitly set prices for the critical period of time in which the threat of entry is high – lest they be found out and pursued by antitrust authorities – they must coordinate tacitly. Accordingly, by a series of sequential price cuts or hikes, they aim to arrive at a mutually agreeable price level. The goal of the exercise is common knowledge among the oligopolists – every one of them knows it, knows that every other one knows it, and so forth, *ad infinitum*, as is the fact that any oligopolist can use the disguise of a rational response to the threat of entry by a new competitor to steal business from his incumbent rivals. Should one oligopolist implement a severe price cut (down to or below his marginal cost, for instance), the other oligopolists will infer a breach of trust, which they would not have inferred had the structure of the pre-emption game – as well as the possible excuse given by the oligopolist – not been common knowledge among them.

Trust, in this case, keeps the price-fixing game from turning into a ‘Bertrand game’ in which the oligopolists dissipate their profits by bidding all of the prices down to their marginal costs. This trust is predicated on a base of mutually shared assumptions – facts and premises each oligopolist knows all others to know; as well as a set of shared premises that allows each oligopolist to make sense of every other oligopolist’s actions in the context of the price-setting game (such as the fact that it is possible for an oligopolist to fake panic at an imminent new threat and slash prices in response but, would only do so provided that every other incumbent takes the same view of the threat in question).
**Vignette 4.** The Board of Directors of XYZ Corporation has reached the decision to terminate the employment relationship of the firm’s CEO at a board meeting that did not include him. The date of the public announcement of his departure has been set. The firm is in a delicate financial and organizational state, with many key employees on the verge of resignation, and with key accounts at stake upon the departure of some key employees, some of whom are loyal to the outgoing CEO. The board expects that the mode, manner, and timing of the announcement will play a key role in determining the ongoing viability of XYZ. To quell rumors and speculations that could lead the outgoing CEO to break confidence and communicate the impending changes in a detrimental way, a controlled and well-timed release of the announcement is desired, with some key employees being brought into a ‘circle of trust’ that can manage the firm on a daily basis in advance of a public announcement.

Because of the board’s fragmentary and sporadic access to the everyday communications within the firm, it is important for the leadership to be able to know, in advance, the informational paths that the news will propagate along, in order to predict the response of the organization and to control possible side effects. It is well known to the directors that conveying the news ‘in confidence’ to key employees may generate an informational cascade in which each recipient also conveys the news ‘in confidence’ to a few trusted employees, to show connectedness, signal their importance, or simply out of a conspiratorial inclination. The question for the Board is: Who can be trusted, and who trusts whom at XYZ? The trust in question is not of a ‘generalized’ kind: it is not merely the inclination to act cooperatively. Rather, what the board needs is a depiction of the informational relationships within XYZ that will enable the news to be communicated in a precise, reliable and secure fashion. Clearly, such a trust relationship will turn on what each party thinks the other thinks – or knows – at a moment in time, and what the relationship between what someone says and what is actually the case in fact is. The trust that any employee ‘A’ will place in any
employee ‘B’ will turn on both A’s confidence in B’s integrity (safeguarding the source and content of the information) and on A’s confidence in B’s competence (saying no more and no less than what is true and relevant at a particular point in time, without any colorful distortions or purposeful omissions). Such confidence may need to be safeguarded by A’s expectation of B’s own trust in A (‘only the trusting can be trusted’), which in turn generates new complications in the description of what a trusting relationship is.

‘Information games’ of the type we have reconstructed in these vignettes are entertaining because the moves they comprise produce changes – potentially very large changes – in a larger pattern of interactive epistemic states which also overturn the emotional landscape of the situation. Baseline assumptions that social agents make of each other – of cooperativeness, trustworthiness, rationality, or docility – are uprooted by single and often involuntarily conveyed signals.

Exformation – that which the sender of a message does not say, but is nevertheless relevant to the receiver precisely because it goes unsaid – can be as informative as information, provided that the right ‘epistemic tangle’ is in place: if Alice thinks Bob knows that Alice is about to be fired and Bob says nothing to Alice when they have lunch together, the absence of a signal from Bob will impact Alice’s trust in Bob, and her estimate of his support.

Ambiguous or complex epistemic states can be useful for either creating or breaking the trust required for information to flow freely; the local and temporary topology of an epinet can change the meaning of signals being exchanged between the agents within it. Differences among the epistemic states of agents and among the relationships between them – that which epinets are designed to capture – make a difference, often a very large difference, to the ensuing dynamics of the relationships, or of the network.

**Epistemic States and Epistemic Networks as Explanation Generating Engines**
The epistemic glue whose microstructure we are aiming to model via epistemic networks is intimately and ubiquitously involved in empirical studies of network phenomena. Networks of interorganizational collaboration [Powell, Koput, and Smith-Doerr 1996] rest on shared knowledge about tasks, technologies and capabilities of other organizations in the same network, as do interpersonal networks of collaborative creative work [Uzzi and Spiro 2005]. The cohesiveness and robustness of such networks hinge on regimes of trust among agents that often make possible the playing-out of ‘private games’ [Burt and Knez 1995] that may be ‘too dangerous’ [Burt 1999] in their absence. Co-mobilization in networks is sensitively dependent on what agents believe other agents will do if the former decide to mobilize [Chwe 1999], as well as on the fact that they know what other agents (validly) know they believe.

Yet, their own social networks often confront agents with ‘horizons of observability’ [Fredkin 1983] that constrain their knowledge of the set of agents in the network to those corresponding to adjacent or alter-adjacent ‘nodes’, thus limiting the explanatory power of models of affiliative behavior predicated on an agent’s knowledge of the position of every other agent within the network [Gould 1993; Jackson 2005]. The explanatory success of network theories of interpersonal and interorganizational phenomena thus depend on researchers’ assumptions about what agents know, what they know about what other agents know, and the extent to which they trust what they and others know.

We are about to develop a precise way of representing states of knowledge, awareness, ignorance, etc. – jointly, epistemic states – of agents in a social network that permits development of new theory about the relevance and importance to the structure and dynamics of (interpersonal and interorganizational) networks (networks tout court, henceforth), as well as of more precise measurement instruments and techniques for testing and validating the theory. When we model social structure as a social or economic network of agents, we pay a price in explanatory depth and
generality when we omit an epistemic model of the structure in question. Consider the problem of predicting which among a large number of possible exchange networks will form among a set of agents interested in net-benefit-of-affiliation maximization [Jackson 2005; Ryall and Sorenson 2007]. Existing analyses typically assume that the value associated with the formation of different ties is given and known to all of the agents and concern themselves with the calculation of the feasible or efficient networks that will emerge as a result of different agents forming the ties that are most beneficial to them. However, if we assume that agents form ties on the basis of cost-benefit calculations regarding the values of different possible ties that are in turn based on their knowledge of the value associated with each possible tie they could form, then we see that the set of possible ties must be conditioned by what agents know or believe about the value of forming any one particular tie. In order for the most efficient of possible networks to form, the function that assigns values to each possible tie has to itself also be known to all network agents.

Two options are available to the realistically-minded modeler who wants to examine the conditions under which this assumption is valid. One is to posit that, even though not all agents are informed about the value of all possible ties they could form, they can become informed over a finite period of time. In this case, the explanatory problem shifts to the mechanisms by which a full-knowledge state can be achieved. Different mechanisms for information dissemination are likely to create different knowledge regimes within the network. Broadcasting the value function, for instance, will achieve full knowledge provided that (a) every agent is tuned in to the broadcaster and (b) every agent considers the presence of the broadcaster’s signal to be sufficient reason for believing the signal to be valid. Stipulation (a) raises questions about the marginal proclivity of agents to tune in to the broadcaster (e.g., it assumes that they believe the broadcaster can and has reason to supply information that is useful to them, and also that they are aware of the fact that they are ignorant of the information, rather than oblivious of it). Stipulation (b) raises questions about the
trustworthiness of the broadcasting source. Alternatively, the value function can be assumed to ‘percolate’ through the network through word of mouth and rumor propagation. The relative success of this explanation will hinge on the marginal proclivity of agents (a) to inform each other truthfully and (b) to believe each other authentically; that is, on the trustworthiness and trusting-ness of network agents – qualities likely to be heterogeneous.

The second option is to assume that not all agents under examination know the value function. This creates a different explanatory agenda, aimed at figuring out ‘who knows what’ at any point in time. One possibility is to ‘survey the field’, but this approach has the disadvantages of (a) assuming that agents know what they believe or (b) inducing knowledge states that these agents would not otherwise have and which cannot therefore function as valid explanatory variables for what ‘would have happened had there been no intervention’ (see Seidel and Westphal 2004 for evidence of such researcher-initiated information contagion). Since, moreover, one is interested in predicting what actions agents are likely to take by virtue of their knowledge, it is also important to understand whether or not different agents ‘believe or trust what they know’, which leads to the need to make finer distinctions in what we mean about ‘knowledge’ in terms of the credibility or trustworthiness of the knowledge source.

What emerges from this discussion is the need to get precise about knowledge even when trying to explain a relatively simple network phenomenon such as purposeful tie formation. Getting precise about knowledge requires more than just an effort to specify a function that maps bits of knowledge to individual network agents; the ways in which they know what they know are also relevant. Higher-level epistemic states such as awareness, oblivion, and ignorance are as important as first order states such as risky and uncertain belief. Moreover, interactive epistemic states such as trust, trustworthiness, trusting-ness, and credibility are crucially important to the kinds of plausible and testable stories that we can tell about network formation. By distinguishing epistemic differences
likely to make a material difference, we are aiming to make the study of network epistemics an important component of network modeling and inquiry.

The Way Forward

We have introduced the notion of epistemic glue as a prerequisite for the explanatory power of network models of social interaction and social action. We showed that this glue has structure, comprising the set of epistemic states and ties among networked agents. We illustrated how the evolution of this structure produces changes in the outcomes of interactions (‘narratives’) and took this to be a telling sign of the causal significance of such structures. We defined epinets as symbolic representations of the glue underlying social networks and established that they matter, as well as, more loosely, how they matter.

The investment to be made in appropriating a new language for modeling and representing phenomena is substantial. In spite of what we hope is a persuasive argument in favor of considering epistemic states in detail and incorporating them systematically into the analytical apparatus of social network analysis, we recognize that some additional surplus of insight and explanatory power is likely required to generate the necessary inducement to compensate for the required cognitive effort. To this end, we summarize below and elaborate in subsequent chapters applications that the epistemic imagery enables in key areas of social network theory and research.

*Insert Figure 1.4 about here.*

Figure 1.4 illustrates the organization of the book. We begin in Chapter 2 by outlining the primitives of an epistemic description language – an EDL – that can be used to describe epinets that comprise individual agents, propositional beliefs, and epistemic states. In Chapter 3, we deploy the EDL to show how interactive epistemic states (what agents think about what other agents think) can be used to understand fundamental network phenomena such as brokerage and closure via the
epistemic analysis of basic mechanisms of network formation, co-mobilization, coordination, and communication. In Chapter 3, we also show how self-referential epistemic states (beliefs about the structure of the network itself) can be used to analyze components of status, including knownness, fame, glory, and clout. In Chapter 4, we examine in detail how interactive epistemic states can be used to unpack and analyze trust-based relationships and network structures, such as ‘circles of trust’ and superconductivity. We transition from epinet structure to dynamics in Chapter 5, introducing a series of moves and strategies that are defined as operations that agents perform on the structures of epinets of which they are part. We also introduce concepts that function in a manner similar to that of equilibrium in game-theoretic accounts, and show how these concepts can be used to understand the long-run dynamics of epinets.
Figure 1.1. Epistemic Network: Arsenic and Old Lace

Common knowledge:
Abby and Martha are good Christians interested in charity work.
Teddy thinks he is President Roosevelt.
Teddy knows everybody thinks he thinks he is President Roosevelt.
Mortimer thinks Abby and Martha are nice Christians interested in charity work.
Mortimer knows Teddy thinks he is President Roosevelt.
Mortimer thinks Teddy and Jonathan are insane.
Abby and Martha want Teddy to think he is President Roosevelt.
Abby and Martha think they help their gentlemen by killing him/do charity work.
Abby and Martha think Mortimer is (a) harsh (critic).
Mortimer thinks Abby and Martha are nice Christians interested in charity work.
Mortimer knows Teddy thinks he is President Roosevelt.
Jonathan knows Teddy thinks he is President Roosevelt.
Jonathan thinks he has to kill Mortimer and eventually Teddy.

Note: Arsenic and Old Lace (and thus these stills from the 1944 film, are in the public domain. All images are in the public domain.
Figure 1.2. The Physicists: Epistemic Network, Act I.

Dr. von Zandt (DZ)

DZ thinks she knows best who her patients think they are.

Inspector (I)

I thinks P2 thinks King Solomon ordered him to kill Nurse Monika.

P2 says he pretends to be Newton.

P2 says he is Einstein.

P2 thinks everybody thinks he thinks he is Newton.

P2 thinks P1 is crazy because he thinks he is Einstein.

Patients (I, DZ, nurses, audience) think P1 thinks he is Einstein.

P1 pretends to be Einstein.

Patient 1 (P1)

Patient 2 (P2)

Patient 3 (P3)

P3 thinks others think he is mad.

P3 thinks P2 thinks he is Newton or Einstein.

All images are in the public domain.
Figure 1.3. The Physicists: Epistemic Network, Act II.

Common knowledge:
- All three physicists think staying in the madhouse is a rational choice to make: They think they should think they are mad.
- The three physicists think Dr. Von Zandt is mad.

Nurse Monika (NM)
- NM doesn’t think P3 is mad so anything he sees must be true.

Patient 1 (P1)
- P1 thinks he is not mad but a physicist and secret agent, Eisler.
- P1 thinks the Intelligence Service thinks P3 is not mad but a great physicist.

Patient 2 (P2)
- P2 thinks he is not mad, but a physicist and secret agent, Kilton.
- P2 knows everybody thinks he is mad.
- P2 thinks everybody thinks he is Beutler.
- P2 thinks he is not mad, but a physicist and secret agent, Kilton.
- P2 thinks I is crossed because he cannot arrest him.

Patient 3 (P3)
- P3 doesn’t want NM to believe in King Solomon/his sanity.
- P3 doesn’t think she doesn’t believe King Solomon appeared to him.
- P3 thinks P2 is a physicist and secret agent spying on him.
- P3 thinks all three of them should stay in the madhouse because they are rational physicists.
- P3 thinks P2 should escape the madhouse and get recognition for his genius.
- P3 thinks P3 thinks King Solomon appears only to him.
- P3 thinks P3 thinks she doesn’t believe King Solomon appeared to him.

Dr. von Zandt (DZ)
- DZ thinks the three physicists and herself are all sane.
- DZ thinks King Solomon appeared to her.
- DZ thinks P3 thinks King Solomon appears only to him.
- DZ thinks P3 thinks she doesn’t believe King Solomon appeared to him.
- DZ thinks P3 thinks King Solomon appears only to him.

Inspector (I)
- P2 thinks I is crossed because he cannot arrest him.
- P2 thinks he is not mad, but a physicist and secret agent, Kilton.

All images are in the public domain.
Figure 1.4. Organization of the Book

Epistemic States

Agents

Propositions

Individual

Collective

Interactive

Knowledge, awareness, ignorance, oblivion

Status, known-ness, clout, fame, glory

Knowledge distribution, commonality

Cohesion, coordination, co-mobilization

Brokerage, closure

Trust

Chapter 2

Chapter 3

Chapter 2

Chapter 3

Distortive and clarifying

Divisive and collusive

Chapter 3

Chapter 4

Chapter 5

Chapter 5

Statics: Epistemic Structure of Social Networks

Dynamics: Moves and Strategies on Epinets