Social Bonding:

connections between the work of Erving Goffman and chemistry as models for social understanding

by

Jason A. Schindler

A PROJECT

submitted to

Oregon State University

University Honors College

in partial fulfillment of
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degree of

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Presented November 26, 2002
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To understand human social environments and interaction, it is often necessary to examine them in creative and metaphorical terms. In this thesis, a model of chemical interaction, atomic and molecular bonding, and the role of electrons, nuclei, and other chemical principles are used to describe the social environment of human interaction. Simultaneously, a comparison is made between this modern chemical model and the classical model of theatrical performances in Erving Goffman's book The Presentation of Self in Everyday Life, a successful and trusted part of the sociological understanding of today. This sociochemical comparison of the chemical model to social interaction showed interesting strengths and weaknesses. While the theatrical model is robust in analyzing the social realm in which humans find themselves, it may not have accounted for aspects of a core self that the chemical model was capable of showing. However, the chemical model suffers from the lack of free will and agency that humans can employ and atoms, functioning on natural laws, cannot. Thus, in understanding each model's strengths and weaknesses the validity of each model is demonstrated and there is a greater total contribution to the understanding of human social interaction.

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I understand that my project will become part of the permanent collection of Oregon State University, University Honors College. My signature below authorizes release of my project to any reader upon request.

Jason A. Schindler, Author

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"All the world's a stage,
And all the men and women merely players…"

—William Shakespeare, *As You Like It*

"Perhaps life is a characteristic of matter, and man is the agent whose part in a cycle of the universe is to break up old worlds and make them into new."

—Robert S. Mulliken, Newburyport High School, report on *Electrons* at age 17

"A man has many skins in himself, covering the depths of his heart. Man knows so many things; he does not know himself. Why, thirty or forty skins or hides, just like an ox's or a bear's, so thick and hard, cover the soul. Go into your own ground and learn to know yourself there."

—Meister Eckhart

SOCIAL BONDING:

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INTRODUCTION

Throughout history, humanity has tried to understand how its society and its organizations work by using models and metaphors of human interactions. One classic model uses the body—the many limbs and organs functioning to explain the aspects of social interaction and how parts interconnected the way they did. The head (a king or person of influence) directed the nervous system (magistrates and officials) to make the hands and feet (soldiers and cavalry) complete his or her directives.

In the Scientific Revolution, the introduction of Newton's physics led intellectuals and scientists of the era to believe that our world was completely understandable through mathematically defined laws of nature—it was merely our task as scientists and philosophers to uncover and understand those laws before we would be able to predict and know all that was happening or going to happen. However, the reduction of society into mathematical terms proved limited in completely describing human interaction.

The use of physical science as a metaphor for social understanding still has merit in a world increasingly understood by its sciences. Given that there are many complexities of human experience and societal relationships, I developed this thesis into an inquiry as to whether a physical model, specifically one of

chemical principles and atomic bonding, can still provide interesting perspectives, discourse, and critique of social interaction. By understanding how atoms and molecules interact and form bonds and other molecules, some of their function may help us to understand how humans form and maintain social bonds, and in what ways the knowledge and application of that process may limit or increase our understanding of human's relationships.

I am, however, only an amateur sociologist—my expertise is in chemistry. To provide reference and due respect to the established sociological foundation created by scholars before me, I have employed Erving Goffman's classic work of sociological theory, The Presentation of Self in Everyday Life, as a companion model to my own model. His theatrical model of social interaction borrows and furthers the idea of life as a stage and of humans being actors in the "play" of life. Goffman suggests that Shakespeare's oft-quoted line is, at least in part, correct in identifying humans as players in a great theatrical performance, and he uses a theatrical argot in discussing that premise.

Like astronomers found when they viewed celestial objects with a telescope rather than the naked eye, certain details become evident when looked at with different lenses. In this thesis I make use of many models, or lenses, of understanding and examining reality—models that have advantages and disadvantages relative to each other. While one model may make one aspect clearer and detailed, it may create "blind spots" to an observer about other important aspects to be considered. In this thesis I have used the theatrical model proposed by Goffman's text as a basis of understanding the sociology in this inquiry. In comparing that theatrical model with the ideas of chemistry, I make use of many models of chemistry proposed by different scientists and theories.

Though I primarily use the models of quantum mechanics and modern molecular orbital theory in this chemistry, aspects may also be borrowed from other chemical models. For simplicity's sake, I will refer to the amalgam of how atoms and chemistry are understood as the chemical model.

My task in this endeavor was to help elicit the similarities and differences between these two models: the theatrical model presented by Goffman and my application of the chemical model in its analysis of social interactions, which I refer to as the sociochemical model. In Goffman's model there is a social theory that is established and accepted in the sociological community, and it is familiar and accessible. The sociochemical model I have proposed as describing social interaction is new and unfamiliar, and I have used the theatrical model as a point of comparison and reference. Through each perspective we see a slightly different description of social interaction. By comprehending both models we can better understand the way in which humans understand how we interact with each other.

CHAPTER I: BONDING

There have been various ways through history to refer to and represent the self in theater. Some of those ways were through masks, as the Greeks and other traditions have employed, to show a socially known role of the character they represented. Erving Goffman references the idea of masks in his writing to represent what he refers to as "front." In social situations, the front or social self that an individual presents to an audience is a representation of themselves created through various means: clothing, size, sex, posture, facial expression, speech patterns, etc. This later becomes important when Goffman discusses the backstage area that is not presented to the public.

The basic metaphor of the sociochemical model I wish to use in describing human interaction is in representing people by the chemical model of the atom. It is the basic unit of matter and the most important feature of chemical understanding. That being said, atoms, much like people, do not usually exist by themselves and constantly interact with other atoms and molecules. Additionally, atoms combine with other atoms to form an innumerable array of molecules that have their own intrinsic properties, perhaps akin to those of social groupings and hierarchies, large and small.

Electrons

Goffman presents to us the way in which social interaction takes place as a front. The parallel to that front in the sociochemical model are electrons. The electrons, and constituent energy levels and orbitals, are the way in which atoms bond chemically, and in seeing this chemistry in a social metaphor, they are what constitute the social bonding taking place as well.

Electrons within chemical bonds also have specific ways of interacting to establish that bond. Goffman shows us how individuals create routines: use their environment, settings, and other aspects of appearance and manner to maintain their dramatic performance. These routines can be used in multiple situations where socialization takes place, but still have rules governing how they may work to make a social connection. In a parallel sense, aspects of the chemical model of atomic bonding can be seen to have a similar structure. Electrons tend to be found in spatial orientations within an atom that chemists describe by mathematical patterns called atomic orbitals. Within these orbitals, electrons have a pattern of movement and energy that gives them certain characteristics and organization within the atom: electrons have boundaries that require them to maintain a momentum and location to satisfy this energetic characteristic. Thus an electron in an atomic orbital can only bond in certain ways with other atoms due to the orbitals established by those atoms' electronic organization. However, these orbitals are still malleable for several different kinds of bonding to arise; one electron's usual position can give rise to bonding of several different types.

These patterns of electron orientation are of primary interest in how we examine the bonding patterns of individuals and are what may be used to describe the bonds created between other individuals. In this analysis we discover aspects of both models, Goffman's front and the electrons of atoms, are both trying to accomplish a description of what makes humans consistently social—a "social glue" that keeps us interacting. Various fields in sociology have described this in many other ways: communication, influence, signals between individuals—both verbal and otherwise. Whereas Goffman uses a theatrical model to describe this socialization and describes aspects like the front that people interact with, the sociochemical model uses electrons to describe how that social bond is formed in terms of energetic transfers maintained between atoms.

Chemical bonds are formed between two atoms because the exchange or sharing of electrons leads to a greater conservation of energy between the bonding atoms. The electrons within the original atomic orbitals form new molecular orbitals with the atoms they are bonded between, combining the properties of both previous orbitals into one. As long as this energy is stable and consistent, the bond will remain intact. If enough energy is added to the atoms to increase the energy of the electrons, or the energy conservation of one bond is replaced by another bond of lower energy, then the original bonded electrons bay break away from that bond in favor of the lower energy. The bond is always in a dynamic state of optimizing the energy of the electrons, and it is part of what keeps the electrons in motion. It is in this binary joining of atoms that we have the simplest kind of molecule.

When two atoms are bonded in this way, the sociochemical model interprets the electron exchange to mean the exchange of the social

signals—interests, influences, communication, and various forms of mental, emotional, and physical intimacy. This electron representation of the affairs of humans is the same as what keeps humans social, connected, and interacting. As long as this connection is maintained and the energy exchanged is consistent, the bond will be stable. If the social exchange requires too much energy to maintain then it is possible the bond may break. In this way it is possible to see the continuity of bonding in both the chemical model and the social model; socialization must continue for there to be a social bond to consider. Electrons can also be thought of as representing patterns that are directed towards particular areas of interest for the person as well. Thus the orbital an electron inhabits within an atom is a routine for bonding with similar routines, and bonds will form between orbitals that represent the interests of like-minded individuals.

The Nucleus

To truly understand what role electrons play in the atom and how they bond with other atoms, and to further discover what these electrons represent in the sociochemical model, it is impossible to discuss them without proper reference to the nucleus. Electrons have a negative charge in chemistry, and in abstract terms they have exactly the opposite electric force than the protons contained within the nucleus of an atom. For this beginning example, we will consider simple atoms that are electronically balanced with the same number of protons as electrons.

The nucleus of an atom is what gives an atom almost all of its mass, is orders of magnitude smaller compared to the space taken up by the atom, and is the defining factor of its elemental nature. The nucleus is very consistent within most atoms. It is physically difficult to alter the composition and state of the nucleus, giving it qualities of permanence and stability. In contrast, the electrons, though actually responsible for the fact of electron sharing that is a chemical bond, are only a part of the entire bonding picture. It is in the optimization of energetic states between the atomic nuclei and the balance of charges between the electrons and the nucleus that all play a role in molecular bonds. In a more complex view of the atom, the nucleus is actually surrounded by layers of atomic orbitals containing electrons. The innermost orbitals are most responsible for balancing the charges of the nucleus, and it is only the outermost orbitals that are responsible for the bonding that takes place. The nucleus, however, is the primary point of interest when considering the individual nature of an atom. The electron orbitals must have a point in which to orbit. The nuclei require the electrons as much as the electrons require the nucleus when considering normal atoms.

In Goffman's social world, there is no direct description of the idea of a centralized being or aspect, a core self, that decides or influences in a grand way how the person is going to interact and bond with others. That is not to say Goffman's model is either wanting of that inner self or denies its existence. Goffman makes some small reference to a kind of inner being when he quotes Santayana speaking of the soul and spirit crystallizing into an idea and says that, "a mask of manner can be held in place from within." He mentions earlier that the point of his model is to study the outward social interactions between

individuals, and thus it makes sense to ignore the "within." It can be also argued from Goffman's model that humans are just the collection of many layers of routines and performance. Intuitively, if he is studying the masks and outer expressions of performance, it does not make much sense to pay too much attention to the actor behind the mask. For us to completely understand the role of the nucleus, we have to go outside of what Goffman speaks of in most of his work. The nucleus has little place in the theatrical model we have previously discussed.

Before we get to that discussion however, again it is relevant to think of these two models as being different perspectives looking towards the same end. In Goffman's perspective, it is most important to examine what is happening in between people interacting with each other, whether or not there is some internal agency that is ultimately influential. In the sociochemical model, we are looking at an atom to see its relationship to the social sphere, and though electrons are the main interaction between other atoms, there is definitely a central point to each atom's, or person's, existence. Indeed other classical models of understanding humans in sociology, philosophy, and religion have had aspects of basic selves, inner being, or souls by which we understand ourselves. It is also interesting to note how in our modern society there are other places where popular culture admits to this knowledge of the outer performance and an inner being. Our modern media mentions phrases like seeing the true self, deep down inside, and taking off masks and appearances. These two models, the theatrical and sociochemical, are seeing things differently. If one model can remind us of one aspect that another does not contain then it shows those other viewpoints to be valid in other ways.

If the nucleus of an atom is representative of some core to human existence, it is important to understand what weight it bears in chemistry. The nucleus cannot, under most circumstances, be naked without electrons, or vice versa. The two are usually inseparable, and the most drastic and violent aspects of chemistry take place when this balance is breached. This core self then, seen in the sociochemical model, has interesting properties between itself and the way a person communicates. As electrons and the nucleus are always part of an atom, a person represented by an atom will always engage in performances of some kind and have a centralized core that does not act directly in this process. In this way, the charges and characteristics of the electrons and the nucleus parallel the influence both the inner and outer selves of human beings have on social and non-social behavior. Their compliment to each other in fact drives an aspect of the principle that bond atoms and people to each other.

Covalent Bonds

In the bonds we have been considering so far we have assumed an equal sharing of electrons. The actual sharing of electrons taking place between atoms in a bond can have different qualities that affect that exchange. Of the possible interactions within atomic bonding there are two main types: covalent and ionic. We will first discuss what covalent bonds represent and in the next chapter how ionic bonds complete our description of atomic bonding. We will also see why this is not quite so determined a dichotomy.

Covalent bonds, in general, are the essentially equal sharing of electrons between two atoms. If the sharing is completely reciprocal it is referred to as a

nonpolar bond and the bonding electrons balance the nucleic charges evenly. In the sociochemical model, this relates to the idea that information, communication, and interaction are equal between the two. What becomes a factor in some atomic arrangements are covalent bonds that do not have equal electron sharing. In molecular arrangements, the arrangement of protons and electrons of each atom determine the degree to which each favors, or has affinity for, electrons. If the electron affinity is higher in one atom, then the electron balance within the bond between the two atoms will shift to give more electrons to that higher affinity atom. This kind of unequal sharing of electrons is described in chemistry as a polar covalent bond. This unequal sharing of electrons is described in the sociochemical model as an unequal social bond between individuals. This unequal sharing could take the form of information control, changes in attention paid to different people, or hierarchies and power plays between individuals.

Though an unequal sharing may initially sound unfavorable, it is important to refrain from quality judgments in addressing these and other aspects of the sociochemical model. Some unequal relationships may be either normal or necessary depending on the social situation; as well, some equal sharing situations give rise to difficulties. Hierarchical structure is, perhaps, a more descriptive way of looking at this property in a social lens. Lower echelons do not have as much say as the managerial positions do, and though there will always likely be some interaction, that interaction will often be one-sided.

These aspects of polar and nonpolar covalent bonds make a relationship to Goffman's lens in his theories of idealization and authenticity. In the theatrical model, idealization is the process of giving one's performance in a way that

exemplifies their social status more than they would actually be allowed. It is a hierarchical claim in the sense that the imbalance of social status leads to an imbalance or change in the communication between those individuals. Authentic performances, on the other hand, involve persons that give mutually believable performances, and can be considered truthful to those performances. We will see later its impact on our understanding of both models of social inquiry.

A further reality of this bond description is that in chemistry, the difference in purely covalent, to polar, to purely ionic bonding is more a continuum than dichotomous extremes. Bonds are often referred to as percent ionic or covalent character rather than strictly one or the other. The properties of the molecule also determine what category it will be characterized. As we consider the continuation from nonpolar to polar covalent bonds to even less sharing, we will soon see what ionic bonds can represent in the sociochemical model.

CHAPTER II: ANTIBONDING

Just as it is important in chemistry to understand the reasons why atoms and molecules do not combine and bond together, it is similarly important to understand where a sociological understanding and perspective will either be less useful, or where the model does not fit what we observe in people. Additionally, in this thesis we are examining the correlation of two models to each other. We need to understand why and when that correlation may not hold. One way we can understand this in using the sociochemical model is through non-covalent bonds and the areas where the certainty and predictability of science has its own limits.

Ionic Bonds

The continuation of the previous discussion of covalent bonds brings us to an extreme of the bonding continuum with ionic bonding. In ionic bonds, the sharing of electrons between ions is essentially abandoned. Each of the atoms involved is much more satisfied electronically by keeping an unequal number of electrons than protons, and the atom gains a charge distributed over the entire atom and electron orbitals. This electron satisfaction originates from the principle that the electronic orbitals around an atom are most stable when they are all filled. Most atoms do not have enough electrons to completely fill the outermost

electron orbitals with the electrons that would simply balance their nucleic charge. As such, bonding takes place so that multiple atoms can be most stable by sharing electrons between atoms in molecular orbitals. In ionic bonding, however, the outermost electron orbitals are filled with electrons by completely taking electrons from other atoms, usually ones that will easily give up electrons to satisfy their outermost atomic orbital filling pattern as well. The reason ionic bonds are still considered bonds is that the ions are not often separated far from their counter ions. Nature requires that the ionic charges balance each other, so complimentary ions cannot go far.

In a sociochemical model, the communication represented in ions by the "taking" of electrons from one atom to another has interesting implications. One explanation, when electron transfer is not taking place, is that the ions involved are controlling the information and communication between them resulting in an imbalance of information. The resulting ionic bond is a bond of atomic charges—the inter-ionic forces involved similar to that of electrons and protons. The ions work to attract each other, and this inter-ionic charge attraction can represent a hierarchy between the constituents. In any hierarchy there must be a state of higher status and lower status for it to take place. In the chemical model there must exist a positive charge to balance a negative charge in ions, and neither can normally exist without the other. In the sociochemical view, this ionic hierarchy is an extreme form of the hierarchy discussed earlier with polar covalent bonds because there is virtually no electron sharing involved. It has also been pointed out that all bonds are a continuum of covalent or ionic, this still holding true, the frequency of electron exchange in ionic systems is negligible.

Further implications of this idea to Goffman's descriptions in a theatrical model may correlate as follows. In the theatrical model, Goffman would describe the relationship given between two ionic atoms as a withholding of information or communication as aspects of misrepresentation. In his definition, misrepresentation of social facts is a kind of lying, as is withholding information or negligence of reporting the truth. However, here it is important to step back from the analysis of these models to see what they mean in context. If this discourse is correct, then the ionic bonding of atoms is also a description of how humans lie, and implies that atoms in the sociochemical model have the ability to lie—a point that may not transfer well between the chemical and theatrical models.

In the ideas of ionic bonds, and as we examine more aspects of Goffman's theatrical model, we begin to see incongruence between the chemical and theatrical models. Goffman's model brings forth aspects to an individual's performance that are difficult to analogize with a sociochemical model. For example, there is the maintenance of expressive control that the actor can employ in his performance in order to elicit the correct understanding of his signals that the audience will understand during his performance. Then there are the performance aspects that involve misrepresenting the facts of the situation in order to gain favor by controlling information or social status. Or a performer may contrive to make a particular performance even though he knows that it is false for him to perform it in such a way. Atoms are not conscious beings, and giving them consciousness, decision-making ability, or complex thought processes is a troublesome area that the sociochemical metaphor cannot hold. It is hard to think of an atom that behaves on natural laws and principles as

capable of deception, feints, or belief in general. What all these aspects of acting in the theatrical model assume is human agency. The will or ability to perform in ways that are contrary to truths known is a very human ability, which has almost no place or understanding in the physical laws of nature.

In examining the lack of agency that atoms exercise, there are two courses of thought on the subject. One is that the sociochemical model itself is shown to be at a disadvantage compared to the theatrical model of Goffman's. Atoms and molecules are only able to make authentic actions based on the natural laws of the universe, and are thus far out of league to be equated to human actions. In Goffman's terms, atoms within the sociochemical model are only capable of making real performances—performances that are the result of unintentional function. This is easy for non-conscious atoms to perform because they have no consciousness to direct it otherwise. It is humans that have a sense of what they desire to happen, and may take steps to perform in ways to make it so. This may be a disadvantage for the sociochemical model since it does not account for this real aspect of human involvement. And though this is a failure of the sociochemical model to accommodate all aspects of human characteristics, we also know that it is merely a model of thought for humans to better understand ourselves. Thus, by showing where we cannot make the model work in all circumstances, we have not lost the model as a whole in the endeavor for we know what does not work—which can often be just as valuable as what does.

Simultaneously, it is in this aspect of authenticity that we may see a strength of the sociochemical model. In Goffman's model, and other models of sociology, human agency is already assumed as part of the basic human make-up we consider in those models. In the sociochemical model however, we cannot

assume atoms have this same agency. The usefulness is when we see where Goffman's and other models of social interaction do not overlap, then we may have an instance that calls attention to the fact that human agency plays an active role to that aspect of the model. This also relates to another point that Goffman makes about authentic performances. Individuals in the theatrical model always strive to give authentic performances presenting themselves as intended. To give inauthentic performances or be discovered in giving them means the performance, regardless of actual truth, is discovered, and the performance reflects poorly upon the individual. If atoms are only able to give authentic performances, the laws of nature are always authentic as well—and are not apparently able to contrive otherwise.

The sociochemical model may be inadequate in describing human agency compared to Goffman's model and may still be able to describe human interaction better in other areas or in different ways. This is again where these two models may be from different perspectives and seeing the blind spots of each other. Many of the following sections will address where alternate perspectives may be seen.

Uncertainty

One of the concepts that is present within the chemical model that fails to completely realize itself in any of Goffman's model is the uncertainty principle. Though it is arguable that aspects of the theatrical model relate to performers being uncertain about the outcome of their performance, the uncertainty principle of chemistry is different in scope. The Heisenberg Uncertainty Principle

essentially states that one cannot know both the momentum and position of an electron in an orbital of an atom. The more precise information known of one aspect, the more imprecise the other aspect will be known. This affects bonding in that no interaction will be completely predictable from a mathematical standpoint since all the starting variables cannot be known—and thus the outcome uncertain. Primarily this is dealt with by averaging a group of atoms or molecules and seeing what they are expected to do most of the time. By a statistical average the probability is known of what will happen, but any particular atom is never guaranteed to behave how it is expected to.

Extending the uncertainty principle back to our previous concept as electrons representing the social interactions performed between individuals, the similarity in the sociochemical model shows that the more one knows about a particular individual in one way, the less information may be known about some other aspect. Also, to know exactly something about an individual leaves for generalities about other aspects to their being. This does not mean that it is still impossible to know other things about a person—only at the same time. The uncertainty principle only applies for instances of time, which makes sense in the human realm. There are always new experiences for each individual at every moment, so it remains a logistic impossibility to know everything simultaneously about one person at any time. Thus, the entirety of knowledge about a person cannot be known and thus never fully predicted in a mechanical view of the social sciences.

Seeing this work further in the sociochemical model, the uncertainty of electrons helps to balance the certainty of electron orbitals around the atom. If the electron orbitals represent the routines present in the theatrical model, then

the uncertainty of the electrons allows for some variety and change within those routines of bonding. Not every encounter or social situation, however routine it may be, will always be exactly the same, and the routines that are constructed have ways of changing and altering their routines if other bonding patterns are serendipitously discovered. In this way there is both a stability found in human interaction and a fluidity, an uncertainty, in the ways people bond.

Antibonding

In previous sections we have talked of how electrons interact and exchange between atoms to create a bond within molecular orbitals. Though we have considered the electrons bonding within a molecular orbital above, in the chemical model there may still be electrons remaining in the molecule that are either in other bonds or not bonding at all. Besides the molecular bonding orbital, some atoms have lone pairs of electrons that exist in their own unbonded orbital taking up space around the atom and creating chemical effects. In the chemical model, these lone pairs of electrons inhabit molecular orbitals that constitute a phenomenon known as antibonding orbitals. If molecular orbitals are the result of a lower energy state achieved by a molecular bonding orbital sharing electrons, the antibonding orbitals result from electrons inhabiting a higher energetic state than the bonding orbitals. Bonding orbitals are said to stabilize the molecular bond, whereas antibonding orbitals destabilize the molecular bond.

What antibonding orbitals can contribute to our understanding of social bonding is a piece of human interaction that the theatrical model does not

address. Antibonding orbitals can best represent factors in social life that detract from successful social bonding. In the sociochemical model, the antibonding orbitals do not usually constitute other social bonds being formed, but they can be thought of as bonds to other non-social activities. Those aspects in human life that may not build social interaction, whether a job, hobbies, or other activities, can sometimes distract from the social lives we engage in. If the number of electrons in antibonding orbitals is less than the electrons contributing to bonding orbitals, then the bond between atoms will remain intact; similarly, if the social bonds between individuals are maintained and stronger than the other activities or antisocial factors, then the social bonds remain intact. On the same note, if an atom is primarily involved with its antibonding orbitals or non-bonding electron pairs its bonding between other atoms will be slight or non-existent. This account of non-social activity is something that Goffman does not seem to touch upon and reminds us that, though humans are primarily social beings, there are other aspects to our being that may not always be involved with social interaction.

Bond Distances

One of the aspects of the theatrical model that Goffman pays specific attention to is the spaces in which social performances take place. The setting in which a performance takes place is similar to the front that the performer presents to his audience. The setting however is always on continuous display through the performance and is a more static statement of the performer's front. If there is a sustained front area, then there is often a backstage that allows the

performer to regroup and plan further performances, relax, and step out of character. Goffman's social space has real environment, a place that can be interacted with, and meaning for the actors on its stage.

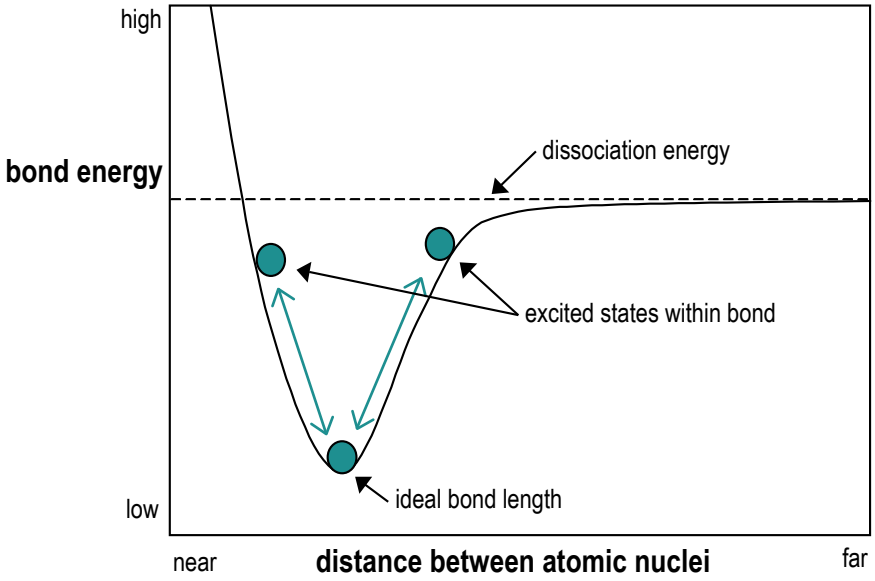
The chemical model does not have such a situation available—no place that an atom is not an atom. The spaces involved in atomic bonding are largely empty save a few speeding electrons. In looking at the sociochemical model however, there is a small sense where an atom might appear to step out of character. In the atomic structure where electrons embody the front of social involvement and the nucleus the core self, we see there is some correlation between the nucleus and this notion of a backstage. At the nucleus, there is a reduction of the electron, and social, interactions and some allowance for being one's core self. A problem with this idea is that in Goffman's terms the setting is not the performer himself but an extension of him. The atom on the other hand is the equivalent of the performer, and to step out of the social roles that are being maintained would require the nucleus to stop interacting with the electrons—impossible for an atom to accomplish since the front of electrons and the nucleus are simultaneously necessary to atomic structure.

The other direction that this discussion leads us is into the realm of atomic bond distances. In any atomic bond there will be the space between nuclei that the electrons inhabit and form the molecular orbital that bonds between them. That distance and space is optimized to allow the most efficient electron exchange, or charge balancing in the case of ionic bonding. Bond distances are short when there are multiple bonds between atoms; more shared electrons between atoms means the atoms must stay closer together to optimize the molecular orbital and energy state of the electrons. Longer bond distances occur

when there are fewer electrons being shared between atoms. The simple correlation in the sociochemical model is that the more information, communication, and interaction representative of more electrons bonding between atoms, the more social connection and closeness will occur between individuals. Similarly, with bonds and people, the shorter or closer the bond is, the stronger the bond will be, and the harder to break.

Bonds can be broken in the chemical model by adding enough energy to the bond so that it will dissociate. Stress can be added to a bond in the form of heat, light, or electric radiation—the key is that it must excite the electrons within the bond. As electrons take on more energy they vibrate and move faster, and if the energy is enough the bond will break and the electrons will return to their atomic orbital configuration. This is similar to the reverse process of bond formation discussed in the previous chapter (see **Figure**). Seeing this interaction the sociochemical model, there is a similar function in the way that a social bond that has too much stress added to it may also eventually break. Stresses here involve exciting the ways we communicate, exchange information, and give signals. If those signals are changed, withheld, or excited by other events or interactions there could be sufficient stress to break the social bond.

Figure: Bond Energy vs. Bond Distance



CHAPTER III: MOLECULAR STRUCTURES

In the previous chapters we have discussed the bonding of atoms as primarily diatomic interactions, only two atoms bonding and exchanging bonding electrons. The larger picture however involves multiple bonding combinations of atoms. Most molecules contain more than two atoms, and to ignore the implications and relevance of that existence would be unwise. The sociochemical study of dyads of individuals or of atoms tends to fall short of describing the complex situations in which people and atoms can be found.

An important point Goffman proposes in his theatrical model is that individuals themselves are not a society, and it is in the interaction of groups of individuals that really is important in understanding the theatrical model. Sociology is not the study of individuals creating societies, but rather individuals functioning and interacting together create societies at various degrees of size. The truer examination of society yields small groups comprised of individuals that interact and help each other and, in the theatrical model, put on the same show. Goffman further points out that it is in these small groups or "teams" of individuals that the primary attention of analysis may lie; all the previous aspects of societal functioning that have been discussed as relating to individuals are most useful when applied to team interactions.

Goffman actually points out that the theatrical model of teams he uses is the more robust treatment of his previous discussion of individuals, and that it is possible to treat a team as having any number of members, including only one or

zero members. When a team is reduced to one member, then the model returns to dealing with individuals, and we are left with needing only one set of rules for the model to consider.

Molecules

Individuals that combine to form a team and put on a similar show, performance, or effect can be thought of in the sociochemical model as a molecule. Molecules are collections of atoms bonded together in ways that allow for charge balancing and energetic favor to be met with the most efficiency. These molecules are still separate from other molecules and atoms in their surroundings, unless the environment happens to contain other reactive constituents.

An interesting comparison takes place between two aspects of Goffman's discussion on teams and our sociochemical understanding of molecules. In teams, any one member has the ability to disrupt the particular performance the team is giving with inappropriate conduct such as revealing the backstage information to the audience in a performance. As mentioned previously, the atom's lack of agency makes it difficult for them to behave in conscious or deceptive conduct. However, the sociochemical application holds validity because if any one atom ceases to be in the molecule, by either breaking bonds or forming bonds with other atoms or molecules and thus bonding "inappropriately" with the other atoms of the prior molecule, then the molecule will be disrupted. In either case, the molecule will have to rearrange the atoms to form another stable compound, degrade into smaller constituents, or form highly

reactive molecules that will react immediately with other molecules to create another disrupted set of molecules. Each constituent of a team or molecule must be appropriately bonding to the other members of that team or atom for it to successfully retain its structure. In more social terms, individuals must work together to stay together, otherwise other teams or situations will form.

The second point that Goffman shows of teams is that each member must cooperate with the other members in maintaining a certain performance towards an audience that the team is playing to, but may not maintain that performance towards other members of the same team. Essentially, the kind of familiarity established within a team that establishes a particular performance can hardly be used on each other because the others know what that performance is about. Like above, the other teammates know the backstage information about the performance.

The parallel in the sociochemical model of this same principle is harder to make than the first, but also makes sense, though not necessarily always true. In one perspective, the molecule cannot actually react or interact with itself, only with other atoms or molecules. The molecule is held together with the sociochemical interactions, electron sharing, etc., we have already discussed. However, there are also exceptions to this rule as well. Many kinds of molecules can react with themselves in oscillating patterns, or in ways that preserve the basis of the molecule, but change minor aspects of structure or arrangement. Nonetheless, these aspects may not bear relevance to the discussion at hand, other than to point out that the sociochemical model has limitations.

If we go from our previous discussion of nuclei and electrons as the core and fronts to atoms, the sociochemical model can see this as members of team

knowing each other's core selves well enough to see through any acts that the front, the electron bonding patterns, may actually perform. In a further humbling sense, our closest friends and colleagues in these kinds of social groups may know us well enough to see through our own performances, especially, as Goffman points out, if those performances are believed by the performer too strongly.

The sociochemical model falls short in Goffman's discussion of teams and aspects of performance that can be linked to human agency. He describes different kinds of teams and the characteristics of what they are and are not, those characteristics falling under aspects of agency: cooperation, manipulation, and contrivance—all of which have difficulties in the sociochemical model.

Activated Centers

Another aspect to Goffman's work that makes an interesting parallel to the chemical model is the idea of directorship. In the theatrical model, many teams will have one member serve as the director of that team. Though all members play the part of the director in ways there is often one director, though it may be traded off or dependent on certain performances. This director makes sure the other members know what is being performed and what considerations should be made of the situation to help everything run smoothly. The director is also responsible for something Goffman quotes as "sparking the show;" the energy to make the entire performance come off with extra energy and a sense of enthusiasm.

This parallels the chemical model in the sense of a functional group or active site being responsible in the major reactivity of the molecule. The atoms within molecules have varying degrees of reactivity towards outside molecules or atoms. The most reactive atom or group of atoms, accounting for the influence the environment may have on the chemistry involved, is called the functional group or "active center."

Though, in a sociochemical sense this is not the same as having atoms tell one atom to perform or direct the chemistry of the molecule, the bonding within the molecule does determine what atoms will behave as the activated center. The active center or centers of the molecule direct the most likely bonding that will take place with the entire molecule. This active atom defines what situations and new molecular and bonding possibilities are for that molecule, and as such has a large role in deciding its fate as a molecule. If the atom that is most active in the molecule and still relatively stable when exposed to other stresses, like the kind that breaks bonds discussed above, then the molecule is likely to remain stable in its current form until a different set of circumstances appears.

Structures

Our discussion of directors also relates to a sense of the hierarchies present within teams of the theatrical model. In the sense that a director may have directorial powers over the other members or atoms within the molecule and the molecule as a whole, there are levels to interaction that become apparent within social groups and molecules of the sociochemical model as well. Taking a molecule like alcohol for instance, a short chain of carbon atoms surrounded by

hydrogen atoms, the oxygen-hydrogen bond on one carbon directs the primary chemistry involved with the molecule. Though the carbons are linked and have various levels of reactivity within the molecule, the hydrogen atoms are bound to their respective carbon and are more dependant on their respective carbon's chemistry rather than the alcohol group. The carbons are then dependent on the alcohol group to decide their primary reactive chemistry. These hierarchies help show how even directorship can have limits within the sociochemical model. The hierarchies involved in more complex molecules can give rise to a strata of atomic reactivity being related to which atoms are more or less directly linked to which atom and how far they are from active centers.

Though directors fit with Goffman's model, the sociochemical model can remind us that directors have limited capabilities as well. Depending on how close directed members are to the director will influence how the molecule will behave. Members farther away from the major director in a group may actually experience more influence from a local director than the main director, and as such, we also see this in chemistry with various levels of activated constituents. In this way it is possible to see that each director can only have influence relative to the amount of activity it has and the members involved in the team.

CONCLUSION

As counterintuitive as it may be, imagination in the realm of science has always played an important role in allowing scientists to find ways to better understand the world around us. Einstein used gedanken, or thought, experiments in trying to understand and develop his own theories of relativity. In this project I have similarly used an imaginative view of chemistry models to relate back to the social sciences.

The sociochemical model allows us a different way of approaching social interaction, one that gives different reference points and perspectives. It is in this alternate viewpoint that its strengths and weaknesses appear. For instance, it is possible with this model to describe how the bonds between atoms, held together by electron exchanges, can describe how humans interact, communicate, and exchange information. Differences in electron or social sharing give rise to inequalities of both molecular and social bonding. Even in the atomic world we find that interaction does not always follow predictable paths; though we may know what is predicted, there will always be a fundamental factor of uncertainty in anything taking place, whether in social or chemical interactions.

We see too where the sociochemical model can fail at describing how humans have the ability to lie and give false impressions and misrepresent their true intentions. Atoms are indeed not people, nor are people atoms. The model still has an ability, though, to see how humans have both an outward social self

and an inner introverted self. The two cannot exist without the other. To be an electronically balanced atom or socially balanced human being—both inner and outer aspects must be satisfied.

Goffman states in his own conclusion that he and his readers are sufficiently versed to know that his theatrical model and Shakespeare contain limitations in viewing the world as a theatrical production, and is not to be taken quite so literally or seriously. The same is true for a chemical model of how people interact. At hand after the masks of characters and performances are dropped, after the atoms and molecules collapse, and fail to show complete human beings, we have the essence of this endeavor. It is about understanding social encounters, the situations humans find themselves entwined within on a daily basis. As curious humans, we try to find ways that we are able to confer an explanation of our experience to others—a definition of the situation in which we find ourselves. It is in these models that we may be able to communicate our understanding of ourselves. There are a multitude of peoples and ways of understanding, and these models are but two.

BIBLIOGRAPHY

Goffman, Erving. The Presentation of Self in Everyday Life. Doubleday: New York, 1959.