

TOWARD A THEORY OF THE LOOSELY COUPLED SYSTEM

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Abstract

Diverse work on the concept of loose coupling is consolidated into a theoretical model of the loosely coupled system. The model proposes that when faced with causal indeterminacy, people develop different views of reality and become more loosely coupled. Assuming they still share some preferences, they use collective judgment to rebuild a workable view of cause-effect sequences. The model is applied to three studies, and implications for theorists, researchers, and practitioners, are discussed.

TOWARD A THEORY OF THE LOOSELY COUPLED SYSTEM

The concept of organizations as loosely coupled systems is widely used and poorly understood. Our agenda in this paper is to attack this confusion by placing loose coupling in a deviation-counteracting model (Maruyama, 1979). We argue that causal indeterminacy is an important antecedent to loose coupling and that judgment is an important consequence of loose coupling. We further propose that judgment reduces causal indeterminacy.

 Insert Figure 1 about here

Causal indeterminacy is defined as disagreement among observers on interpretations of means-ends connections. Factors which define causal indeterminacy are non-routineness of tasks, selective perception, and bounded rationality.

On a conceptual level, loose coupling is defined as the simultaneous presence of coupling and decoupling mechanisms. On an operational level and in common usage, it is a term that emphasizes the weakness of coupling mechanisms and the strength of decoupling mechanisms, especially in comparison to tight coupling. An increase in loose coupling is a movement toward weaker coupling and stronger decoupling, and an increase in tight coupling is a movement toward stronger coupling and weaker decoupling. The phrases "loose coupling" and "loosely coupled system" are often used without referents, but this has been a confusing

practice. A precise recipe to describe loose coupling is "loose coupling between specified elements on specified dimensions."

Judgment is defined as the ability to create detailed, internally consistent rationales for action. This definition implies a familiarity with the action, possible rationales for action, and prevailing standards of rational choice. Consequently, judgment also carries connotations of understanding, good sense, expertise, wisdom, and intelligence. Organizations can increase the frequency and/or the quality of judgment. Increased frequency of judgment implies that there are more people exercising judgment or that people are exercising judgment more often. Increased quality of judgment implies that people are sensing more details or organizing those details in more credible rationales.

A variety of studies illustrate the model's general formulation that loose coupling generates the judgment necessary for organizations to cope with causal indeterminacy. Manning's (1979) analysis of loose coupling in a metropolitan police department showed that police are better able to deal with the indeterminacies of problems on the street because the police system is loosely coupled, allows discretionary action, and enables the police to enact realities which they can comprehend. Firestone (1985) argued that principals may contribute to a school's well-being by loosening couplings to the district office and to other parts of the environment, thereby allowing teachers to exercise more judgment in their work. Clark (1986) found that the activity of knowledge creation in systems of higher education is a task on which there is considerable disagreement about causes and effects. He argued that, for participants to cope with this indeterminacy, systems should be loosened, power divided, variety supported, and disorder legitimized, all of which becomes possible if

officials believe "they are doing all right when the system as a whole looks like a mess, nearly everyone feels powerless, and no one can identify who is doing what to whom" (p. 273). Birnbaum (1981) found that loose coupling within interdisciplinary research groups generated more judgment and more enactment of smaller determinate environments in the form of articles published and students graduated.

The loose coupling model that explains these diverse cases is presented in six sections. The first section analyzes loose coupling research and argues for a specific interpretation of the loose coupling metaphor. The second, third, and fourth sections each focus on one of the three causal links proposed by the model: the second section describes the processes by which causal indeterminacy leads to loose coupling, the third section describes how loose coupling generates increased frequency and quality of judgment, and the fourth section suggests several mechanisms through which increased judgment reduces causal indeterminacy. The fifth section presents more in-depth applications of the model to research by Covalski and Dirsmith (1983), Meyer (1980), and Manning (1979). The conclusion identifies key implications of the model for theorists, researchers, and practitioners.

Loose Coupling

The focal variable in the model is loose coupling, or more precisely, the looseness of couplings within a system. There are two influential general definitions of loose coupling. Glassman (1973) wrote that "The degree of coupling, or interaction, between two systems depends on the activity of the variables which they share. To the extent that two systems

either have few variables in common or if the common variables are weak compared to other variables which influence the system, they are independent of each other. It is convenient to speak of such a situation as one of loose coupling" (p. 84). Weick (1982) wrote that a loosely coupled system is a system in which elements affect each other "suddenly (rather than continuously), (2) occasionally (rather than indirectly), (3) negligibly (rather than significantly), (4) indirectly (rather than directly), and (5) eventually (rather than immediately)" (p. 380).

The agreement among loose coupling theorists on these general definitions breaks down when researchers try to describe loosely coupled systems. There are at least four competing definitions of loosely coupled systems: the counter-rational, uni-dimensional, multi-dimensional, and dialectical interpretations.

Within the counter-rational interpretation, researchers emphasize the ambiguous, chaotic, unpredictable, and uninterpretable nature of loosely coupled systems (e.g. Browning, 1982). Loosely coupled systems are defined as confusing interactions of problematically coupled components.

Within the uni-dimensional interpretation, researchers focus on a single dimension on which loose couplings occur, such as communication, resource dependence, or influence (e.g. Murphy & Hallinger, 1984, p. 7). Loosely coupled systems are defined as systems which exhibit a single loose coupling on a specified dimension, such as between institutional and technical activities (Meyer & Rowan, 1977), negotiated orders and official structure (Thomas, 1984), or organizations and their environments (Glassman, 1973).

Within the multi-dimensional interpretation, researchers allow for complex patterns of couplings on many dimensions, ranging from two dimensions (Firestone & Herriott, 1982) to six or more (Beekun, 1988). Loosely coupled systems are defined as systems in which there are weak couplings on several dimensions.

Within the dialectical interpretation, researchers look for a balance of coupling and decoupling (Das, 1984; A. Meyer, 1980; Weick & Orton, 1988). Loosely coupled systems are defined as systems which are simultaneously coupled and uncoupled.

Each of these four interpretations implies different theories of causality, different measurement theories, and different sets of implications for organization members. Variation among researchers in the clear specification of a core loose coupling metaphor, and variation in researchers' adherence to that metaphor once specified, explains most of the uneven quality of loose coupling research.

The present model builds on and extends the dialectical interpretation of loosely coupled systems. This interpretation requires a sensitivity to both tight and loose coupling. Researchers generally have oversimplified the concept of loose coupling by emphasizing looseness and deemphasizing coupling. For example, Thomas defined loose coupling as "a lack of connections, or slippage, between organizational niches and the behaviors that are intended to bind organizational goals to organizational practices" (1983, p. 244). Firestone, Herriott, and Wilson described loosely linked schools through two characteristics, "the absence of shared goals" and the "decentralization of power which allows for substantial teacher autonomy" (1983, p. 3). Gummer, writing for a social work audience, stated that "loose coupling has come to refer to organizational practices

which operate independently of the administrative mechanisms" (1984, p. 9). The term has been translated into French as *manque de coordination* (Withane, 1984, p. 243), which translates back into English as a lack, want, shortage, deficiency, or breach of coordination (Rudler & Anderson, 1952).

The problem with all of these definitions is that there is little reason to think that elements have any relation to one another. A world of independent elements is a world of uncoupled systems, not loosely coupled systems. Many definitions of loose coupling as uncoupling can be traced back to Glassman's influential statement, cited earlier, which equates "independent" with "loose coupling." If the systems are independent then they are clearly loose, but in what sense are they coupled?

In contrast to the prevailing interpretations of loose coupling as decoupling, authors who use a dialectical interpretation give equal attention to looseness and coupling:

1. "The image is that the principal and the counselor are somehow attached, but that each retains some identity and separateness and that their attachment may be circumscribed, infrequent, weak in its mutual affects, unimportant, and/or slow to respond" (Weick, 1976, p. 3).

2. "This paper has described patterns composed of tight and loose organizational couplings The first pattern consisted of primarily tight couplings within the organization offset by primarily loose couplings to its environments. . . . The second pattern consisted of tight and redundant couplings with environments offset by loose and provisional couplings within" (Meyer, 1980, pp. 20-21).

3. "[L]oose coupling . . . manages to combine and mix up, in a head-on collision (and coalescence), two apparently opposing 'qualities' or conceptual schemata, namely, the idea of looseness and the idea of

coupling (which conveys the quality of tightness or concreteness, having to do with links and connections). It can be described somewhat as a dialectical notion that has been successfully, if ambiguously, dove-tailed into one full-blown idea" (Das, 1984, p. 262).

In these three uses of loose coupling, there is a balance between responsiveness and separateness, coordination and independence, and tightness and looseness. This balance preserves the point that organizations represent an ongoing effort to manage the contradictions between the looseness of autonomy and the tightness of control. To emphasize only one side of the contradiction is to lose sight of the core dilemma which animates any organized activity.

The concept of loose coupling reconciles the contradictions of open and closed systems (Thompson, 1967), non-bureaucratic and bureaucratic organizations (Gouldner, 1954), and organic and mechanistic systems (Burns & Stalker, 1961) by arguing that any system contains pressures toward looseness (decoupling mechanisms) and pressures toward tightness (coupling mechanisms). Decoupling mechanisms weaken dependencies among system elements whereas coupling mechanisms strengthen dependencies. In any system, both mechanisms are present all the time. Those systems in which coupling mechanisms are predominant are tightly coupled systems, approaching the logical impossibility of completely coupled systems. Those systems in which decoupling mechanisms are predominant are uncoupled or minimally coupled systems, approaching the logical impossibility of completely decoupled systems. As the two sets of mechanisms have equal dominance, the system becomes loosely coupled. These systems are described by two words, one of which --

"loose" -- captures tendencies toward decoupling, and one of which --
"coupling" -- captures tendencies toward coupling.

Causal Indeterminacy as a Determinant of Loose Coupling

Causal indeterminacy, whether in the form of uncertainty (Thompson, 1967), ambiguity (March & Olsen, 1976), or equivocality (Daft and Lengel, 1986), is a central variable in many explanations of organizing. In this section we focus on the relationship between causal indeterminacy and loosely coupled systems.

By causal indeterminacy, we mean uncertain means-ends connections. Tasks such as producing pins and shoveling pig iron seem causally determinate; tasks such as educating or curing people seem causally indeterminate. Yet it is possible to define portions of pin-production and iron-shoveling as causally indeterminate and portions of education as causally determinate. Work by Tolman and Brunswik (1935) and Einhorn and Hogarth (1986) helps clarify causal indeterminacy as a variable.

Brunswik and Tolman demonstrated variance in degrees of causal indeterminacy. By asking two questions (Do means lead to goals? and How accurately do cues represent means?), Brunswik and Tolman identified a variety of "causal textures" -- combinations of objective and subjective data with widely varying degrees of causal indeterminacy. In some causal textures, a cue is a reliable indication of a means, and the means has a good probability of leading to the goal. In other causal textures, a cue is an ambiguous indication of a means, and the means has an ambivalent probability of leading to the goal. By systematically categorizing causal

textures, Brunswik and Tolman demonstrated that causal indeterminacy is prevalent in most instrumental relationships (see Weick, 1979).

In a more sophisticated definition of causal indeterminacy, Einhorn and Hogarth (1986) proposed a measure of the strength of a causal explanation. The measure is built around three nested equations. The first equation is a measure of the strength of the causal chain that links the initial cause (X) to the focal event (Y). Einhorn and Hogarth used the example of a causal chain in which sunspots lead to stock price changes: sunspots change the weather which changes agriculture which affects the economy which reduces profits which causes price changes. The covariances of each link in the chain are multiplied to produce a measure of the strength of the causal chain:

$$Q_L = \prod_{j=1}^l c_j$$

where l = the number of links in the causal chain and c_j = the covariance of the j th link. If Q_L is low, the effect of sunspots on price changes is causally indeterminate.

The first equation is embedded in the second equation, which is a measure of the gross strength of a causal explanation:

$$s(X,Y) = Q_T Q_B Q_L (\lambda_C Q_C + \lambda_S Q'S)$$

The strength of X as an explanation of Y can be modeled through Q_T (whether or not X occurs before Y), Q_B (whether or not X is part of the normal background), Q_L (the strength of the causal chain), Q_C (the covariation of X and Y), $Q'S$ (the similarity of cause and effect), and the lambdas (attention factors). Notice how the formula is expanding from simple covariance to include more variables drawn from the context.

The third equation models the net strength of a causal explanation:

$$S_k(X,Y) = s(X,Y) - \sum_{k=1}^K w_k s(Z_k, Y)$$

The net strength of X as an explanation of Y is the gross strength of X as an explanation of Y minus the sum of the strengths of K alternative explanations of Y (Z_k) each of which is weighted by an attention factor (w_k). Now the judgment context has expanded to include the effects of alternative explanations of causality.

Einhorn and Hogarth's work serves as an introduction to the loose coupling model. First, like Brunswik and Tolman, Einhorn and Hogarth define the structure of causal indeterminacy: causally determinate situations will have a single strong explanation and causally indeterminate situations will have multiple weak explanations. Second, it emphasizes the prevalence of causal indeterminacy: "Put succinctly, people know that they do not have complete causal knowledge. Therefore, the awareness of incomplete knowledge provides the basis for why causal judgments are generally judgments of probable cause" (p. 8). Third, Einhorn and Hogarth's work frames causality as a human construction which means it can be influenced by judgment.

Causal indeterminacy appears in organizations in at least three forms: nonroutine tasks, selective attention, and bounded rationality.

Causal indeterminacy often has a technological origin in nonroutine tasks. When individuals work with routine tasks, they have already reduced the causal indeterminacy generated by the task, if such indeterminacy ever existed. Nonroutine tasks have several characteristics that make them indicators of causal indeterminacy, as Weick and McDaniel

(in press) demonstrated in their differentiation of routine problems from nonroutine problems (Table 1). As an organization performs more nonroutine tasks, it confronts more causal indeterminacy.

Insert Table 1 about here

A second indicator of causal indeterminacy is selective perception by observers, a process Glassman described as a problem of observational shortcuts: "If the observer is not looking at or understanding the operation of variables involved in coupling then his conceptual system will show a looser coupling than exists in the real world. Similarly, a looser, more indeterminate, relation may appear when the focus is narrowed and one looks at a very small range or time interval of variation, perhaps because of limitations of the instruments or analysis used. The above qualifications are useful because the complexity of living systems means that their stability will be seen only over relatively long intervals within which one may want to look at details of organization and also because one will ordinarily look at only part of the range on only some of the variables involved in the coupling" (Glassman, 1973, p. 85). To paraphrase Glassman, people are more likely to perceive the world as indeterminate if they don't look at the right variables, don't understand the variables they look at, or look only at small ranges of variation for brief periods. These observational shortcuts lead to the impression of indeterminacy and make it hard for people to agree on cause-effect relations.

The third indicator of causal indeterminacy, the source that is most important to our model, is bounded rationality (see Hogarth, 1980, pp. 4-6). People with limited information processing capabilities, memories that lose details, and attention spans that are short, individually will notice different portions of their surroundings and will process different portions at different speeds. As a result of the idiosyncratic perceptions formed under these conditions, people will find it difficult to coordinate their actions, will share few variables or weak variables, and will resort to incremental strategies to cope with this variance.

These idiosyncratic perceptions are the source of loosely coupled systems. Causally indeterminate causal textures, which are generated by a combination of nonroutine tasks, selective attention, and bounded rationality, activate relatively more decoupling mechanisms as participants attempt to make sense in idiosyncratic ways. Thus, an increase in causal indeterminacy leads to an increase in loose coupling. To illustrate this process in more detail, we draw on the findings of several researchers.

Katz argued that physicians participate in a "flight from uncertainty" (1984, p. 553) by narrowing their diagnostic and treatment vision through specialization and conformity. By specializing, physicians have created "not a unitary profession but a federation of professions with differing ideologies and senses of mission" (p. 554). By conforming to peers, physicians are "educated for dogmatic certainty, for adopting one school of thought or the other, and for playing the game according to the venerable, though contradictory, rules that each institution sought to impose on its staff, students, and patients" (p. 552). The structural consequence of massive uncertainty, according to Katz, is the creation of a federation of professions, a structure we refer to as a loosely coupled system.

Clark (1986) linked the indeterminate qualities of knowledge to the loosely coupled nature of universities: "[A]n academic system works with materials that are increasingly specialized and numerous, knowledge-intensive and knowledge-extensive, with a momentum of autonomy. This characterization applies most strongly to advanced systems, but even the most retarded systems will be based on a half-dozen or more distinct bundles of knowledge that have their own internal logics and an inherent bent toward autonomy" (Clark, 1986, p. 16). Because the manipulation of knowledge generates a steady stream of non-routine tasks that must be performed by people who have narrowed perceptions and bounded rationality, the result is more loose coupling in the form of specialization, autonomy, and multiple logics.

Manning (1979) suggested, from his study of the semiotics of a police department's 911 call system, that loosely coupled systems are most likely to occur where 1) an organization's communication system is the technological core, 2) there are limited sources of information, and 3) information moves in one direction, with few opportunities for feedback. These are conditions which generate causal indeterminacy. Technological cores where the primary input is information are less routine than cores where the primary inputs are materials, especially when limited sources of information narrow perception, and a lack of feedback imposes limits on rationality. The resulting uncertainty of the task leads police organizations to adopt structures that are loosely coupled on two dimensions. First, the roles of operator, dispatcher, and police unit are kept distinct and in relative ignorance of each others' activities. Second, the police units themselves are geographically isolated from each other and are expected to translate a small piece of dispatcher information about the situation into

a rich interpretation of the situation and an effective response. These structural loose couplings have a balance of coupling mechanisms (information flow and task) and decoupling mechanisms (geographic isolation and diversity of experience).

The link between causal indeterminacy and loose coupling becomes even clearer when we look at organizations that have changed from tightly to loosely coupled systems. One example of this type of historical analysis is Golembiewski's comparison of the early Southern Political Science Association with the current SPSA. He described the early organization as characterized by "centripetal pulls" and the later organization as characterized by "centrifugal pushes." The centripetal pulls (early institutional penury, small size, strong policy commitments, shared generalist orientations, and significant accomplishment by members) create causal determinacy, which generates tight coupling. The centrifugal forces (growth, out-of-region in-migrants, diverse institutional agendas, uneven prominence of some schools, and social and economic uncertainties of members) create causal indeterminacy, which generates loose coupling.

Judgment as a Consequence of Loose Coupling

The proposed model is, in many ways, anticipated by Thompson and Tuden's work (1959). Thompson and Tuden argued that beliefs of organization members determined decision strategies, and that different decision strategies were supported by different organizational structures. The two dimensions for their model were 1) whether participants agreed or disagreed on which means led to certain ends, and 2) whether

participants agreed or disagreed on which ends should be preferred. By crossing these types of beliefs, Thompson and Tuden created their well-known matrix of decision strategies. They rank these strategies by difficulty in the following order: computation (agree/agree), majority judgment (disagree/agree), compromise or bargaining (agree/disagree), and inspiration (disagree/disagree).

Thompson and Tuden's most interesting analyses occurred when they speculated on what type of organizational structure would emerge to support these decisions. Computation is supported by a bureaucratic structure, majority judgment is supported by a collegial structure, compromise is supported by a representative structure, and inspiration is supported by an "anomic structure."

Each of these structures is in some ways a loosely coupled system: the bureaucratic structure is "an organization of specialists" (p. 198), the collegial structure has "authority vested in the members" (p. 200), the representative structure has "several factional preference scales" (p. 201), and the anomic structure has "randomness and disorganization" (p. 203). However, the collegial structure is most consistent with our definition of loosely coupled systems as simultaneously coupled and decoupled. The collegial structure allows disagreement on means-ends connections while requiring "fidelity to the group's preference hierarchy" (p. 200).

Recall that in a loosely coupled system people share few variables, share weak variables, and have differing views of causality, but they remain coupled on some dimensions. A loosely coupled system is loosened by disagreement about means-end connections, but coupled by agreements about preferences. This combination of disagreement and agreement is predicted to encourage the adoption of judgment as a decision strategy.

The strategy of judgment occurs repeatedly in discussions of loose coupling (e.g. Perrow, 1984).

Thompson and Tuden used the term "judgment" as shorthand for the social activity of majority judgment, by which they meant, "The case where there is not only differential perception [of the same empirical phenomenon] but also differential interpretation, and this is most clearly illustrated by the voting situation in which the collective judgment determines the decision" (p. 199). Thompson and Tuden explicitly assign judgment to the organizational level: organizational decisions are made by majority or collective judgment.

After more careful analysis, it becomes apparent that judgment on an organizational level is composed of two variables on a group or individual level. First, there is a frequency variable. The voting metaphor invoked by Thompson and Tuden requires as many judgments as there are voters. The collegial structure is more judgment-intensive than other structures. Second, there is a quality variable. When individuals or groups are expected to exercise judgment, their wisdom, intelligence, and expertise should increase. The collegial structure is composed of "wise and knowing" (p. 200) people, or "judges" (p. 199), who look at problems from their "own special vantage point[s]" (p. 199).

Acts of judgment are more suited to a loosely coupled system than to either an uncoupled system or a tightly coupled system. A loosely coupled system modelled after a collegium promotes wise choice or enactment of factual premises because people have equal influence, equal information, and a decision scheme of majority rule. By contrast, an uncoupled system (e.g., an "anomic structure") has few means to combine diverse bits of information and no means to assess consensus, and a tightly coupled

system (e.g., a "bureaucratic structure") has few means to gather the information which accurately reflects the indeterminacies that confront the system. Given the relative advantages of the loosely coupled form for problems of causal indeterminacy, it is not surprising that collegium forms such as the judiciary (Hagan, Hewitt, & Alwin, 1979), universities (Rubin, 1979), trade unions (Katz, 1964), and voluntary associations (Golembiewski, 1979) are heavily represented in the loose coupling literature.

Corwin (1981) cited three researchers who had each argued that the structural condition of loose coupling allows the development of the cognitive condition of judgment. Barnard asserted that "All complex organizations" have "zones of indifference" which permit discretionary behavior (1938); Crozier saw "freedom of action" as a driving force behind groups' efforts to preserve and enlarge their domains and limit dependence on other groups (1964, p. 156); Lortie (1969) wrote that school structures allow teachers to carve out zones of autonomy. The process each of these theorists described is the creation of judgment through loose coupling.

Another way of stating that loose coupling generates judgment is to argue that tight coupling inhibits judgment. In his book on the systemic causes of accidents, Perrow (1984) demonstrated that tightly coupled systems stifle operator judgment. It becomes impossible for operators to experiment, adapt to, or be responsible for the unexpected incidents that inevitably occur in these systems. Tight coupling, combined with interactive complexity, triggers system accidents. The solution, according to Perrow, is to decrease the tight coupling of the most dangerous systems

so that operators can exercise judgment on a smaller set of possible interactions.

When considering the relationship between loose coupling and judgment, it is important to emphasize that there is a lower limit to the exercise of judgment. If too much judgment is exercised by system components, the system ceases to be a system. As people become increasingly dissimilar in their views as to which causes have which effects, the system moves from tightly coupled (agreement on both causation and preference), to loosely coupled (agreement on preference only), to uncoupled (agreement on nothing). Whether people remain loosely coupled or become uncoupled when they face puzzles of causation, depends increasingly on their perceived agreement (Eisenberg, 1984) on preferences among different possible outcomes in the puzzling world they face.

As causation becomes problematic, the coupling mechanism of common values becomes increasingly important as a source of guidance for ways to deal with causal indeterminacy. This is why professionals, people who are defined in part by their shared values, are associated so often with loosely coupled systems. The presence of shared values allows them to resist the pull toward complete fragmentation of effort that is the threat of causal indeterminacy.

Judgment as a Determinant of Causal Indeterminacy

Einhorn and Hogarth argued that causal indeterminacy is inseparably connected to judgment. Because, according to their argument, causality is an attribute assigned by observers to a situation, it cannot be anything

other than a judgment. Einhorn and Hogarth's phrase linking the two concepts is "judging probable cause" (1986). In this section we argue that judgment, through a number of diverse mechanisms, reduces causal indeterminacy.

The theme of imputing probable cause in the interest of greater certainty is evident in Simon's (1976) distinction between value judgments, which were decisions that determined final goals, and factual judgments, which were decisions about particular actions that implemented these objectives. This is the same distinction that Tolman and Brunswik (1935) and Thompson and Tuden (1959) used. Simon recognized that the word "factual" could imply a certainty or objectivity that would rarely be found, so he inserted a disclaimer: "The word 'factual,' though possibly misleading, is used for lack of a better term. It is clear that the 'facts' on which practical decisions are based are usually estimates or judgments, rather than positive and certain items of fact. To add to the confusion, the term 'valuation' is often applied by writers to refer to this process of judging, or estimating facts" (1949, footnote 3, p. 5). To exercise judgment, therefore, is to "choose factual premises whose truth or falsehood is not definitely known and cannot be determined with certainty with the information and time available for reaching the decision" (p. 51). When people exercise judgment they reduce causal indeterminacy by choosing or constructing the factual premises upon which causal indeterminacy is built.

The key ambiguity in Simon's linking of judgment to causal indeterminacy is represented in the phrase "exercising judgment": 1) does increased judgment mean a more frequent use of the process of judgment ("more exercising of judgment"), or 2) does increased judgment mean a

higher level of expertise, wisdom, and intelligence ("exercising more judgment")? If there is more exercising of judgment, causal indeterminacy is reduced through a process of more choices being made. If participants exercise more judgment, causal indeterminacy is reduced through a process of better choices being made.

March has referred to this distinction between frequency of judgment and quality of judgment as a problem of calculated rationality and systemic rationality: "The search for intelligence in decisionmaking is an effort to rationalize apparent anomalies in behavior. In a general way, that effort imputes either calculated or systemic rationality to observed choice behavior. Action is presumed to follow either from explicit calculation of its consequences in terms of objectives, or from rules of behavior that have evolved through processes that are sensible but which obscure from present knowledge full information on the rational justification for any specific rule" (1978, p. 591). Under calculated rationality, people choose factual premises; under systemic rationality, people construct factual premises.

Calculated rationality is a form of analytic judgment evident in micro-economic theories of choice. These theories often assume that individuals are able to compute their preferences and the relations between various actions and desired outcomes. Such assumptions become more complex as a steady stream of biases and heuristics are incorporated into the theories by behavioral decision theorists and other students of choice (Kahneman, Slovic, & Tversky, 1982).

Systemic rationality is a form of catalytic judgment that is evident when forceful actions create orderly contingencies among events and remove some indeterminacy. Self-fulfilling prophecies are an example of

this process, but the more general formulation is that people can enact regularities into their environment (e.g. Smircich & Stubbart, 1985; Weick, 1969). People who disagree about causation can reestablish some determinacy by voting for a subset of factual premises which they will treat as binding, but they can also manipulate the environment (Hedberg, Nystrom, & Starbuck, 1976) so that it actually contains explicit cause-effect ties on which they all can agree.

The important point about judgment is that it is a strategy to remove causal indeterminacy that functions best when there is latitude, which can be supplied by loose coupling, to choose and/or enact a smaller, more comprehensible, more meaningful subset of factual premises which replaces the larger, less comprehensible, less meaningful set of causal indeterminacies. These larger sets of causal indeterminacy undermine monolithic organization by encouraging fragmented effort and idiosyncratic perceptions.

Occasions where perceived control is the means by which judgment reduces indeterminacy are evident in the interactions between doctors and patients. Katz argued that doctors wear a mask of confidence and act as living placebos in order to create hope, reassurance, and certainty for patients with indeterminate symptoms. By doing so, physicians feel they discourage consultation with "quacks" who exude more certainty, mobilize greater patient energy to deal with the disease, and prevent additional complications from the secondary effects of depression, fear, and helplessness. When physicians act as if they understand an indeterminate disease and have it under control, they often trigger mechanisms that make the indeterminate more determinate.

The use of judgment to reduce causal indeterminacy is not confined to medical practice: It is also evident in the negotiated orders that are constructed in maximum security prisons (Thomas, 1984). Thomas found that guards, civilians, and prisoners used compromise, exchange, corruption, conning, hassling, and intimidation as negotiating techniques through which participants could construct the situation more to their liking. The organization did not follow its formal procedures, but instead followed a constantly shifting set of negotiated orders. Negotiation implies a reliance on the judgment of the negotiator, and order implies a reduction in causal indeterminacy.

Structures such as the negotiated order are special cases of a larger mechanism through which judgment reduces causal indeterminacy. It has long been noted that organizational purposes, shared assumptions, or cultures, which will be referred to here generally as institutionalized beliefs, reduce the uncertainty of organizational members. Institutional theorists generally argue that institutional beliefs are forced on or imprinted on organizations from rationalized institutional myths outside the organization (Scott, 1987). The loose coupling model supports an alternative process in which loose coupling activates more behaviors, efforts to justify these behaviors result in the construction of more factual judgments, and causal indeterminacy is reduced when these judgments are diffused and aggregated into a set of institutional beliefs (Weick, 1988). When organization members cooperate to build a social reality that reduces collective ambiguity, they are using individually-developed judgments to create a collectively-held set of institutionalized beliefs which allows them to see their world as more causally determinate.

The Self-Regulation of Loose Coupling

The core argument of the loose coupling model is the following: Causal indeterminacy leads people to develop different views of reality. When people have different views of reality, they share fewer variables and they share weaker variables, which means, by Glassman's definition, that they become more loosely coupled. Assuming they still share some preferences, they use collective judgment and function as a collegium to rebuild a workable view of cause-effect sequences.

As an extended example of how to apply the formulation, we examine Covalleski and Dirsmith's (1983) analysis of loose coupling between hospital administrators and nurse administrators. The core issues are 1) nurse autonomy to deal with constantly changing patient conditions whose causation is unclear and 2) nurse compliance with accounting and accountability constraints imposed on the nursing unit by hospital administrators. "At the institutional level, the hospital administrator, while bespeaking the virtues of control, should step back from making decisions and controlling activities and let departments use information to generate internal complexity and novel thinking to keep up with a changing environment Nursing representatives should, in turn, be involved in using budgeting information to represent the cause of the department. This information is useful in that it is: a useful symbol for dramatizing technical rationality, defensible to questioning from internal competitors vying for scarce resources and assists hospital administration in depicting the hospital as coming to grips with rising costs. However, the nursing representatives, having acquitted themselves of the advocacy role,

should abandon the bureaucratic mask and assume the clan mask for coordinating and controlling subordinates" (p. 337).

A nurse administrator needs to advocate the concerns of his or her unit upward in budget language to help hospital administrators satisfy their constituents, but he or she must be careful not to treat the nurses in the unit using only the same budget images. If the technical core is to run effectively in the face of unclear knowledge of cause-effect relations, then systems must encourage judgment in order to create small pockets of cause-effect clarity. Such arrangements, however, are harder for administrators to control and evaluate, harder for administrators to justify to outsiders, and less consistent with lay theories of organizations which feature the desirability of control, accountability, tight coupling, and formalization.

The system prescribed by Covaleski and Dirsmith is represented in the first model in Figure 2a as a stable, self-correcting system. Suppose, however, that a nurse administrator does not buffer the nurses from administrative mechanisms and pushes these mechanisms down into the unit where causation still remains unclear. If this happens, the unit gets into a vicious circle where indeterminacy encourages tighter coupling, which reduces latitude, which allows indeterminacy to climb even higher, which triggers even further tightening. That scenario creates an even number of negative relationships between system elements, which is the defining characteristic of a deviation-amplifying system that is likely to disintegrate. A system where the bureaucratic mask displaces the clan mask is represented in Figure 2b.

Insert Figure 2 about here

To loosen couplings is not to forego evaluation, because performance is evaluated on a "localized" basis (p. 336). Nor does loosening represent an exercise in hypocrisy. Advocacy of different logics for the same activity is not hypocrisy if different audiences with different theories are being addressed. The work situation is simply portrayed in the terms to which each is most responsive. It is portrayed in images of coupling to those outside who favor bureaucracies, and in terms of looseness to those inside who favor clans. Because the system is loosely coupled, both sets of images have a grain of truth.

Alan Meyer's hospital research provides two complementary examples of the loose coupling model -- one tightly coupled system ("Memorial Hospital") and one loosely coupled system ("Community Hospital"). Memorial Hospital's administrator described the hospital as an "institution that provides excellent basic health care but refers out cases that are esoteric, complex, or that require sophisticated medical machinery" (p. 9). In other words, this hospital avoids causal indeterminacy by refusing to accept nonroutine tasks. This allows tight coupling: "Staff specialists guide the typical patient through a familiar sequence of hospital procedures, ranging from an efficiently administered battery of presurgical tests to a smooth but tightly scheduled trip through the operating and recovery rooms" (p. 11). The hospital intensifies this tight coupling by minimizing slack human resources. Consistent with the argument that judgment is reduced by tight coupling, it is the hospital's

policy to discourage members from joining external professional associations (p. 11).

Community Hospital encourages causal indeterminacy through its active attachment to "a number of volatile sectors of the general health-care environment" (p. 12). The administrator at Community devoted 70 percent of his time to external contacts, compared to only 10 percent for Memorial's administrator. High causal indeterminacy leads to loose coupling: Meyer described Community as "a loose federation of heterogeneous components, many of which coalesce around distinct specialties of groups or patients" (p. 13). The judgment that we would expect to emerge from this loosely coupled system is found in Community's "well-established reputation for innovative approaches to health-care delivery" (p. 12).

Covaleski and Dirsmith's research illustrates that the loose coupling model is deviation-counteracting. Meyer's research emphasizes that the model has two sides, one driven by causal indeterminacy and one driven by causal determinacy. Manning's description of a police organization (1979) demonstrates that within organizations there are some subsystems that magnify coupling, some that magnify the balance between coupling and decoupling, and some that magnify decoupling.

Manning described a medium-sized police organization which used a 911 emergency call system to determine 85% of the tasks assigned to its officers. He focused on the amplification of ambiguity and the increases in discretion within the system as 911 calls moved from operators to dispatchers to officers.

The operators' task is to code the 911 calls into one of 245 possible codes. This task is routine and causally determinate; there is a well-

understood series of coding rules for the operators to perform their task, which eventually becomes routine. Causal determinacy suggests that the operators' task should be tightly coupled on some dimensions. The operators are carefully monitored, their computers control the sequence and require the completion of their tasks, and they are not allowed to follow up on calls they have coded. Tight coupling leads to a low degree of judgment among operators. They are not expected to understand much of the details in the eventual disposition of the phone calls they receive, they have little police experience, and they are lower-status and lower-paid than other members of the police organization. Low judgment should lead to increased causal indeterminacy, but in this subsystem there does not appear to be much change in causal indeterminacy -- the incoming calls and the operators' interpretation of them is becoming increasingly routine. The sub-system is locked into a cycle of stable or increasing levels of causal determinacy, tight coupling, and low judgment.

The dispatchers' sub-system exhibits a more smoothly-alternating application of the loose coupling model. If the dispatchers work on a causally indeterminate task, they can free themselves from normal work constraints to rearrange priorities in making assignments over the radio. A causally indeterminate input allows the dispatchers some freedom from coupling. This decoupling allows the dispatcher to develop the judgment necessary to reduce the causal indeterminacy. If the dispatchers work on a causally determinate or routine task, they are more likely to operate within the coupled system, which should decrease the amount of judgment necessary. Long periods of work in a low judgment mode should dull the dispatchers' abilities to respond to causally indeterminate situations, thus compounding the causal indeterminacy. The back-and-forth movement

between causal indeterminacy and causal determinacy, coupling and decoupling, and high judgment and low judgment are consistent with the loose coupling model.

The police subsystem is the inverse of the operator system. Calls passed through to police units on the street are presumably the most complicated problems received by the operators. Police officers are allowed a variety of decouplings, including control over where they are at any point in time, how much contact they maintain with headquarters, and how busy they are. This leads to their having a higher degree of judgment to apply to a variety of complex situations. The loose coupling model suggests that the application of a high degree of judgment should reduce causal indeterminacy, but outside of specific situations which they are able to resolve, this does not happen. The stream of incoming radio calls does not significantly change from causally indeterminate to causally determinate. The police officer subsystem is locked into stable or increasing levels of causal indeterminacy, loose coupling, and high judgment.

When the police system is considered as a whole, the operator role balances out the police officer role. Causally indeterminate tasks are sorted and separated from causally determinate tasks. The most causally indeterminate tasks are resolved by loosely coupled officers with high levels of judgment, and the most causally determinate tasks are resolved by tightly coupled operators with low levels of judgment.

Conclusions

Given the preceding explication of the loose coupling model, we now will try to link the model with theory, research, and practice. The most important implications for each activity will be discussed.

First, theorists should note that the loose coupling metaphor is differentiated into four distinct formulations: counter-rational, uni-dimensional, multi-dimensional, and dialectical. The dialectical interpretation organizes loose coupling research most compactly, preserves the concepts of dilemma and paradox (Quinn & Cameron, 1988), and describes a complex mechanism to deal with complex environments.

Second, the paper moves away from the concept of loosely coupled system as an image disembodied from a theory toward a more explicit and refutable theoretical formulation. Loose coupling research needs to move toward theoretical models in which loose coupling is a variable rather than merely an attractive image.

Third, the self-regulating model asserts a significant role for tight coupling in organizations. Critics of loose coupling (e.g., Lutz, 1982) have claimed that loose coupling researchers ignore harmony through an obsessive focus on chaos (Bacharach & Mitchell, 1981). Several authors have used the rhetorical technique of 1) critiquing Weberian models for focusing too much attention on rationality, 2) critiquing loose coupling models for focusing too much attention on irrationality, and finally, 3) presenting images which reconcile the competing forces (Bacharach & Mitchell, 1981; Firestone, 1980; Tyler, 1985). The present model addresses these criticisms through an explicit focus on coupling as a variable which ranges from loose to tight. If there were only loose coupling, the system

would eventually degenerate to uncoupling and cease to be a system. If there were only tight coupling, the system would eventually become rigid and unable to support itself through adaptation to changing environments. A useful loose coupling model must allow for both tight and loose coupling.

A fourth theoretical implication of the model is that disagreements on causation are assumed to be more influential than disagreements on preference. Since organizations are basic means-ends structures, limited knowledge is more of a threat to rationalized means-ends structures than are disagreements about preference. We assume that shared preferences are durable coupling mechanisms because objectives are routinely stated at such an abstract level that people can agree on them despite their differences (Eisenberg, 1984).

The preceding theory suggests several key research tasks. First, researchers should increase their ability to measure different types of loose coupling. Astuto and Clark (1985) have differentiated dimensions of coupling and types of elements that are coupled. They describe five types of coupling: edificial (between structural elements), functional (between tasks), procedural (between expected connections, e.g. intention-action), ideographic (between sensemaking activities), and extra-organizational (between the organization and an element in the environment). Because different types of elements imply different types of coupling, "loose coupling" and "loosely coupled system" are overly general terms if they are not used with reinforcing details. Researchers who discuss loose coupling should use the grammatical formula presented earlier to make explicit their understanding of what the phrase means: "loose coupling between specified elements on specified dimensions."

Second, the definition of loose coupling as simultaneous coupling and decoupling presents several difficulties that researchers need to watch for. Loose coupling often loses its dialectical tension between coupling and decoupling when it is simplified into a simple uni-dimensional variable running from a minimum of "loosely coupled" to a maximum of "tightly coupled." This happens because researchers are not trained to work with variables that take more complex forms than linear variables (Bobko, 1985). There are three ways to approach this problem. First, researchers can ignore the tension between coupling and decoupling, assume that a decoupling is simply a lack of coupling, and simply measure the strength of coupling. Weak couplings become loose coupling and strong couplings become tight couplings. Second, researchers can regress several measures of coupling and several measures of decoupling onto a dependent variable labeled loose coupling. Third, researchers can use structural equations modeling notations in which loose coupling is a second-order latent variable and coupling and decoupling are first-order latent variables. Forms of inquiry, such as Bagozzi's "holistic construal" (Bagozzi & Phillips, 1982), that do not assume that variables must be operationalized exactly as they are conceptualized, allow researchers the flexibility to create more complex latent variables than have been used in the past.

Third, researchers should be aware of problems which may emerge because the model is not bound to a single level of analysis. Our examples in this paper range from small groups (Birnbaum, 1981) to large universities (Rubin, 1979). The present model assumes no differences across levels of analysis, but research may indicate the model is sensitive to level of analysis. Another level of analysis problem is that in all of our examples, causal indeterminacy and loose coupling are assigned to one

level of analysis, and judgment is assigned to a lower level of analysis. This shift of analysis is an important part of theories about loose coupling, but it will require researchers to watch for the statistical difficulties associated with multiple levels of analysis (Rousseau, 1985).

Fourth, the model needs to be tested in fragments and as a whole. For convenience, the three hypotheses in the model are labeled the loose coupling hypothesis, the sensemaking hypothesis, and the enactment hypothesis. The loose coupling hypothesis states that when a system is confronted with causal indeterminacy, it moves toward loose coupling (between specified elements on specified dimensions). The sensemaking hypothesis states that loose coupling (between specified elements on specified dimensions) leads to judgment. The enactment hypothesis states that the imposition of judgment on a situation reduces causal indeterminacy. Multiple studies already exist, using different concepts and language, which test each of these hypotheses. These studies should be consolidated and analyzed through a loose coupling perspective. Original research should test the model as a whole within one context.

A fifth important point for researchers is that the model is difficult to test because it is cyclical. The simplest solution to this problem is to eliminate one of the causal links. A more complex solution is to add at least three more variables to the model, so that each of the three present variables has a cause outside of the cycle (e.g. complex technology creates causal indeterminacy, product diversity creates loose coupling, and education level creates judgment). Ideally, the loose coupling model should be directly transferable from theoretical presentation to empirical testing, but its current form preserves several key ideas: First, it emphasizes the inverse propositions of the model: causal determinacy

increases tight coupling, tight coupling decreases judgment, and decreased judgment increases causal indeterminacy. Second, the current cyclical model portrays organizations as constantly changing combinations of causal indeterminacy, loose coupling, and judgment. Changes, according to the model, do not simply pass through an organization, but have reverberating, multiple effects as an organization struggles, pendulum-like, to find a stable center for each of the three variables in our model. Third, the current cyclical model allows the creation of several linear models, depending upon researchers' preferences for focal or central variables. Although the present model is organized around loose coupling, other researchers may choose to emphasize causal indeterminacy or judgment.

In addition to implications for theorists and researchers, the loose coupling model also generates some preliminary practical implications. If organization members have stable, chronic indeterminacy (as in interactive complexity) they need to keep the structure loose (not top down) so that judgment can be exercised by those who operate amidst stochastic events. The common theme in loose coupling research is that indeterminacy is dissolved by loose structures and judgment, not by tight structures and computation. The argument demonstrates that hierarchical control is not a precondition for effective functioning, as is often assumed in organizational research, and suggests instead that hierarchical control will reduce effectiveness if indeterminacy is a persistent problem.

To administer a loosely coupled system means several things: It means the managers must reaffirm coupling mechanisms such as shared preferences since these mechanisms are the glue that keeps loose coupling from deteriorating into uncoupling; the managers must insure that capabilities for judgment remain high since judgment is the direct means

by which indeterminacy is reduced (e.g. encourage professionalism, the sharing of preferences, and the application of professional values to resolve nonroutine problems); the managers must monitor the context within which loose coupling occurs so that it remains deviation counteracting and does not become deviation amplifying; and the managers must assess whether the balance between coupling and decoupling mechanisms allows the requisite amount of judgment to cope with the levels of indeterminacy which the system confronts.

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Table 1

Differences between Routine and Non-Routine Problems

ROUTINE	NON-ROUTINE
1. Easy to develop SOP to handle it.	1. Hard to develop SOP to handle it.
2. Changes slowly.	2. Change continuously or in spurts.
3. Clearly recognizable pattern.	3. No recognizable pattern.
4. Easy to understand.	4. Difficult to understand.
5. Low uncertainty.	5. High uncertainty.
6. High familiarity.	6. Low familiarity.
7. Easy to classify.	7. Hard to classify.
8. Information treated for what it is.	8. Temptation to treat it as routine or as noninformation.
9. Simple search indicates how to process it.	9. Complex search needed to find suitable way to process it.
10. Can be processed by one system.	10. Requires information exchange among multiple systems for processing.
11. Easy to quantify.	11. Hard to quantify.

(from Weick and McDaniel, in press)

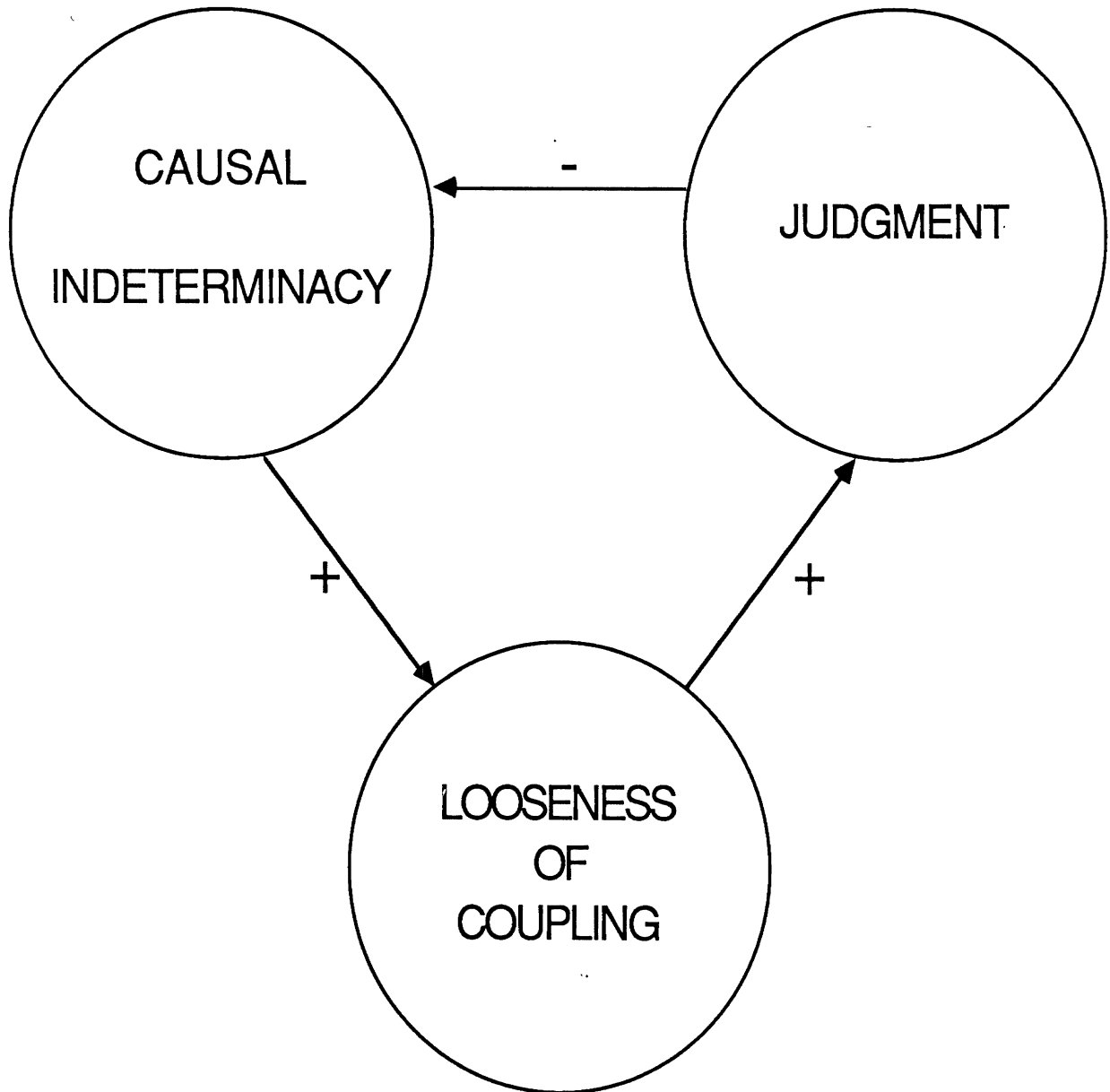


Figure 1. Self-regulating feedback loop between causal indeterminacy, looseness of coupling, and judgment.

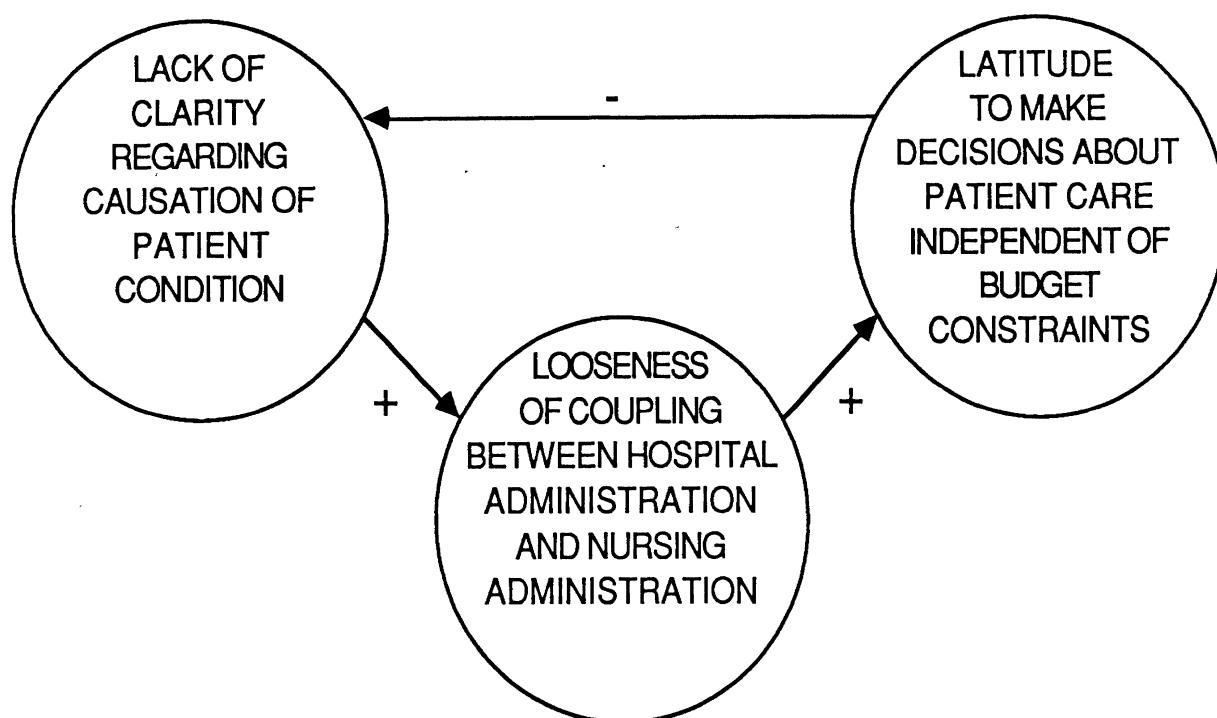


Figure 2a. A self-regulating application of the loose coupling model to Covaleski and Dirsmith's research on nursing administration.

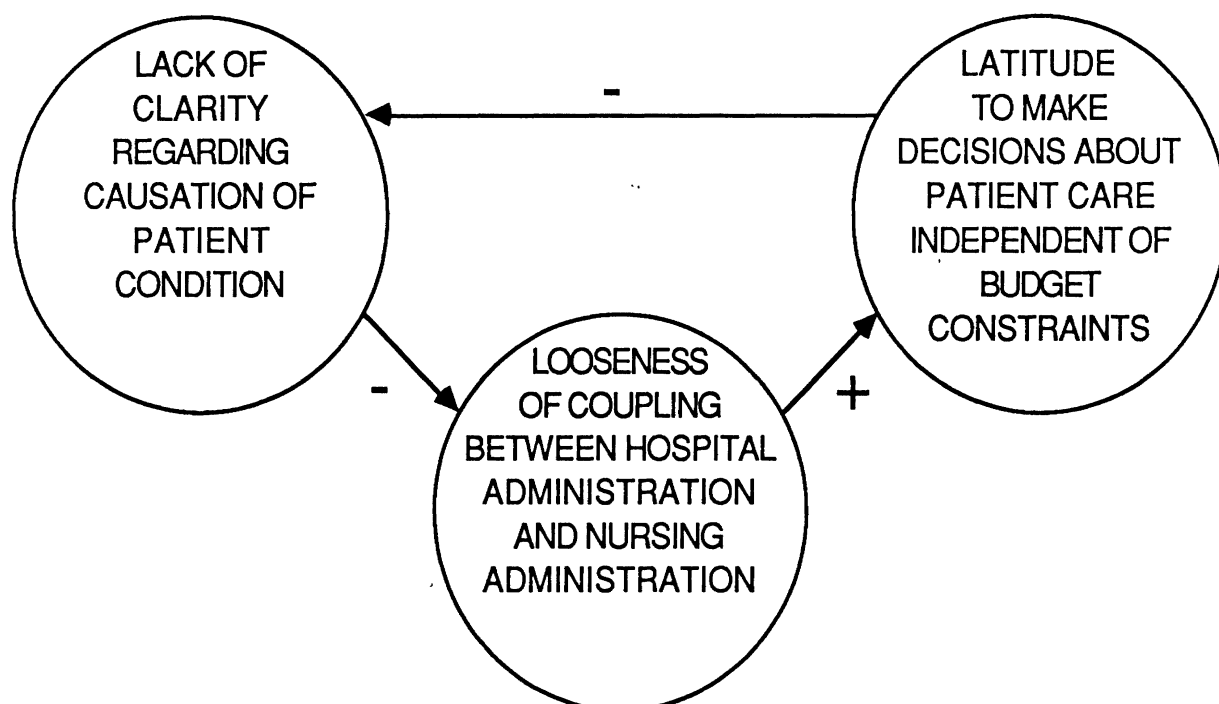


Figure 2b. A vicious circle application of the loose coupling model to Covaleski and Dirsmith's research on nursing administration.

Figure 2. A self-regulating and a vicious circle application of the loose coupling model to Covaleski and Dirsmith's research on nursing administration.