

**DEVELOPMENT OF A STRUCTURAL MODEL OF ACTIVITY
AND A METHOD FOR ANALYZING ACTIVITY SYTEMS**

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Smith CS, Francovich C. *Development of a Structural Model of Activity and a Method for Analyzing Activity Systems*. (2002) Proceedings of the 5th World Congress, International Society for Cultural Research and Activity Theory (ISCRAT). Amsterdam, June,2002.

Supported by U.S. Veterans Affairs HSR&D Grant # PCC-98-010

Word Counts: Summary 368

Body (with figures and diagrams) 7562

Suggested Congress Theme

(4) 'Role of institutions and organizations in forming activity and shaping identity'
[Themes 6 (unit of analysis) and 5 (methodological controversies) are also appropriate]

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SUMMARY

Structural models of activity are useful for integrating observations and theory. However, in our experience the ‘subject’ as an element in activity theory is problematic. Many structural models of activity see the subject as part of a whole. As such, it is understood as a discrete element that one can ‘hold constant’ while observing or analyzing other elements of the system. We found that pragmatically applying this concept was untenable. Our data suggest that the subject is in an existential domain, whereas activity is a physical-social-historical phenomenon, and the two are dynamically co-determined. We believe that two fundamental issues need to be addressed: i) the theoretical and methodological location of the subject in activity systems, and ii) the role and status of the observer in thinking, writing, and talking about activity systems.

We present a structural model of activity (a work in progress) and an analytical method that are a potentially important and more sophisticated treatment of the subject. In particular, we believe the reasons that our model treats subjects in a more ecologically valid way are:

- The nature of an activity system, and opportunities for improvement, are best revealed during important episodes of breakdown (non-optimal functioning).
- Our methodology approximates the first-person perspective of the subject in response to breakdown. The subject may be acting as an individual, a member of a goal-oriented work group, or a spokesperson for organizational values.
- Our methodology provides allowable and culturally appropriate explanations of the breakdown from the psychological, sociological, and material perspectives.

- Our methodology assesses the relationship of subjects involved in a breakdown to their sub-cultural group, via their cultural competence.

This paper is organized into two sections followed by some brief conclusions. The first section outlines our theoretical approach to the treatment of the subject in activity systems. It includes discussion of participation, communities of practice, domains of explanation, and cultural competence. The second section describes the development of our model, the application of our analytical method, and the validation of the model and method. What we hope to add to the field of activity theory is a more rigorous theoretical stance toward the subject, complemented by a method that provides greater access to subjective experience.

SECTION I: BACKGROUND

Activity theory has become an important multi-disciplinary approach to cultural research (Chaiklin et.al., 1999; Engström et.al., 1999a). However, there are several views about what constitutes an activity theory (Lektorsky & Engström, 1980). We will begin by establishing our perspective. We believe that activity theory must account for intra-personal, inter-personal, and cultural-historical influences on observed behavior. The theory should articulate how the community continually negotiates and creates important artifacts and language, and how newcomers are able to internalize these. It should document, without judging, any significant cultural or sub-cultural differences and highlight historical influences that led to these differences. The theory should explain how physical artifacts and meaning-rich language become mediating tools, and should allow for possible distinctions between the two. The methods must be pragmatic and directly applicable to fieldwork. In short, we desire a theory with enough structure to help organize and make sense of ethnographic observations coupled with a method that helps select and focus further observations and interventions.

We believe that a significant problem for activity theory is a consistent methodological bias toward objectification of the subjective elements of an activity system. This critique is based on significant methodological problems we have encountered in over a decade of studying clinical interactions in one medical setting. Others (e.g., Ho, 1991; Latour, 1996; Ratner, 1997) have also observed that a too casual or insufficiently cross-disciplinary approach to human activity tends to obscure dynamic psychological, social, and cultural elements of actual systems. A detailed focus on artifacts, division of labor, rules and norms, and the 'object' of activity without a more

nuanced and cross-disciplinary approach to activity as a whole results in incomplete analysis. Ratner (1996) observes:

“from a dialectical perspective, activity and psychological phenomena are interdependent, interpenetrating moments of one relation. They are elements of a common unity. They are not separate independent factors that interact.” (page 424)

The functional boundary of the subject (e.g., individual person, member of immediate work group, member of organization) is determined by subjects themselves, perhaps unconsciously, and is not completely specifiable by outside observers. Third-person descriptions of an activity system necessarily de-emphasize the first-person perspective of individual subjects and much of the nuance involved in dialogue between subjects. This makes it difficult to address the dynamics of embodied experience, negotiation of meaning, and tension between cultural norms. Without a more closely reasoned treatment of the 'subject' in an activity system, theorists and researchers will not adequately cover the complexity or meanings inherent in the observed system. Without a more ecologically valid approach to both the subject and the problem of explanations, system or educational interventions aimed toward improving outcomes or processes will be of little value.

I. a. Participation

An important component in the tradition of activity theory is the notion of subjective participation. Activity theory has incorporated a number of critical perspectives on subjectivity, the development of the self, and identity. Vygotsky (1978; 1986) and Leont'ev (1978) form the basis of much of this theorizing. One of Leont'ev's major contributions was the distinction between operations, actions, and activities in understanding human behavior. His indexing of these terms to conditions, goals, and

motives was a bridge between collective activities and the meanings or purposes experienced by individual subjects. Yet considerable problems remain. How exactly does an individual subject experience collective activity? What roles do the beliefs, hopes, fears, and desires of the individual have in collective behavior?

Numerous others ¹ have grappled with the fundamental problems of consciousness, personality, identity, and subjectivity in relation to activity. One unifying concept in this tradition is the notion of 'participation'. We define participation as the totality of experience from a subjective perspective that is both conscious and unconscious. Much as Wenger (1998) uses the term, we take it as a "complex process that combines doing, talking, thinking, feeling and belonging. It involves our whole person, including our bodies, minds, emotions, and social relations" (p. 56). Participation as a category subsumes those elements in activity systems that are understood as the subjective embodied perspectives of living beings.

Participation itself is generally unavailable for analysis (see Heidegger in Dreyfus, 1991), but it is frequently interrupted or perturbed by breakdowns. While breakdown is not isomorphic with participation, the nature of these breakdowns gives us some idea about the underlying structure of participation as it relates to observable system functions. Breakdowns are also critical catalysts for change, improvement and learning (Koschmann, et.al., 1998).

One problem we discovered in using existing activity theoretical structural models was determining the correct unit of analysis for the participating 'subject'. The self or person is both embodied as an individual (the internal) and as a social being (external).

¹ For instance, Bateson, 1979; Brushlinsky 1990; Cole & Engeström 1993; Cole & Scribner 1974; Dewey 1958; Ingold 1991; Lave 1988; Reed 1996; Rogoff 1990; Varela, et.al. 1991; Wenger, 1998; Winograd & Flores 1987.

Our sense of participation is exactly at the boundary of these existential states, and changes when we act out of embodied reflex, as goal-oriented team members, or as the mouthpiece for local norms and customs. Meanings in an activity system exist both as social artifacts (the product of collective histories) and as current beliefs, purposes, and understandings of individuals within the system. How then do we, as external observers, decide which perspective is the most useful one for a given analysis?

Here, the work of Maturana (1978; Maturana et.al. 1995) provided some clues to our difficulty. According to Maturana, a living system is organizationally closed (entirely self-referential) but thermodynamically open (has flux of energy/matter). It continually reproduces itself and, in the process, creates a boundary. The boundary is *determined* from within the organism, and can only be *inferred* (correctly or incorrectly) from outside. The organism adapts to perturbations/breakdowns (both internal and external) through selective structural changes. Structural drift occurs over time because of structural coupling to elements or processes outside the boundary. These concepts can also be applied to a social system as subject (Luhmann, 1992; Mingers, 1995). Language, a closed self-referential system, is a structuring token of coordinated relevant action abstracted from stable contexts that are encountered with some regularity. Organizational closure of the social unit occurs through patterns of conversation (beliefs, explanations, values). Conversation assumes/reproduces the roles of each participant and creates a social/symbolic boundary (expectations, loyalty, understanding, confidentiality). The system is coupled to external conversations in ways that have been meaningful to its function over time.

These perspectives led us to three assumptions used in our structural model.

- The functional boundary of the subject (e.g., the person, the immediate work group, or the sub-cultural group) can only be determined by the subject.
- While the boundary of the ‘subject’ itself is not totally recognizable from outside, clues to where the subject considers this functional boundary can be obtained by observing breakdowns.
- The clues will exist in the language and artifacts surrounding breakdowns.

I. b. Communities of Practice

How do values and beliefs become reified, and how do these reifications affect activity? Vygotsky’s (1978) concept of the zone of proximal development is important in understanding the social process whereby the individual internalizes group concepts. Engeström (1987) defined this as the “distance between the everyday actions of individuals and the historically new form of the societal activity that can be collectively generated as a solution to the double bind potentially embedded in...everyday actions” (page 174). Lave and Wenger (1991) further explored the nature of this individual-collective exchange by studying a wide variety of learning situations. They found that the community regulates the learner in two ways: by selective legitimization of newcomers into the group; and by providing graduated, meaningful subtasks, which are part of group’s product and are appropriate to the learner’s development. Graduated exposure to and use of the community’s language, tools, and artifacts is the mechanism of internalization. Our study, occurring in an academic training site, had many of these features. The learner gradually advances from becoming part of an existing practice, as a newcomer, to being a stakeholder in the ongoing development of new practices, as an old-timer. Wenger (1998) further clarified this as a constant dialectic between

‘participation’ in a role appropriate to the existing practice of the group, and ‘reification’, the making real or concrete historical practices and roles that have been successful. These perspectives led us to two more assumptions used in our structural model.

- Subjective participation is constantly reified into important elements (e.g., membership, norms, and assets) that represent successful modes of action.
- There is often tension between an individual’s sense of participation and the group’s reified elements.

I. c. Domains of Explanation

The language one chooses to describe an activity system can affect the analysis of that system. One can have a first-person understanding in language (subjective). This would include what words mean to you, kinesthetic understanding of action words, how words make you feel, etc. In conversation, one has a relationship with *another* (inter-subjective). This includes embodied communication (gestures, body language, voice timber), active listening, and dialogue. The third-person perspective from language (objective) is like the dictionary definitions of words. It is an entirely self-referential system whose denotive definitions are precise, internally consistent, static, and reductive. To tap completely into the ‘subject’s-eye-view’ requires access to the first-person perspective of the ‘other’ through dialogue.

Explanations (including those from existing activity theory models) tend to occur in the third-person within three perspectives derived from the dominant Western philosophies of description and analysis. We term these the ‘psychological’, ‘social’, and ‘material’ explanatory domains, and are indebted to Wilbur (1998) for his comprehensive and clear thoughts on the subject. For example, the literatures in cognitive science,

psycholinguistics, & consciousness studies (the psychological); situated theory and social learning theory (the social); and physics and biology (the material) provide different conceptual lenses for interpreting activities.

The psychological domain reflects a subjective empirical worldview that roots our experience, learning, and development in a 'bottom up' trajectory, suggesting that individual development is responsible for cultural development. Descriptions of activity from this perspective focus on the individual's emotions, cognitive models, sense of identity, and commitment to values as they lead to personal behavior and affect the group (e.g., Piaget, 1971; Lincoln & Guba, 1985; Brunner, 1990).

The social domain is reflected in the compelling literature connecting human development and consciousness to social and cultural influences. The social perspective is more a 'top down' approach to the development of consciousness and language, interpreting our subjective sense of being as an internalized social norm. From this perspective, we become who we are by internalizing socially developed structures. Descriptions of activity from this perspective focus on the group's openness and friendliness, roles, norms and rules and how these affect the behavior of the individual (e.g., Vygotsky, 1978; Leont'ev, 1978; Dewey, 1969-1991).

The material domain is reflected in a physical view of the world, seeing human beings as the additive result of natural selection. From this perspective come behavioral models that view human beings as acting and reacting to a physical world with subjective psychological and socio-cultural affects as secondary phenomena and always the result of experience—not its cause. Descriptions of activity from this perspective focus on how structure, material constraints, local job layout, and deployment of the group's assets

affect the language and behavior of individuals and the group (e.g., Chomsky, 1986; Edelman, 1989; Dennet, 1991; Reed, 1996).

A major departure between our model and Leont'ev's is that he seems to have collapsed or assimilated his activity categories solely into the "psychological" domain (to deal with what we understand as the subject/object problem). We believe that there is a radical interdependence between participation and the full spectrum of explanatory domains. Leont'ev appears to have been preoccupied with the problem of reflection and representation, reasoning that because the only way that we can know is through our biological apparatus for knowing (the brain) then all arguments have to begin and end with the mind (psychological domain). In other words, explanations about phenomena must always be indexed to the individual's psychology (e.g., goals and motives) because it is the only domain concerned with the problem of observation and limited by its central place in the overall philosophical project. We are not saying that Leont'ev believed that the psychological domain is in any way the origin or cause of phenomena, but that all explanations about phenomena have to pass through and be rendered by the mind. In contrast, we made the following assumptions about explanations:

- We must attempt to understand and investigate participation from all three domains of explanation (psychological, social, material).
- We must also attempt to find a methodology based on dialogue (interactions) rather than description.

I. d. Cultural Competence

Cultural competence is a measure of how well an individual's responses correlate with sub-cultural norms. Cole (1988) was one of the first to point out the shortcomings of

existing activity theory models with regard to cultural diversity. Engeström, et.al's (1999b) conceptualization of "knot-working" as the dynamic convergence of relatively stable activity systems with different needs and norms brought into sharper focus the issue of sub-cultural differences. We also found in our research that participants from different sub-cultures could view the same artifact or wording quite differently, often in conflicting ways.

This led us to literature on organized cultural patterns. Kroeber (1948) was the first to describe "systemic culture patterns" defined by coherent systems of knowledge, often tacit, that had associated semantic domains with special meaning for the group. Systemic culture patterns are coherent subsystems of knowledge that aggregate and persist as a unit. They have sufficient internal organization that they may also diffuse as a unit. Each may be thought of as having an associated semantic domain that provides a way of classifying and discussing the elements in that culture. Schein (1996) further developed these concepts when looking at how organizations behave. He found that there are three sub-cultures present in many organizations that are particularly important when trying to understand the dynamics of the organization in response to breakdown or change. In his terms, these are the operator culture (responsible for delivering the goods or product), engineer culture (who design the processes by which the organization delivers its products or services), and the executive culture (who are responsible for the strategic survival of the organization). Looking at the critical values of these sub-cultures—enough time and resources to produce (operators), predictability and control (engineers), and cost and market share (executives)—clear conflicts are predicted. We found (Smith, et.al., 2000) not only that these sub-cultures existed in our institution under

study, and that the predicted tensions did occur, but also that presenting this information back to members was a useful adjunct for designing solutions. This would agree with Argyris' (1992) "double loop" institutional learning, where one needs to jointly look beyond actions and consequences to the governing variables leading to both (p. 68).

Romney et. al. (1986) used similar concepts to develop a theory of cultural competence and an analytical technique known as cultural consensus analysis. It uses a mathematical model that treats informant statements as probabilistic data. It assumes that there exists a "high concordance code" of socially shared information and beliefs; that informants vary in the extent to which they know this code; that all informants have non-negative cultural competence; and that each informant answers independently of each other informant. The mathematical analysis determines the degree to which a group shares a set of cultural beliefs, prospectively estimates culturally correct answers, and estimates cultural competence (defined as the individual's ability to produce the set of all culturally correct answers) for each individual, and a group average.

Our method of cultural consensus analysis (CCA) uses the ranking of a series of statements to make determinations about how cultures view the relative importance of different phenomena. We believe it is a promising method to include when analyzing activity systems because of the following characteristics:

- Cultural consensus analysis identifies sub-cultures and points out important differences between the values and beliefs of these sub-cultures.
- Cultural consensus analysis has access to subjective, first person experience because it is a delayed inter-subjective dialogue rather than a third-person description.

- Cultural consensus analysis also acts as a bridge, bounded on the one hand by the individual subjective sense of participation, and on the other hand by culturally acceptable explanations.

SECTION II: THE MODEL

II. a. DEVELOPMENT

We set out to analyze how two activities, postgraduate training and patient care, affected patient outcomes and learning in an academic internal medicine clinic. Activity theory was selected as a structuring framework for the analysis. We used a mix of free coding (derived from the data) and template coding (an outline of likely-to-be-important categories). Our coding templates contained categories from Engström's widely accepted activity theoretical model, such as rules, artifacts, and the division of labor (Engström, 1987). We spent two years observing, interviewing, and analyzing patients, residents, faculty, and others in our academic clinic. From these activities, we discovered important themes (breakdown being the most important), created a taxonomy of breakdowns, and ultimately created a structural model of activity in our clinic.

II. a. i. Themes: Two trained observers collected ethnographic data in our academic medical clinics over the course of one year. Observations were made from the clinic waiting areas, work stations and exam rooms and include: 40 general observations of clinic participant interactions; 6 interviews of key personnel; 10 "shadows" of a patient's entire visit to the clinics (for a resident clinic); 4 observations of residents; and 4 of faculty during their half-day clinics. This totaled more than 130 hours of observations and interviews. Real-time field notes were transcribed immediately following observations or interviews, resulting in the data set of 2919 paragraphs of text.

Two coders met once to twice weekly. All new transcript data were analyzed at each session for salient themes. Once a possible theme was identified, a working ‘necessary and sufficient’ definition was created for that theme. In the following session, each theme, with definition, was applied to the next data set. Discrepancies were resolved by discussion and revision of the theme definition if necessary. In this way, both the theme definition and examples became more robust and precise. After thirty coding sessions, a stable set of fifteen themes was identified. A free-coded category called breakdown emerged as the most important of these fifteen themes.

We had two difficulties during this analysis, determining the correct unit of analysis and choosing the correct explanatory perspective. At times, we found it difficult to non-arbitrarily select a unit of analysis for a particular observation. Patients deal with one person, but that person may act as though they are an individual, an integral part of the clinic, or a representative of the entire institution. Patients themselves can also act from multiple perspectives. The following examples from our data demonstrate this difficulty.

CARPAL TUNNEL (patient-individual)

Resident: “You look like you are doing good [sic]. Do you have any...problems?”

Patient:: “My arms fall asleep at night and then they are very painful. I think it might be my neck and I’ll just have to live with it”

Resident: “It may be, but there are some things we can do besides surgery and you don’t have to just live with it. Do the carpal tunnel braces work?”

Patient:: “I only have one from years ago”

Resident: “We’ll order them for you at prosthetics”

CHECK IN (patient-clinic)

Patient:: “I’m here to check in”

Clerk: “What’s your name and ‘last four’ (checks in computer)”

Clerk: “Still at xxx?” (patient nods), married?(nods), Medicare A&B?

Patient: “Yeah”

Clerk: “OK sir, I’ll get [the record] back to the nurse and [doctor]”

ESTABLISHING CARE (patient-hospital)

A new patient with multiple recent problems is now trying to establish care at our facility

Nurse: “[Do you] want to get care here or just medications?”

Patient: “Mostly just medications. [I’d] like to keep my outside doctor”

Nurse: “You’re not allowed to do that. If you get your medicine here, you need to see one of our doctors. Otherwise it’s too confusing”

Another problem was the unambiguous analysis of an observation when there was more than one possible perspective for explanation. For instance, should the following patient quote be taken at face value, where the problem is due to room availability in the mornings (material)? Or, is the staff suppressing the patient’s delusions by placing limits on his rationalization (psychological)? Finally, could the clinic be designed to meet the doctor and staff’s needs rather than the patient’s (social)?

SLEEP DISORDER

“I have a sleep disorder and don’t fall asleep until 400 in the morning. I can’t make morning appointments because I fall asleep at the wheel coming in. I see Dr. “A” and no one listens. They say they can only see me in the morning.”

As we analyzed breakdowns, the most prominent and important theme, we realized that the unit of analysis problem could only be solved from the subject’s point of view. That is, did they presume that they were acting as an individual, as a member of a goal-oriented task group, or as a spokesperson for sub-cultural norms?

The issue of perspective also became interesting. After reading Wilbur’s (1998) book and some of the supporting literature, we became convinced that an integrated method for analyzing data from all three domains of explanation (psychological, social, material) was important.

II. a. ii. Taxonomy: Because of the importance of the theme breakdown (represented in 43% of our data), the rest of our analysis focused on this category. We described ‘breakdown’ as occurring when participation prevents attainment of optimal functioning.

It may be resolved, propagated, or left unresolved. Other works on the topic of breakdown support our descriptions (Koschmann, et.al., 1998; Heidegger in Dreyfus, 1991). We identified 156 vignettes from the data that represented the full spectrum of breakdowns observed. We then used these vignettes to construct a taxonomy of breakdown types.

The data from these observations support the mapping of breakdown categories to a hierarchical model of participation that we defined as the engagement, agency and accommodation levels. This focus on participation further highlighted the need to develop a new methodology that approximates dialogue and provides information about the first-person subjective sense of participation. Each level requires the level below to be intact. They represent successively more complex forms of skillful coping within a sub-cultural niche.

- Engagement breakdowns occur when an individual is participating in a reflexive way in a breakdown situation that precludes acceptance of the validity of another actor.
- Agency breakdowns occur when the individual is operating from a rational mode, but is participating in such a way in a breakdown situation that precludes cooperative attainment of an immediate goal with other important actors.
- Accommodation breakdowns occur when an individual is participating in a thoughtful way to a breakdown situation that precludes operational alignment with the values, beliefs, and norms of the group.

For simplicity, we will select examples from the psychological domain that are analogous to Leont'ev's conditions, goals, and motives. However, we discovered

examples from all of the explanatory domains, and often understood the breakdown in greater richness and depth by analyzing it from all three domains.

Engagement Breakdowns. These types of breakdowns reflect a lack of connection to other people. They are typically characterized by emotion-driven behaviors that are reflexive and generally aimed at attaining a desire or avoiding discomfort. Engagement breakdowns we observed were individual and automatic (e.g., action thwarted by overwhelming emotion); due to group behaviors (e.g., “us” vs. “them” attitude); or due to background environmental constraints (e.g., time pressure leading everyone to be ‘short tempered’). Below is an example from our data to demonstrate this level.

ANGRY

Resident: “What’s been going on since I last saw you?”

Patient: (laughing) “Well, the grass is growing!” ...

Resident: “Have you gained weight?”

Patient: (loud) “Look in your computer! I’ve lost weight!” ...

Resident: (noticing oxygen saturation) “Your oxygen in your blood is low”

Patient: (sarcastically) “Well, I guess you’re gonna give me a pill for that too!” ...

Resident: “Still smoking?”

Patient: (yelling) “I’ll quit today! I’ll just quit! I just smoked my last cigarette!”

The observer noted, “The patient is becoming more irritable and challenging in his manner. He frequently misunderstands [the resident’s] remarks and [the resident] has to clarify and repeat. [The patient] responds as if it’s [the resident’s] fault rather than a hearing problem.” The observer also remarked that the resident’s response to the overt confrontational style of the patient was to ignore it or giggle inappropriately, and that this exacerbated the confrontation.

The above is an example of an engagement breakdown for both the resident and the patient. The patient is overwhelmed by anger. He is not able to view the resident as having valid concerns. Because of this, he is less able to engage in a meaningful care

dialogue. The resident's reflexive response to this 'threat' is fight-flight (withdrawal), and inappropriate giggling. He sees the patient's behavior as unjust and invalid. His response is seen by the observer to escalate the patient's anger, increasing the communication breakdown and preventing the resident from fully engaging in a meaningful care dialogue.

Agency Breakdowns. Participants may successfully engage only to experience breakdown at the next level. In agency level breakdown, the individual is operating from a rational mode, but is participating in such a way in a breakdown situation that precludes cooperative attainment of an immediate goal with other important actors. An agent uses conceptual models to try and achieve a goal. We believe conceptual models are comprised of context, causes, consequences, and correct action. These are shared and negotiated through language and dialogue. Types of agency breakdown that we observed include individual heuristic biases (e.g., bias toward curable versus chronic disease), distortions caused by role within the group (e.g., overvaluing an influential person's idea), and breakdown due to structural aspects of the job (e.g., correct action thwarted by lack of a necessary tool, such as a stapler). Here, conflicting concepts between the designer of the job environment and the worker in that job are separated in time.

The example "Carpal Tunnel" in the themes (II.a.i.) section above represents an agency breakdown. From the text surrounding the passage, it is clear that the patient has tried carpal tunnel braces in the past. Their effectiveness is not explored during this observation. This is an example of agency breakdown for both the resident and the patient. The patient's role (low power status in the interview) may have caused his concept of the disease to be under-valued. This leads to a decreased ability of the patient

to cooperatively attain the goal of symptom management. For the resident, there may be a heuristic bias toward a ‘curable’ model of the illness. This is a common phenomenon in our data, and can lead to conflict about goals and expectations (especially around pain control) and blame if the patient does not get better. The resident does not explore the evidence that might conflict with this model. This leads to a decreased ability cooperatively attain the same goal.

Accommodation Breakdowns. Participants may be engaged and acting effectively as agents only to experience accommodation breakdown. In an accommodation breakdown, an individual is participating in a thoughtful way in a breakdown situation that precludes operational alignment with the values, beliefs, and norms of the group. In any culture, core values and beliefs, developed collectively over time, produce a context for meaning. These are supported with assets (time, personnel, and money) and applied as rules (e.g., guidelines for resident time off), division of labor (e.g., a job description), and physical artifacts (e.g., a white coat). However, these tokens may be distorted or at odds with individual values. Accommodation breakdowns we observed include the individual choosing not to align with a norm (e.g., deciding not to use the computerized medical record), distorted group norms (e.g., norm based on convenience, not core values), or when assets were not appropriately aligned with norms (e.g., insufficient staff to handle anticipated workload).

STRATEGY

Nurse: “Dr. XXX, what did you do with all your patients?”

Resident: (joking and laughing) “I told them not to come in!”

Nurse: “The way to do it is to schedule the ‘no shows’ again in your clinic! Dr.

YYY used to do that until [the faculty supervisor] caught on!”

(Much laughter from both)

This is an example of an accommodation breakdown for both participants. The resident and nurse are choosing not to align with an institutional norm, which might be stated ‘the major purpose of clinic experience for residents is to learn from ambulatory patient care’. The observation reflects a common sentiment in our data. Learners often feel “they are too busy taking care of patients to learn”. This reflects a conceptual divide between what the resident sees as educational activity and patient care activity. This is at odds with the institutional view.

For any participatory level, it is necessary to analyze the data from the perspective of all three explanatory domains. This example from the accommodation level demonstrates the requirement well. While it is easy to identify the breakdown as being due to the resident’s attitude (psychological), there are at least two other possibilities:

- 1) The group norm is distorted because of convenience, economics, or politics (social): Is this the best setting in our system for ambulatory education? What is the service/education ratio in this clinic? Do regulatory requirements distort the amount of time spent in ambulatory settings?
- 2) The norm is valid, but not matched by assets (material): How well are residents protected from other demands while in the clinic? Is there appropriate evaluation of the achievement of important goals for this experience? Are the results of this evaluation provided as feedback to all stakeholders?

The taxonomy is now seen to determine the correct unit of analysis for a given observation, at least within the context of breakdowns. When viewing a breakdown from the subject’s perspective, the following rules are applied to determine the unit of analysis.

- If the participant demonstrates reflex action that precludes acceptance/interaction with another important actor, the level is engagement and the unit of analysis is the individual.
- When the participant is operating from a rational model, but is unable to cooperatively attain an immediate goal with another actor, the level is agency and the unit of analysis is the immediate, goal-oriented working group.
- If the individual is operating in a thoughtful way that precludes operational alignment with the group’s values, beliefs and norms, the level is accommodation and the unit of analysis is the organization.

Table I. The taxonomy of breakdown types observed in our data	
Accommodation Breakdown	<p>Cause: Thoughtful participation, but precludes operational alignment with the values, beliefs, and norms of the group.</p> <p>Timing: Historical or prospective</p> <p>Examples: Individual- doctor choosing not to use the computerized record Group- not complying with mandate for public alcohol CAGE screening (bad norm - distorted by convenience) Clinic- doctor fails to make latest formulary switch (lack of feedback about switch to providers)</p> <p>Opportunity: Improve sharing of critical information, consensus building, and system innovations.</p>
Agency Breakdown	<p>Cause: Rational response, but precludes cooperative attainment of an immediate goal with other important actors.</p> <p>Timing: Current, short-term</p> <p>Examples: Individual- projection of “rational choice” (e.g., patient will adopt HgbA1C < 7 because it is supported by science) Group- value of suggestion distorted by person’s status (patient’s diagnosis ignored) Clinic- small speculum not immediately available</p> <p>Opportunity: Improve direct communication, listening, planning, and process involvement.</p>
Engagement Breakdown	<p>Cause: Reflexive response precludes acceptance of the validity of another actor</p> <p>Timing: Immediate, reflexive</p> <p>Examples: Individual- Fight/flight response due to anger from patient Group- “us” versus “them” attitude toward patients Clinic- running behind, visit “starts angry”</p> <p>Opportunity: Improve self-reflection, skills, and specific activities.</p>

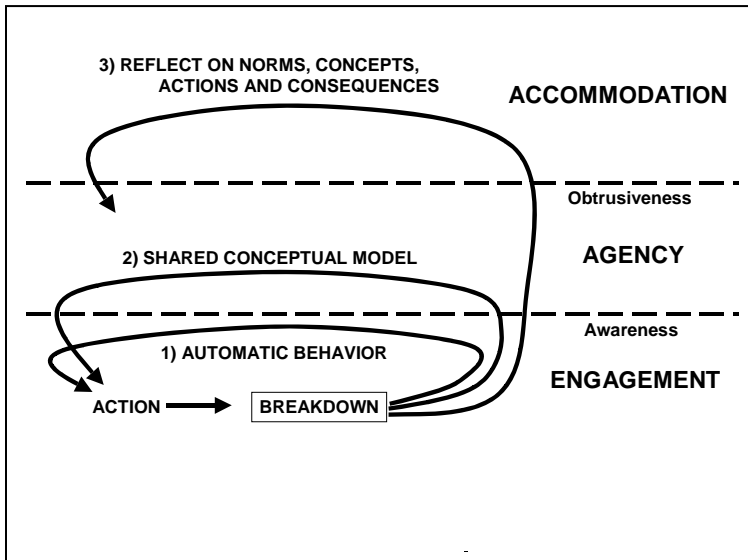


Figure 1. A graphical depiction of our taxonomy. Actions may be reflexive or concept-driven. Some actions lead to breakdown. Breakdown may be due to an automatic, reflexive behavior below the level of awareness (engagement breakdown). Engagement may be successful, but participants may be unable to come to a shared conceptual model dictating next action (agency breakdown). Breakdowns that occur over and over become obtrusive, reflecting significant differences in values, beliefs and norms between groups (accommodation breakdown). Breakdown is an important

catalyst that demonstrates relationships between actions, consequences, concepts and norms.

II. a. iii. Structural Model: After the taxonomy of breakdown types was established, we used this taxonomy and the dynamic relationships in the vignette data to create a structural model of breakdown and learning. To address the problems discussed above, we read the bodies of literature cited in the introduction and went back to Engström’s original structural model (figure 2).

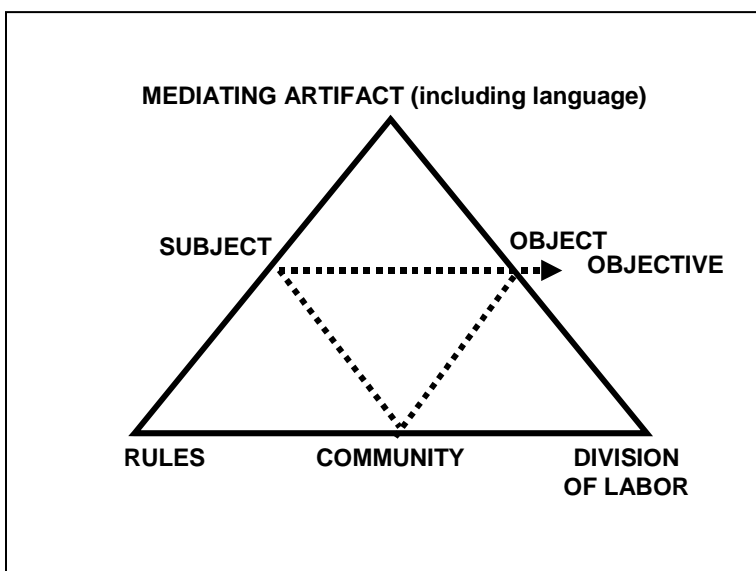


Figure 2. Engström’s (1987) cultural-historical model of distributed cognition.

We noticed several things about his model in light of our reading. First, the middle triangle (subject-object-community) seemed to correlate well with the literature on participation. Next, the three outer triangles each seemed to correlate well with one of the domains of explanation: subject-object-artifact with the psychological domain; subject-community-rule with the social domain; and community-object-division of labor with the material domain. Finally, we noticed that the outmost tip of each of these triangles (rules, artifacts, division of labor) were all reifications in the community-of-practice sense (Wenger, 1998). This gave us the notion of folding up the corners of Engström’s model to arrive at a tetrahedron. Figure 3 shows our new structural model.

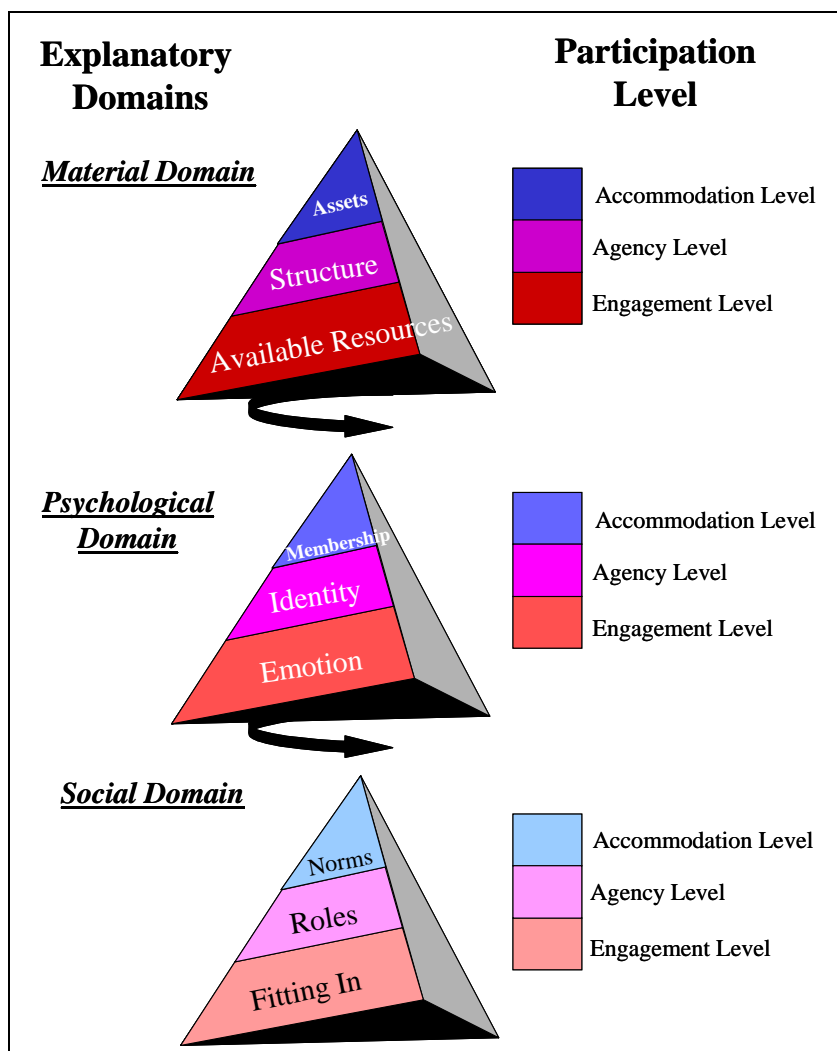


Figure 3. Our structural model is obtained by folding up Engström’s model, applying our taxonomy, and re-labeling each face with categories appropriate to the participatory level (vertical) and explanatory domain (face). We model one tetrahedron for each major sub-culture in the activity system.

Along the vertical dimension, one moves from participation to the reified products of the community along our three taxonomic categories. Each face represents one of the domains of explanation. Each element in that face represents a unique appraisal of the breakdown from that participatory level and explanatory domain.

II. b. ANALYTICAL METHOD

We are now able to specify our analytical method after reiterating our main assumptions. First, the correct unit of analysis is inferential, determined by the pattern of dialogue surrounding a breakdown situation (e.g., an engagement level breakdown is analyzed at the individual level). Second, communities-of-practice constantly reduce the complexity of participation to reified products—membership decisions, norms, and asset allocations—based on historically successful patterns. Third, breakdowns must be investigated from all three domains of explanation (psychological, social, material) using methodology that approximates interpersonal dialogue. And finally, application of cultural consensus analysis to an activity system can lead to working hypotheses about underlying causes of recurrent breakdown, and can guide possible solutions.

The initial step in our method is to generate cultural consensus statements. To do this, we engage in ethnographic observations to create an initial model of the activity system for the purpose of determining critical leverage points. These are significant tensions between the goals and values of one sub-culture and another. Trigger questions are generated from these leverage points. Focus groups or some other method of member checking are performed to obtain critical sub-culture's reactions to the trigger questions. We use *verbatim* responses to create statements for cards that can be used for cultural consensus analysis. Although the first step is quite involved, the time and energy dedicated to this step may not need to be repeated for similar activity systems once a set of statements has been created. They may be generalizable to other settings.

Step two is to perform the cultural consensus analysis (CCA). We give the statements on cards to several subjects and ask them to sort them by order of importance.

As mentioned above, this is analogous to a dialogue with critical actors that gives you two important pieces of information: it tells you what sub-cultures you have in the activity system; and it shows you where the biggest differences (and likely the greatest sources of breakdowns) are between those sub-cultures' values and beliefs. The analysis is performed by creating an NxN matrix of the proportion of matches along all pairs of subjects (where N = number of subjects). A minimum residual method of factor analysis is applied to this matrix, resulting in an estimate of each informant's competence. Standard assumptions for identifying a true sub-culture in the analysis are that there are no negative competence scores and there is a ratio of $\geq 3:1$ between the eigenvalues of the first and second factor (Romney, et.al. 1986).

The third step is to locate key breakdowns on the structural models. This is done from the perspective of each major sub-culture, because each has its own tetrahedron representing their own norms, assumptions about assets, and membership expectations. The level is selected by applying the taxonomic rules to the CCA data:

- If, in the case of significant CCA differences, the participant demonstrates reflex action that precludes acceptance/interaction with another important actor, the level is engagement.
- When, in the case of significant CCA differences, the participant is operating from a rational model, but is unable to cooperatively attain an immediate goal with another actor, the level is agency.
- If, in the case of significant CCA differences, the individual is operating in a thoughtful way that precludes operational alignment with the group's values, beliefs and norms, the level is accommodation.

These likely areas of breakdown are then discussed with stakeholders using focus groups or interviews to record reactions, salient stories, and experiences. The most fruitful explanatory domain is selected by examining the wording used in this data.

- Language that reflects that the breakdown is due to something, or the lack of something in the physical environment suggests the material domain.
- Language that reflects feelings, ideas, or individual beliefs suggests the psychological domain.
- Language that reflects rules, norms or deployment of assets suggests the social domain.

The fourth step is to examine connections between the located breakdown and other areas by moving around the participatory level and up and down the explanatory domain. This often focuses the question, suggests further observations, or clarifies root causes.

An example may help to clarify the four steps. The CCA has been created and applied at our institution (steps 1 and 2). In the mathematical analysis, we found patients, residents, and faculty to be three separate sub-cultures. One significant difference between patients, residents and faculty was in “achieving clarity and agreement on the patient’s goals and the doctor’s goals”. It was the number one priority (out of sixteen, where one is most important) for residents, number two for faculty, and number eight for patients. Statements, like this, that polarize sub-cultures are used to develop working hypotheses about underlying patterns of breakdown. This difference did seem important in discussions with participants. The most common example provided was tension between patients and doctors relative to changing harmful health behaviors (smoking, excessive alcohol, poor diet, lack of exercise). All groups felt that doctors treated it as more important or achievable than patients did. This statement about patient’s and physician’s goals is at the level of agency (agreement on goal-directed action). For doctors, it is in the social domain (language reflecting rules and norms). For patients, it is in the psychological domain (language reflecting motivation and fear). Analyzing this statement

from the doctor's perspective makes the primary location (step 3) in our tetrahedral model 'role' (see figure 3). Analyzing it from the patient's perspective makes the primary location 'identity'. The model predicts breakdowns due to tension between patient's self-identity (shame, responsibility, self-efficacy) and the 'roles' that doctors try to assign to patients.

The next task (step 4) is to explore the differences further using the model. Exploring the agency level, how does the patient's (psychological) identity, such as feeling powerless, contribute to a perception that goal sharing is futile? What (social) rules are doctors using to assign roles for behavioral change? Do clinic (material) structures, such as time allotted for visits, contribute to these tensions? Next, we look up and down the involved domains from the agency level. From the patient's (psychological) domain—are they paralyzed by fear of change (engagement level), or do they feel like members of the team involved in optimizing their health (accommodation levels)? From the doctor's (social) domain—do clinic personnel help the patients fit in (engagement level), and are the norms for suggested behavioral change valid (accommodation level)? Potential solutions, such as patient self-advocacy training, increasing time for visits, or doctor-patient communication workshops are as different as these questions. The model and the intuitions/experience of the stakeholders will guide any intervention equally.

II. c. VALIDATION

We have performed a local criterion-related validation of the analytical method as follows. We examined focus group, observational, and cultural consensus analysis (CCA) data to look for cross-modality correlations among the three sub-cultures of residents,

faculty, and patients. Our version of CCA relies on structured ethnographies (similar to observations of activity systems) to create a model. Critical leverage points (tensions between the values of different sub-cultures) in the model are crafted into trigger questions for focus groups of subjects. *Verbatim* answers from these focus groups are then placed, one statement to a card, on index cards. Similar subjects are then asked to rank order the cards by importance. This method has been used to detect important differences in attitudes and beliefs about breast cancer screening (Chavez, et.al., 1995). In our CCA data, each group ranked “Checking the computer for accurate patient information” differently. It was the number six priority (out of sixteen, where one is most important) for residents, number nine for faculty, and number twelve for patients. This agreed well with our focus group data.

(Resident Focus Group) *How does the computer affect the clinic visit?*

“I can always get whatever it is that I want.”

“I know exactly where to go to find out why I want to see them back; what issues we’re addressing.”

(Faculty Focus Group) *How does the computer affect the clinic visit?*

“I think, overall it’s been a very positive thing. I don’t do notes while patients are in the room, but to be able to access the data [is good].”

“Getting data out of it is a value. Putting data in is a pain in the neck.”

(Patient Focus Group) *How does the computer affect you while you’re in with your doctor?*

“I don’t like it. Some of the things they say, it seem like I’m constantly filling in the blanks.”

“I don’t particularly care for them...most of the time by the time I explain why I’m getting this type [of] medicine my fifteen minutes is up.”

The CCA rankings also correlated with several direct observations during the earlier phases of the study.

COMPETING WITH THE COMPUTER

Resident: (typing and clicking on the computer)

Patient: (begins to say something and then stops mid-word; notices the resident is dealing with the computer) "Excuse me"

Resident: (doesn't notice the interruption).

Patient: (staring off into space in silence for a few minutes)

COMPUTER

Patient: "Now that [residents] use those computers, they ask me how I'm doing; I tell them and they say, 'It doesn't say that in here!' They just don't listen to me!"

The other areas of greatest difference in our CCA were: i) importance of continuity, ii) importance of discussing significant events in the patient's life, iii) education about lifestyle changes, iv) achieving clarity and agreement on goals, and v) notification about lab results. Focus group responses and direct observations also strongly supported these rankings.

We also tested the validity of the assumption that a CCA created at one institution was exportable to a similar institution. We did this by applying our CCA cards at another academic internal medicine clinic from our network that is located 600 miles away. These data strongly support the exportability of the CCA. First, the faculty and residents were again found to be independent sub-cultures. Faculty, residents, and patients in this sample had eigenvalue ratios nearly identical to the original sample. Second, many of the areas of greatest difference in our data were also seen in the other clinic's data (e.g., importance of continuity, importance of discussing significant events in the patient's life, achieving clarity and agreement on goals) and the ranking skew was in the same direction. Finally, as seen in table II below, the correlations between similar sub-cultures at different institutions were greater than the correlations between different sub-cultures within the same institution.

Table II. Correlation matrix for the CCA rankings of patients, residents, and faculty from our institution (A) and another institution in our network (B).

	Patient-A	Resident-A	Faculty-A	Patient-B	Resident-B	Faculty-B
Patient-A	1.00					
Resident-A	0.04	1.00				
Faculty-A	0.18	0.70	1.00			
Patient-B	0.87	--	--	1.00		
Resident-B	--	0.84	--	0.58	1.00	
Faculty-B	--	--	0.82	0.66	0.76	1.00

CONCLUSIONS

We report here on a structural model and analytical method that are a work in progress. While they are based on a plausible synthesis of activity theory and other significant thinking, they have not yet been tested in several settings. We hope to pique the interest of researchers in the field of activity systems, who could further test the validity of this structural model and analytical method. Of special interest to us is to test our model and use of cultural consensus analysis in health care systems and cultures widely divergent from our own.

It is clear that our use of activity theory is purely pragmatic, as a tool to structure concepts and observations of an activity system in order to guide change and improvements. This approach may be at odds with more theoretical treatments of activity theory. We hope, through our efforts, to facilitate discussion and to support the process of unifying abstract theories and pragmatic applications.

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