Schema blending and stable structure in online social systems

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Abstract: Autonomous online social systems can emerge from the interaction between the stable social practices of soliciting and eavesdropping when they are performed online. These practices are distributed manifestations of the stable mental operation of conceptual blending. The technology mediating the communication in the practices must be polymorphic, noisy and open.

Keywords: superorganisation; autonomous business; online community; distributed cognition; emergent community.

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1 Introduction

Many online socio-technical systems function and operate similarly to offline systems, despite differences in implementation. Because of this functional and operational similarity, we refer to such systems as *superorganisations* – the artificial equivalent of Wilson's (2000) superorganisms, in which features of a colony of organisms are substantially similar to the features of individual organisms. Of particular interest to us are superorganisations that can function autonomously, without workers or managers guiding them and without centralised control. Examples of such autonomous superorganisations include the online auction *eBay.com*, the web journal *Xanga.com*, the picture-rating service *HotOrNot.com*, and the electronic message board *YesNoMaybe.com.* Though some of these are commercial enterprises that, in fact, employ personnel for support, we view them as autonomous superorganisations because they could conceivably function without these employees, a possibility acknowledged by high-level managers of these enterprises who have been quoted publicly as saying "a monkey could drive this train" (*e.g.*, Lashinksy, 2003).

Such autonomous superorganisations are stable and have operated successfully for years. While we know that they exist, like superorganisms, we do not quite understand how they develop and run autonomously. As cognitive scientists, we view them as kinds of intelligent systems and aspire to uncover a common process theory (Mohr, 1982) that explains both how they emerge and how they operate autonomously. What would constitute such a process theory? Note that by definition, since these systems are autonomous, they are self-managing or, more generally, *self-organising*. According to Camazine *et al*. (2001, p.8), self-organisation is:

> "… a process in which pattern at the global level of a system emerges solely from numerous interactions among the lower-level components of the system. Moreover, the rules specifying interactions among the system's components are executed using local information, without reference to the global pattern".

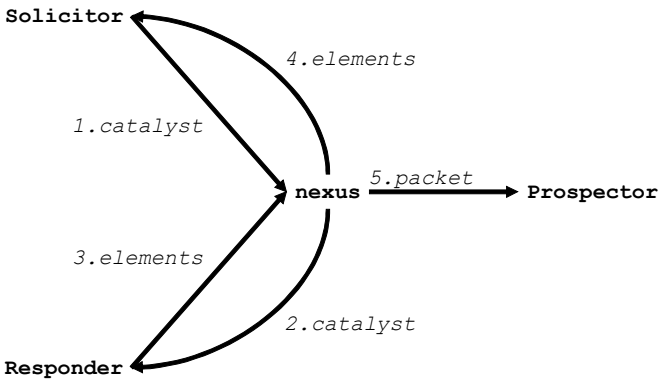
Thus, we would expect a process theory of an autonomous superorganisations to explain how a global pattern within the superorganisation emerges from the interactions between local processes.

Our first step, in building a common process theory of autonomous superorganisations (hereafter, abbreviated as 'superorganisations') is to identify a common pattern at the global level of the system that they all contain. Unfortunately, *prima facie*, there does not appear to be such a pattern. Aside from the way the above-mentioned superorganisations all use internet technologies, there seems to be little in common among eBay, Xanga, HotOrNot, and YesNoMaybe – functionally and operationally, they appear quite different.

2 A common global pattern: the symbol engine

Hutchins (1990) argued that computational work in collaborative systems is achieved via the propagation of representational state across media. Thus, if there is a common global pattern doing computational work, one way to find it would be to chart the propagation of representational state in various superorganisations and to find commonalities in these charts. Indeed, charting the propagation of representational state across media in superorganisations reveals a common mechanism, the *symbol engine* (Flor, 2004b), a distributed cognitive system consisting of three kinds of actors (solicitors, responders, prospectors) organised around a technology (nexus). The symbol engine generates a constant stream of symbols by coordinating the activity of these actors and this technology in specific ways (see Figure 1).

Figure 1 The symbol engine: a common global pattern in superorganisations



A solicitor supplies a catalyst to an online technology or nexus (*e.g.*, a seller entering a description of an item into an online auction; or a person posting a topic on a web forum). A responder receives the catalyst and replies with elements (*e.g.*, a potential buyer contributing a bid, or a person offering an opinion). The nexus organises the catalysts and elements as a packet that can be acquired by prospectors (*e.g.*, an online auction making the current bid and bid history available to auction watchers, or a web forum making a topic-opinion thread available to forum lurkers). Table 1 shows how these parts work together in the four aforementioned superorganisations.

Table 1 Superorganisation and symbol engine parts

superorg (.com)	*nexus*	*solicitors responders prospectors*	*catalyst*	*elements*	*packet*
Yes	forum	topic posters	topic		
No		opinion posters		opinions	
Maybe		forum lurkers			thread
Hot	picture rater	picture posters	picture		
Or		picture voters		votes	
Not		picture viewers			picture score
Xanga	blog	journal writers	entry		
		commentators		comments	
		subscribers			diary annot.
eBay	auction	auction sellers	item info		
		auction buyers		item bids	
		auction watchers			bid history

Analysing the movement of observable representational state across the media in various superorganisations exposed the global pattern of the symbol engine. Given this common global pattern, our remaining steps are to:

1 determine the nature and function of the local processes that constitute the symbol engine

2 explain both why they initiate and how they interact to manifest this global pattern.

3 Analysis of local processes in a superorganisation: YesNoMaybe.com (YNM)

The local activities consist of the actors (solicitors, responders and prospectors) vectoring symbols (catalysts, elements and packets) to and from a technology (nexus). However, the details of the processes that underlie these activities are not apparent from an analysis of observable representations alone. Because symbols in these cases are produced by people in coordination with technology, understanding production requires characterising processes and structures that are internal to the people involved. To induce what those internal processes are and how they coordinate with technology to manifest the global pattern, we analyse data from a successful superorganisation: YesNoMaybe.com.

YesNoMaybe.com (abbreviated 'YNM') is the most popular teen advice forum on the internet (Alexa, 2004). In a forum, members can post messages and other members can reply to them. The forum technology organises related messages into a 'thread.' Table 2 shows a part of a discussion thread taken from YNM. We selected this example because it typifies the kind of threads found on YNM. In the thread, G1 (solicitor) posts a topic asking for help with a social problem, and G2 (responder) posts an opinion containing several strategies for G1 to try.

Table 2 Data: advice thread (*packet*)

Actor	*Catalyst/Element*
G1 – solicitor	Hey, I've been friends with this guy since fifth grade, and I've also liked him since fifth grade. It's more than like though, I know I'm in love. I'm in 10th grade now and we went out once in seventh grade...We are still really good friends and everything.
	I'm pretty sure that he's getting signals that I like him, and I think that might be scaring him farther away from me than I'd like it to be. I know we are perfect for each other, and we have so much in common; from our birthdays to what we eat, to thinking and saying the same things at the exact same time. We flirt often, but i don't know, it's kinda like flirting as friends, if you know what I mean.
	It's really hard to get over this guy, and I've reaaaallly tried to like others, but I know there's only one I will always love.
	What I'm basically trying to say is...help...I need some advice. Do you think it's possible that he'll ever like me again? How can I make him see that we are perfect for each other?
G2 – responder	Well, you could try the 'Make him Jealous' approach....
	Flirt with other guys when he's around and sometimes when I tried it he would tell me we had to go do something, like he wanted me away from them....
	And see if he does get jealous, keep doing that sometimes, and if he doesn't, just keep sending litte signals like a brush up against the arm or little things like that when you're together to make it seem less obvious..
	Or you can tell him you are sorry for the really flirty behaviour, your just trying to keep your friendship (if you say he is pulling away)
	Just try some of those things....

This kind of exchange is so commonplace among individuals living in close proximity that, while perhaps amusing, it seems unremarkable. However, the internet addresses of G1 and G2 indicate that they were both in the USA, but from different states, Virginia and Kansas. The ability of people to advise others who live in different parts of the country and who have never met is, in fact, quite remarkable. This sort of exchange of ideas would be impossible without the technology of the internet for propagating text from solicitor to responder and back again. Moreover, the propagation of text would itself be useless if the participants could not understand and use the information presented.

Apprehension of the information in the thread recruits a number of fundamental cognitive processes, not the least of which is the ability to read and understand English. The information is useful because readers whose specific circumstances differ can still make use of the advice. In fact, even third-party readers – potentially including readers of this paper – can understand and use the advice provided by G2 to advise teens in similar situations. Through a detailed analysis of the thread, we will demonstrate the local cognitive process that makes it possible for solicitors, responders and prospectors to derive a common schema from it.

The exchange shown in Table 2 begins with a post by G1 in which she describes an asymmetric relationship with a male friend B1. G1 likes B1, but it seems that B1 does not necessarily like G1 back. We can view G1 posting a topic as an attempt to acquire a *schema* for attracting B1. However, to do so she does not simply post, 'How can I make this guy like me?' Rather, her posting is rich with background information about herself, the history of her relationship with B1, and includes a description of schemes she has

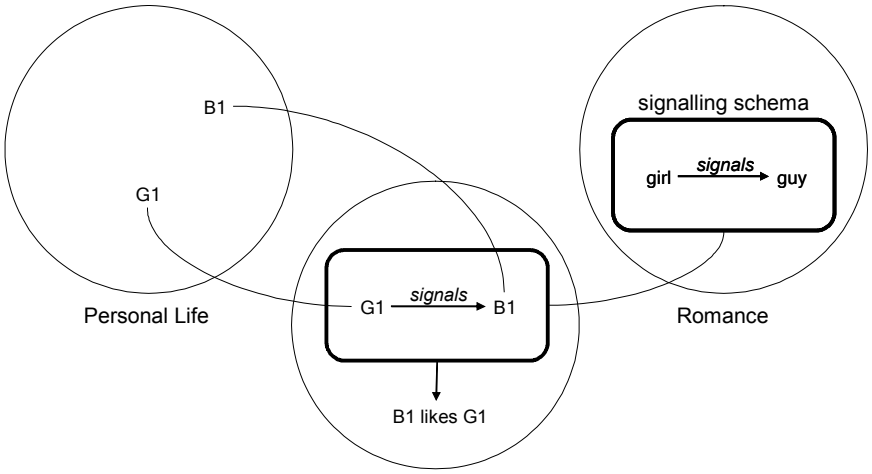
already used unsuccessfully to interest B1. Only after providing this background information does she ask for help. Similarly, G2's reply can be seen as providing a number of schemata that G1 can use in order to attract B1. Moreover, G2's reply includes personal details about her own romantic experiences that presumably serve to motivate her suggestions for G1.

The inclusion of personal details in both query and response suggest that the exchange of information (in this case, attraction schemata) is mediated by cognitive processes that integrate information at multiple levels of abstraction. Conceptual Blending Theory (Fauconnier and Turner, 2002) accounts for meaning construction in terms of specific methods for combining information from different domains, often yielding novel emergent structure. In describing her unsuccessful attempts to attract B1, G1 can be seen as constructing a number of simple integration networks, as outlined by conceptual blending theory. Though other models of reasoning might be able to account for some aspects of meaning construction in this discussion thread (*e.g.*, structure alignment and structure mapping; Gentner, 1983; Gentner, 1998; Gentner and Medina, 1998), the complete thread requires the sort of double-scope blends that are unique to the conceptual blending theory.

3.1 Solicitor analysis

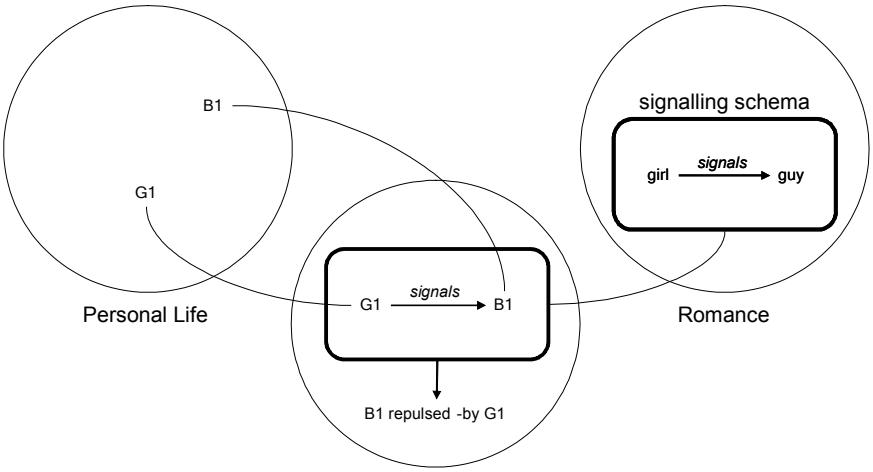
Conceptual integration networks consist of concepts from two or more input domains, a blended concept that includes some structure from each input, and frequently includes generic concepts that represent abstract commonalities shared by the inputs. The two input domains in this example are G1's personal life and a more abstract domain of background knowledge about romance. One attraction schema from the romance domain involves the female signalling her attraction to the male and ends with the male initiating a romance. A simple form of conceptual integration might involve projecting the fillers from the personal domain (G1 and B1) to the blended space, to be integrated with the slots in the abstract signalling frame. In an abstract simulation ('running the blend'), this would end with B1 responding to G1's signals by initiating a romance (see Figure 2).

Figure 2 Normative application of the signalling schema



However, G1's statement "I'm pretty sure that he's getting signals that I like him, and I think that might be scaring him farther away from me than I'd like," indicates that this strategy has had a different effect on her own personal experience. In the initial (rather abstract blend), the relationship between G1 and B1 is assumed to involve mutual attraction without mutual knowledge (*i.e.*, B1 is attracted to G1 but does not realise that G1 is attracted to him). The disanalogy between the outcome of the blended scenario and what actually happened (B1 was repelled by G1's signals) suggests that the underlying assumptions in the frame in the romance domain do not obtain in the personal domain (see Figure 3).

Figure 3 Actual application of the signalling schema



Another strategy for dealing with unrequited love is to give up on the desired target and pursue alternatives. G1 indicates familiarity with this strategy with her comment, "I've reaaaallly tried to like others, but I know there's only one I will always love." In the abstract romance domain, the woman gives up on the man and pursues a different one. If this schema is integrated with G1 and B1 from the domain of G1's personal life, G1 stops pursing B1 and develops other interests. Again, the disanalogy between the abstract application of this schema and its concrete instantiation in G1's case suggests that the presuppositions of this schema were not met.

The sorts of cultural models G1 invokes (signalling attraction, switching the object of affection) are idealised models that may require substantial adjustment to meet the demands of any particular case (Quinn and Holland, 1987). Thus, by describing strategies that have been tried but failed, G1 makes it possible for other people to draw inferences about the nature of her relationship with B1, based on the observed results of her implementation of the culturally shared romance schemata. In appealing for help, G1 sets up two similarly structured integration networks. The first involves integrating the fillers from her personal life with the general send-signals schema, and the result of the integration differs from the normative response in the romance input. The second involves integrating the fillers from her personal life with the try-to-like-another schema from the romance input; again the result differs from the desired and normative application of this schema.

In asking, "How can I make him see that we are perfect for each other?" G1 suggests that responders construct their own network with her personal life as one input and a cultural attraction schema as the other. Whether consciously or not, G1's rich posting has the effect of socially distributing the space-building process so that readers can construct their own integration networks, with an input structured by their (indirect) knowledge of G1's personal life and a general attraction-schema from the domain of romance. G1 will ultimately use the responders' responses to complete a new integration network with the novel attraction-schema.

3.2 Responder analysis

G2 posts an opinion containing several such attraction-schemata including 'Make him Jealous' and 'tell him you are sorry', each of which could serve as an input to the sort of integration network G1 is attempting to construct. But, like G1, G2 provides more details about her own personal life than necessary to answer the query. For example, she writes, "Flirt with other guys when he's around and sometimes when I tried it he would tell me we had to go do something, like he wanted me away from them...." G1's query reminds G2 of a similar situation in her own personal life from which G2 constructs a novel blend. The domains in G2's blend involve G1's personal life and G2's personal life. In both the G1 and the G2 inputs, a girl is attempting to attract a boy who may not share her interest in a romantic relationship. This commonality is represented in the generic space in the integration network.

G1's posting provides the information that helps the responder to construct the G1 input. The responder's similar experience serves to structure the G2 input. Additionally, the G2 input contains successfully applied attraction-schemata. In the blend, the fillers from the G1 input are projected into the blend and integrated with the various attraction-schemata from the G2 input. For example, G1 and B1 might be integrated with the make-him-jealous schema from the G2 input. However, rather than running the blend and projecting how this schema will work for G1, G2 merely describes how it worked for her. G1 and other readers are free to draw their own conclusions about the consequences of the make-him-jealous schema in G1's particular circumstances. Nonetheless, the example makes the make-him-jealous schema a salient attraction-schema that can be tried by G1 or by others in her position.

3.3 Prospector analysis

Anyone can read the exchanges or threads on YNM. Reading threads on YNM, as measured by page views, outdistances the posting of topics or opinions by two orders of magnitude; the ratio of page views to postings is approximately 106:1. In short, forum lurking – an instance of eavesdropping in the symbol engine – is more popular than posting topics or opinions. We suggest that this popularity is related to the way in which eavesdropping can result in the acquisition of new schemata. The conceptual blending processes necessary to create these schemata may be intrinsically pleasurable. Moreover, acquired schemata are potentially valuable, as prospectors may encounter future situations that require the schema, or they may have friends or associates that can benefit from the schema.

Eavesdropping occurs in two steps. First, the lurker must relate to the situation – being a 10th grade girl. A forum lurker L reads the topic posting and, like G2, constructs an input space for G1's reality containing G1, B1, and frames describing the relationship between G1 and B1. The other input is L's own life. In contrast to G2's blend, where the schema from the G2 space was integrated with fillers from G1 (*i.e.*, G1 and B1), in the lurker's blend the G1 input provides the schema, while the fillers (or at least one of the fillers) comes from the L input. L projects properties and relationships from the G1 input and the element L from the L input into the blend to be integrated. If L identifies with the girl in the G1 input, then the L element would fill the slot filled by G1 in the G1 input. If L identifies with the boy in the G1 input, then the L element could fill the slot filled by B1 in the G1 input.

After reading G1's posting, L then reads G2's opinion posting and attempts to integrate some information from G2's blend with her own. For example, one input might involve L's previous blend (constructed in response to the G1 topic posting) in which L likes an imagined counterpart of B1 (that we will call BL) and wants to attract him. The other input would be recruited from the network constructed for the G2 opinion posting, in which G2 attracted B2 by flirting with other guys and making him jealous. The schema from this G2 input is projected to the blend where it is integrated with the L and BL elements. L can thus imagine herself attracting BL by making him jealous. The practice of lurking presumably makes the make-him-jealous schema available to L to either guide her own behaviour, or to advise others who may be experiencing unrequited love.

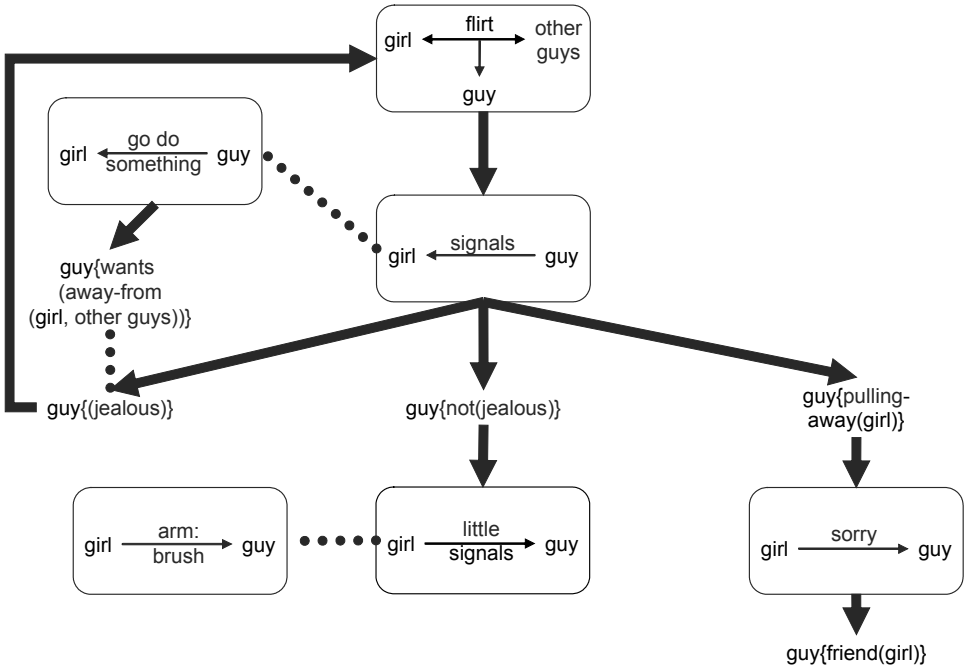
3.4 The common schema

The above analysis demonstrated how solicitors, responders and prospectors alike could use the mental operation of conceptual blending to integrate a single frame of an action schema. Figure 4 depicts the complete schema containing the frames and states specified in the advice thread.

Thus, the function of these local activities is to replicate a common schema, differing in the vectoring of data used to create that schema. From a cognitive systems perspective, YNM is not merely a web forum, it is a schema replicator, consisting of multiple actors, (solicitors, responders and lurkers) who use technological artefacts (computers that communicate via internet protocols) to propagate, modify and construct schema.

Hitherto, we know the global pattern, the local activities that constitute it, and the local processes that underlie these activities. The final step is to explain why actors engage in these local activities, and how their interaction leads to the emergence of the global pattern of the symbol engine.

Figure 4 Action schema derived from the thread



4 How the global pattern of the symbol engine emerges from the interaction between local cognitive processes for schema blending

Our analysis showed that through participation in the symbol engine, the solicitor (G1), responder (G2), and prospectors (lurkers) all come to share the same action schema. A similar analysis can be performed for the other superorganisations we mentioned – in all cases, running the symbol engine results in shared schemata, for instance, in an online auction, the resulting shared schema might relate to an item's value. Explaining the emergence of the symbol engine starts with explaining why the three types of actors – solicitors, responders and prospectors – engage in these schema-blending activities online.

4.1 Dynamic environments: why actors engage in the local activities of schema blending online

The thread provides clues about why actors engage in schema-creating activities. The topic poster has encountered a problem in her social environment that she does not have a solution for. Since schemata are the mental representations of solutions, she needs a schema. Generally, we can assert that actors create schemata because their environments pressure them with situations requiring adaptive responses, and schemata are the mental representations that drive these responses.

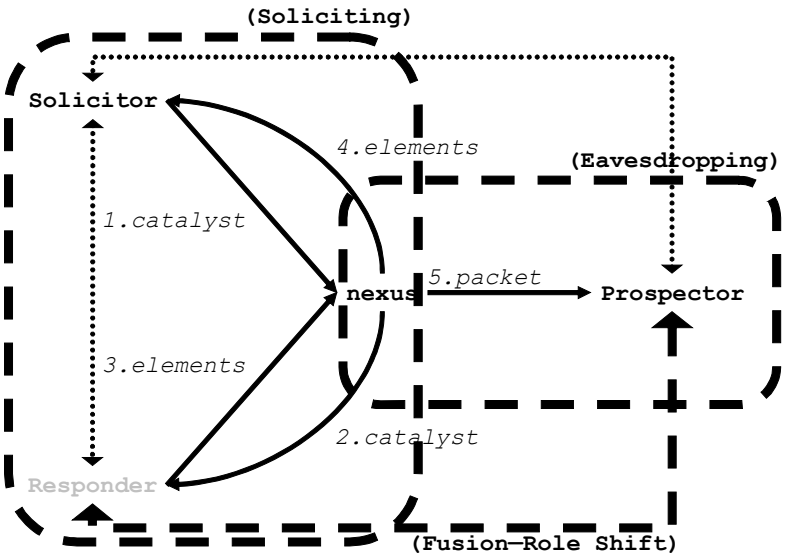
4.1.1 Schema methods

Actors have many different methods available for generating schema *offline*. Using conceptual blending, an actor can integrate existing mental structures into new schema, unassisted. Failing to do so unassisted, an actor can incorporate blending with other practices like trial and error. When trial and error is costly, an actor can resort to stable *social practices* like 'soliciting' help from others (D'Andrade, 1981). Finally, it is adaptive for actors to have a schema prepared before encountering a situation. By constantly 'eavesdropping' on other actors, an actor can acquire schemata for future encounters. Eavesdropping and its many variants, such as watching and overhearing, is a fundamental strategy used by all learners to acquire schemata (Rogoff *et al*., 2003).

4.1.2 Why engage online

In the symbol engine, what appear to be three distinct local activities for schema-blending in the symbol engine are merely technology-mediated forms of the stable social practices of soliciting and eavesdropping (see Figure 5), both of which incorporate conceptual blending as a key process component. While actors can engage in these social practices offline, they prefer technology-mediated forms because the online forms conserve effort and minimise social consequences. For example, when soliciting help online, one can get multiple responses by simply posting a single topic; when eavesdropping, there is little chance of getting caught.

Figure 5 Symbol engine as emerging from two distinct social practices organising three local schema-blending activities



The desire both to conserve effort and to minimise social consequences explains why solicitors and prospectors go online to engage in soliciting and eavesdropping, but it does *not* explain why responders go online to help. Why would an actor waste time and effort going online to help other people? One answer is that although the cognitive gains may not be apparent, an actor may derive emotional or social gains from helping others online – responders may be individuals who derive some kind of satisfaction from altruism, or who desire to construct 'face' by giving advice (Goffman, 1959). However, a more parsimonious answer is that actors, generally, would not waste time and effort going online to help others. It fact, it is unnecessary to posit that actors go online to help others with their problems. The symbol engine can emerge without actors engaging online as responders.

4.2 How the global symbol engine emerges from social practices that are based on local schema-replicating activities

Simon (1981, p.209) wrote that: "complex systems will evolve from simple systems much more rapidly if there are stable intermediate forms than if there are not." Now, our complex system is the symbol engine, the stable lower form is the mental process of conceptual blending, and the stable intermediate forms are the social practices of soliciting and eavesdropping online. Because these social practices are stable, actors will initiate soliciting and eavesdropping online.

It does not matter whether or not there are actors who go online as responders to help others. What matters is that solicitors and prospectors go online, believing that there are responders – that they possess mental models of the social practices that mirror those in Figure 5 (see dashed boxes). For example, topic posters (solicitors) post requests for help on YNM (nexus), believing there are opinion posters (responders) that will reply with advice. Lurkers (prospectors) go online expecting to read threads on YNM from solicitors and responders.

Once solicitors and prospectors decide to engage in soliciting and eavesdropping online, the technology can be designed to shift these actors into the role of responder. To do so, the technology must have certain properties. It must be:

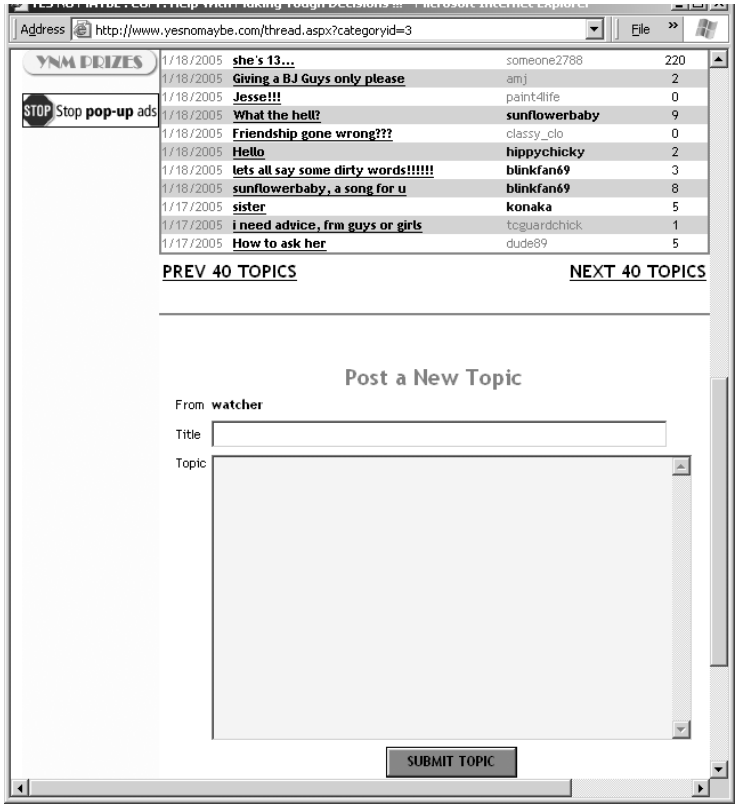
- *polymorphic*, supporting both soliciting and eavesdropping
- *noisy*, having signals from one practice bleed into the signals of the other practice
- *open*, allowing actors to vector content into the channels intended for actors in the other practice.

A technology designed with these properties will facilitate *social fusion* – actors switching roles from one practice to the next, *e.g.*, prospector to responder (see bottom of Figure 5).

As an example of social fusion, take a lurker (prospector) that goes to an online forum just to eavesdrop. This actor is not interested in helping out, but merely in reading about others' problems and the solutions to those problems. The lurker goes to the same website, YNM, as solicitors, because YNM is polymorphic and supports both soliciting and eavesdropping. However, YNM is not designed so that solicitors go to a separate section of the site to solicit, or that lurkers go to a separate section of the site to read threads. Content for soliciting is mixed in with content for eavesdropping on the same page. The media holding the content for soliciting and eavesdropping is *noisy*, containing

content from both practices. Figure 6 shows topic postings (listings with zero replies, intended for responders), mixed in with threads (topics with one or more replies, intended for prospectors).

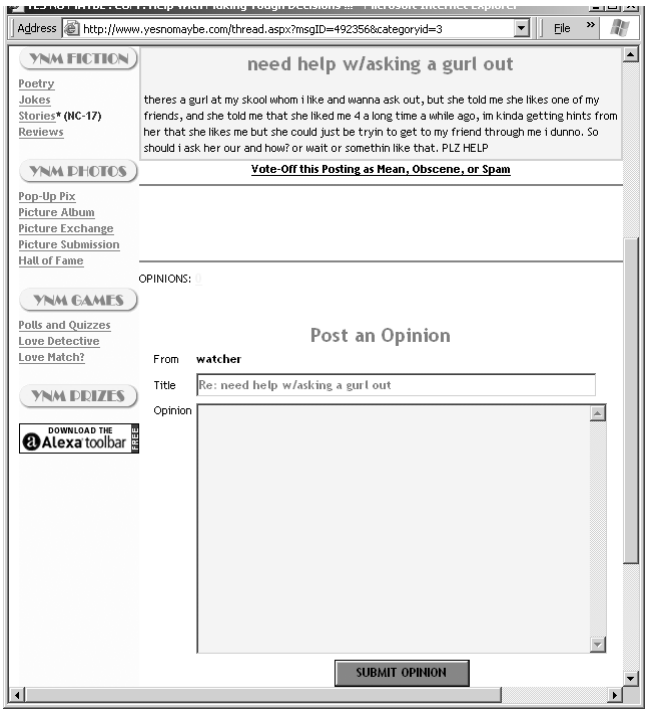
Figure 6 Topics mixed with threads



Now, suppose a lurker decides to click on one of the topic postings. Not only can the lurker read the solicitor's request (see top of Figure 7), the lurker can also reply to it because he or she has access to the form intended for responders (see bottom of Figure 7). YNM qua technology nexus makes the channel for vectoring a reply back to the solicitor *open* to lurkers reading the posting. When a lurker replies to a posting, he or she has shifted roles from prospector to responder (see bottom of Figure 5).

Why would a lurker help a solicitor? It is well known among cognitive anthropologists that people share specific cultural models "(schemata) that are widely shared...by members of a society and that play an enormous role in their understanding of the world and their behaviour in it" (Quinn and Holland 1987, p.4). Such cultural models or knowledge is usually learned from others through their talk (D'Andrade, 1981). Internet technologies such as YNM, give others another medium to propagate cultural models for structuring experience and organising behaviour – provided that actors are in a position to notice differences in cultural models and have the ability to share them. A nexus that is polymorphic, noisy and open provides these opportunities.

Figure 7 Channel for response mixed with content viewed



4.3 Summary: how a symbol engine emerges

To summarise, we can see the symbol engine emerging as follows. A distribution of dynamic and isomorphic environments, *e.g.*, the social environments of teens, continually pressures their actors with situations requiring adaptive behaviours. Schemata – mental structures – drive the adaptive behaviours exhibited by actors. If an actor does not have a schema prepared, he or she can use the *mental operation* of conceptual blending to create one.

Failing to blend a schema unassisted, an actor can engage in three general methods for blending a schema with assistance:

1 personal experience, *i.e.*, acting

2 soliciting, or

3 eavesdropping.

The last two methods are *social practices* that an actor can implement in many ways, *e.g.*, an actor can solicit help from friends, family members, or strangers, either in person, over the phone, or through e-mail. The specific method an actor chooses, as well as its implementation, is a function of both effort and consequence minimisation. Online instances of eavesdropping and soliciting can both conserve effort and minimise social consequences. Thus, actors will tend to engage in online implementations of these practices.

One can design the technology mediating the communication in the online social practices so that it:

- is 'polymorphic' – simultaneously mediating both soliciting and eavesdropping
- has 'noisy' channels – content intended for actors engaged in soliciting can bleed into the content intended for actors engaged in eavesdropping, and vice versa
- is 'open'– allowing cross-talk between actors in different practices.

An online technology designed with these properties, will facilitate actors switching roles from one practice to the next. We refer to this role switching as *social fusion*.

Social fusion leads to an emergent socio-technical system: the *symbol engine*. In YNM, the symbol engine appears to both actors and external observers as if it consists of three groups of users – posters, repliers and lurkers – coordinating with a technology nexus (YNM). This is an illusion resulting from social fusion. Only two groups of users are actually necessary – posters and lurkers – who engage in soliciting and eavesdropping, respectively.

Because the properties of the mediating technology permit social fusion, a prospector can shift into the role of responder, which is necessary for the soliciting practice to complete. Moreover, in doing so, the prospector not only completes the soliciting practice, but creates a thread for future prospectors. Thus, fusion allows sharing and eavesdropping to mutually reinforce and complete one another, manifesting the global pattern of the symbol engine as diagrammed in Figure 5.

5 Discussion: from blending to symbol engines to superorganisations

In superorganisms such as ant colonies, complex structures such as leaf nests and ant bridges emerge from ordinary individual activities, in which individuals performing actions are not aware of their global consequences, as Hölldobler and Wilson (1994, p.107) noted:

> "The amazing feats of the weaver ants…comes not from complex actions of separate colony members but from the concerted action of many nestmates working together…one ant alone is a disappointment; it is really no ant at all."

Similarly when looking at a superorganisation such as YNM, it can be quite disappointing. It is easy to see people doing rather mundane actions: soliciting advice, providing advice and eavesdropping. Conceptual blending researchers might see very basic conceptual integration networks. Technology researchers might see known online phenomenon. But like the ant colony, the individual components have little resemblance to the complex feats of the superorganisation. The superorganisation is an emergent consequence of the collective actions of simple components.

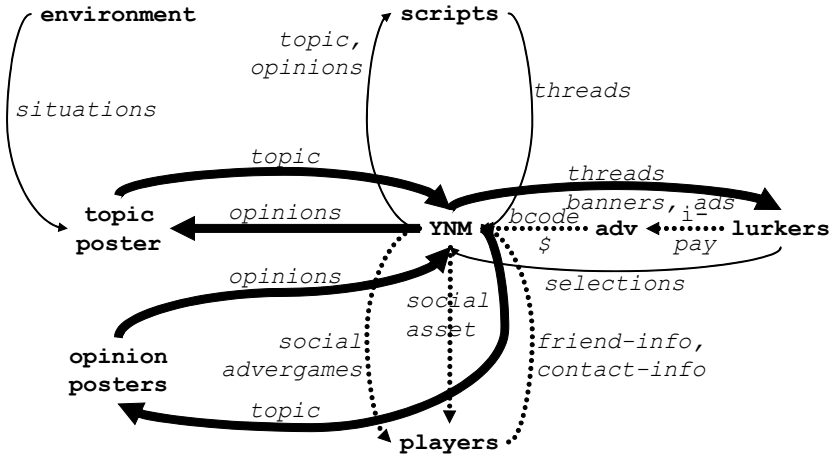
Looking closely at YNM, we have seen a complex hierarchy of stable processes, each leveraging and extending previous processes for new purposes. At the individual level, we have seen the powerful conceptual blending mechanism (Fauconnier and Turner, 2002). At the social level, we have seen the stable and ubiquitous practice of sharing cultural models (D'Andrade, 1981; Quinn and Holland, 1987) – through soliciting and eavesdropping – that leverage conceptual blending as a replication mechanism. We are now starting to see stable distributions of people and technology such as the symbol

engine – a kind of distributed cognitive system (Hutchins, 1995) – that is an emergent consequence of conceptual blending, cultural model sharing and technology mediation.

The complex feats of the superorganisation, such as online auctions and electronic forums, mask a stable blended organisation of people and technology. And these stable blended organisations can be used to construct novel kinds of superorganisations. For example, Flor (2004a) showed how adding income and advertising mechanisms to the symbol engine of YNM created an entirely new form of superorganisation, an autonomous business that automatically generates revenue and customers without any employees or managers guiding it (see Figure 8).

Undoubtedly, there are other stable forms of blended organisations that can serve as the basis for more complex superorganisations. The challenge is to identify other stable cognitive, cultural, and technological activities to build on – in addition to conceptual blending, cultural model sharing, and technology mediation.

Figure 8 YNM as autonomous business



Notes: The bolded lines delineate the symbol engine; dashed lines describe added (advertising or income) mechanisms

References

Alexa (2004) *Most Popular in Advice*, http://www.alexa.com/browse/categories?catid=468878 (retrieved 7 January 2004).

Camazine, S., Deneubourg, J., Franks, N., Sneyd, J., Theraulaz, G. and Bonabeau, E. (2001) *Self-organization in Biological Systems*, Princeton, NJ: Princeton University Press.

D'Andrade, R. (1981) 'The cultural part of cognition', *Cognitive Science*, Vol. 5, pp.179–195.

Fauconnier, G. and Turner, M. (2002) *The Way We Think*, New York, NY: Basic Books.

Flor, N. (2004a) 'An analysis of the design of a programmable autonomous business', *Journal of Systems and Information Technology*, Vol. 7, pp.111–118.

Flor, N. (2004b) 'The architecture of the symbol engine in an autonomous business', *Proceedings of the 2004 IEEE Conference on Electronic Commerce*.

Gentner, D. (1983) 'Structure-mapping: a theoretical framework for analogy', *Cognitive Science*, Vol. 7, pp.155–170.

Gentner, D. and Medina, J. (1998) 'Similarity and the development of rules', *Cognition*, Vol. 65, pp.263–297.

Gentner, D. (1998) 'Analogy', in W. Bechtel and G. Graham (Eds.) *A Companion to Cognitive Science*, Oxford: Blackwell, pp.107–113.

Goffman, E. (1959) *The Presentation of Self in Everyday Life*, New York, NY: Doubleday Anchor.

Hölldobler, B. and Wilson, E. (1994) *Journey to the Ants*, Cambridge, MA: Harvard University Press.

Hutchins, E. (1990) 'The technology of team navigation', in J. Galegher, R. Kraut and C. Egido (Eds.) *Intellectual Teamwork*, Hillsdale, NJ: Lawrence Erlbaum Associates.

Hutchins, E. (1995) *Cognition in the Wild*, Cambridge, MA: MIT Press.

Lashinksy, A. (2003) 'Meg and the machine: unstoppable eBay is no. 8 among FORTUNE's fastest growing companies', *Fortune*, 1 September 2003.

Mohr, L.B. (1982) *Explaining Organizational Behavior*, San Francisco, CA: Jossey-Bass, pp.35–70.

Quinn, N. and Holland, D. (Eds.) (1987) 'Culture and cognition', *Cultural Models in Language and Thought*, New York, NY: Cambridge University Press.

Rogoff, B., Paradise, R., Arauz, R., Correa-Chavez, M. and Angelillo, C. (2003) 'Firsthand learning through intent participation', *Annual Review of Psychology*, Vol. 54, pp.175–203.

Simon, H. (1981) *The Sciences of the Artificial*, Cambridge, MA: MIT Press.

Wilson, E. (2000) *Sociobiology*, Cambridge, MA: Harvard University Press.