A Complexity Science-Based Theory and Philosophy for Music Therapy Practice and Research

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Introduction

This paper is based on the research and writing I have done for work on my forthcoming book, Music and Soulmaking: Toward a New Theory of Music Healing. I began work on this theory and philosophy of music therapy nearly ten years ago. The impetus for this research was my frustration with the current scientific model and, especially, with the reductionistic paradigm for research. Often as a practicing music therapist, I would see the effect of a music therapy intervention on a client. It was clear that the music therapy made a positive, beneficial difference to the client and client functioning. Then in an effort to "prove" that music therapy "worked" I would embark on a research project. As required by scientific method, I would set a hypothesis and design the research protocols controlling all variables except the music or aspect of the music
I thought was "causing" the positive therapeutic change. And yet time and again, I would get no significant results. The research "proved" that what I had observed, had known deeply and absolutely through my experience of the effects of my music therapy intervention were wrong. There were no significant results. But how could my observations of client change be so wrong? Was I that self-deluded to believe in the efficacy of my work when, in fact, it had no value? What about the confused, agitated client with Alzheimer's disease who talked and smiled during a rhythm-based music therapy activity? What about the severely, multiply-disabled child who made her first purposeful, goal-directed movement only during music therapy? How could these results and countless others not really exist?

It became clear to me that what was wrong was the tool for researching a complex, intricate process like a music therapy intervention. Dennis Fry's (1971) observations of the study of music in general highlight the problem. "In the case of music there is also continuous interaction between the physical character of the musical stimulus and its physiological and psychological effects so that a more thorough study of music would demand at least the combining of a physical, physiological and psychological approach. Modern science has relatively little information about the links between physical, physiology and psychology and is certainly not in a position to specify how the effects are related in music, but most scientists would recognize here a gap and would not want to deny the facto of a connection" (quoted in Aldridge, 1996, p.23). There are clearly gaps and deficiencies in the approach taken by "modern science" that prevented these methods from substantiating the impact of music therapy interventions.

Modern scientific method, like all paradigms, is based on a series of assumptions - an idea or belief we take for grated as "the way things are".
The assumptions of scientific method are well known to us. They include determinism, potential for control, objectivism, positivism, reductionism, linear development, and the context-free nature of phenomenon. I will briefly examine each of these assumptions.

Determinism is the belief that absolute truth about the nature of the world already exists and is waiting to be discovered. Scientific determinism assumes we can determine how a process works (like alleviating depression with music) and then prove that the discovery is true. This leads to another assumption, replicability. If you have "proven" something works, you can safely assume, under the same circumstances, you can repeat the process. Determinism also leads to the assumption of control. If the laws of nature can be determined, then humans can manipulate these laws to control it.

Objectivism is another assumption of the scientific method. This is based on the belief that the world is an objective place. An observer can, with care, look at a phenomenon from a distance and study it separately from herself. Human contaminants, like bias and emotion, are eliminated. This belief relates to several other assumptions of modern science - positivism and materialism. Positivism and materialism are the assumptions that the real world is what is physically measurable. A process or phenomenon is not "real" unless it is physical and measurable. This leads to the belief in mechanism - the world, including human functioning, is a machine. These assumptions emphasize structure and discount on-going process.

Reductionism, the next assumption of modern science, is the process of understanding a phenomenon by studying the behavior of its elemental parts, which leads us to an understanding of the whole. A process in its wholeness apart from an examination of its component parts is never considered. In scientific method, this reductionism leads to the "proof" so
highly valued. Reductionism also leads to the next assumption, linear development. Linear development assumes that complicated processes are made up of identifiable parts and progress from simple to complex and inferior to superior. It also assumes that big effects are created by big inputs and that small changes can not significantly influence a phenomenon and can be ignored.

Finally, modern science assumes that phenomena are context-free. Context is made up of identifiable elements that are systematically related. It is the environment within which the phenomenon occurs. Context is routinely ignored or assumed to be controlled in scientific method.

Though scientific method has brought us much - technology, material gains - it clearly has limitations, as evidenced by its inability to either explain or prove the efficacy of music therapy interventions. As I began to explore music therapy theory, I felt the need to find a scientific paradigm that better fit the processes I observed in music therapy. I feel I found that paradigm in the new science of complexity.

**Complexity Science**

Complexity science, also referred to as chaos theory, is a newly developed scientific paradigm related to systems theory. It is the science of the global nature of dynamical systems - systems in motion. According to Williams (1997), complexity is a "...type of dynamical behavior in which many independent agents continually interact in novel ways, spontaneously organizing and reorganizing themselves into larger and more complicated patterns over time" (p. 449). Complexity science recognizes basic underlying inter-relatedness and interdependency of the various parts of a whole system (deQuincey, 2002). It focuses on hidden patterns, nuance, and the sensitivity of real things. And complexity science estab-
lates the "rules" or constants for how the seemingly unpredictable leads to the new (Briggs & Peat, 1999). Complexity science is the science of the real, practical, messy world. Nature, then, is recognized as a highly complex, interlocking network of nested, dynamical systems. "Relationships between 'parts' are dynamic, ever-changing, because they involve complex networks of feedback and feedforward loops. It becomes difficult, if not meaningless, to identify or isolate individual causes...Such nonlinear evolution means it is impossible to accurately predict the behavior of complex systems..." (deQuincy, 2002, p. 30-31). Dynamical systems are simultaneously stable and ever-changing. They are in a constant state of renewal. Complexity science also asserts that everything in nature is complex - from weather systems, to economic trends, to population growth, to the formation of mountain and rivers, to the functioning of the human body, to health and disease. This complexity also includes the functioning of the human mind and its products like consciousness and music. I will now briefly summarize the principles inherent in complexity science to contrast its assumptions to the current scientific paradigm.

**DETERMINISTIC CHAOS**

Chaos theory explains how new patterns of order emerge from the movement patterns of dynamical systems. Unlike entropic chaos, which is a state of disorder characterized by a total lack of organization or structure, the deterministic chaos seen in complex systems in motion is the sustained and seemingly random, unpredictable evolution of a system. But over the long run, it is this chaotic movement that gives rise to new order, new patterns in the system. In fact, a highly complex system is highly unstable - it is the source of creativity. Such a system is said to be at the edge of chaos, a place of optimum vigor and potential. In this way chaos is extremely complex information - not the absence of order - out of which new and more adaptive patterns emerge.
ORDER AND FORM

Complexity science addresses *deterministic* chaos because it is out of the highly complex information of the chaotic movement that new order and form (known as a *bifurcation*) occurs. A moving system reaches a state of chaotic movement through iterative feedback - when output returns to serve as input over and over again (much like compound interest). As Briggs & Peat (1999) point out, a moving system breaks into chaotic movement when this physical movement as feedback enters resonance. "Resonance happens when systems vibrate or swing in sympathy with each other so that the tiniest connection between them progressively magnifies their mutual interaction" (p. 155).

I will use the example of a smoke trail off an extinguished candle to illustrate the process of bifurcation. When the candle is blown out a single smoke trail occurs. As this moving system increases its complexity through iterative feedback (the smoke trail begins to move in air currents and adds into the continuing stream from the wick), a doubling phenomenon occurs - the single smoke stream breaks into two. With more complexity (movement) through additional movement (feedback), doubling occurs again and the two streams become four. These new branches or bifurcations in the movement flow continue to double until, at the furthest distance from the candlewick, the smoke breaks into a seemingly chaotic pattern of movement. I say seemingly chaotic patterns because complexity science, through mapping the points of the movement, has found an underlying order and form to the chaos over time.

This order comes from the action of *attractors* in the system. An attractor exerts a magnetic appeal for the system acting as a set of stable conditions. They underlie and govern the dynamic behavior of the complex system. A good example of the attractor action is the Cymatic research of Hans Jenny (1974). Most of us have seen the videotapes of sound of various frequency and amplitude creating specific shapes in various materi-
als (sand, iron filings, liquid). If you watch the video carefully, as the tone begins, you first see chaotic movement of the sand particles in no particular pattern or shape. Then a particular form emerges and is stable. But if you look closely, you will notice that the sand particles are still moving. The frequency at a particular amplitude acts as an attractor revealing the underlying order implicit in the chaotic movement. This is deterministic chaos - the complex movement and the presence of one or more attractors (in this case a periodic vibration that is the tone) determines the order and form that will emerge.

There are a number of possible attractors in a dynamical system. A fixed point attractor is a place of no momentum and no displacement, like a swinging pendulum vibrating back and forth around a point of rest until the movement stops. A limit cycle attractor is a regular, periodic vibration. As the Cymatics example illustrates, the frequency of a tone, because it is periodic, is a limit cycle attractor. A torus attractor occurs when there is coupled motion of an oscillating pair. A perfect interval in music likely creates a torus attractor. As a dynamical system increases its complexity, it jumps from fixed point, to limit cycle, to torus attractors. But when the system breaks into chaotic movement, a new attractor, the strange attractor, emerges. The strange attractor is the implicit order underlying chaotic movement. It is the activity of a collective chaotic system composed of interacting feedback loops among its many scales of organization (Briggs & Peat, 1999). All attractors working within a complex system create form through the branching or bifurcations they create. There is a constant, 4.4492016090, that predicts when bifurcations occur. This constant is universal - different complex systems behave exactly the same way. The patterns of chaos reveal a universal order inherent in the nature of any dynamical system - water turbulence, population growth, healthy human heart beat, and the resonance characteris-
tics of musical instruments. The bifurcations create shapes or patterns. The characteristic patterns that emerge in dynamical systems are known as fractals. A fractal is a map of the movement patterns in the system. Fractal organization and functioning is the same at all levels of scale - from the largest to the smallest. It is a form that has self-similarity. A visual fractal, the Mandelbrot set, is a good example of this principle. The entire fractal has a characteristic shape. When a small portion of that shape is magnified, it looks the same as the entire form. This is self-similarity - as above, so below.

Though there is an underlying order in chaotic systems that gives rise to form, the process is so intricate our ability to observe these systems and predict their behavior is extremely limited. In fact, unpredictability is the overriding principle of complexity science. Even at the most basic level of complex behavior, systems go in unpredictable directions. They lose their initial conditions and cannot be reversed or recovered. This certainly is opposite of what the current scientific model says. There are several characteristics of complex systems that give rise to this unpredictability.

**NONLINEARITY**

Complex, dynamical systems are nonlinear in nature, meaning that the relationships between factors in the system are not proportional. The whole does not equal the sum of the parts. Nonlinearity involves the influence of the amplified "small". Nonlinear systems are profoundly influenced by the subtle. Because of this exquisite sensitivity, nonlinear systems cannot be broken apart and added together. If you do, you get different results because the many small differences will be different each time you re-construct the whole. This sensitivity to initial conditions, or the so-called Butterfly Effect, describes the dramatic effect that small factors can have on large systems because of the underlying web of rela-
tionships and iterative feedback in dynamical systems. Complex systems are sensitive to even the smallest change or input. It becomes impossible to know, let alone predict, what factor has made the important impact. This idea is again in sharp contrast to the current scientific paradigm that assumes linear development where only "big" things can have big effects.

**WHOLENESS**

Unpredictability, nonlinearity, and sensitivity to initial conditions require complex systems to be considered in their wholeness. Complexity science tells us that a natural event in motion - human neural firing, a hurricane, or a musical concert - must be seen as an unfolding, whole process. Studying an isolated portion of that event can not tell us much about what is really occurring. Different from the reductionistic, deterministic assumptions of current science, cutting up and examining the parts of dynamical system cannot tell us its true nature. Because the whole is always in a state of flux or transformational change (a dynamical system is always in motion), the phenomenon must be studied in its whole aspect.

**EMERGENT PROPERTIES**

The order and form that emerges from the complex movement patterns of a dynamical system are greater than and different from the sum of its constituent parts. These different properties are known as emergent properties of a dynamical system. For example, when hydrogen and oxygen combine in a ratio or 2:1, water results. Water is an emergent property of this combination of hydrogen and oxygen because water has unique properties different from either hydrogen or oxygen.

Having described the principles of complexity science, it is now time to relate this new scientific paradigm to music therapy practice and research. To do this, it is necessary to look at both music and human functioning from the perspective of complexity science.
Many researchers and theorists, myself included, believe that the phenomena of music meets the criteria for a dynamical system (Wallin, 1991). First, music, as a physical event, is immensely complex. A single, complex (note the terminology) tone with its overtone series is by itself a complex physical vibration. And vibration is movement. When you combine the tones, timbre, and multiple parts of a musical event, an incomprehensible amount of complex movement is generated. Music has a nonlinear quality where the whole is greater than the sum of its parts. This gives rise to emergent properties of this dynamical system. Our experience of a musical event like a symphony concert is an example. The combined efforts of all the musicians playing the various musical parts and the conductor coordinating the effort is greater than and different from the individuals parts. As a life-long second violinist, I can certainly attest to this phenomenon. Alone each part is rather unremarkable but put together, the musical event is far greater than the sum of its parts. And all these various elements fuse together into a single experience.

Like all dynamical systems, music must be considered in its wholeness. Music, to be music must be considered as a whole. When we listen to music, we do not hear each distinct part or recognize chord progressions. Even professional musicians, who are trained to hear and recognize a chord sequence or rhythmic device, does not hear these parts as separate entities. The music is heard and enjoyed as a whole thing. As a violinist, I hear the symphony as a unit, I do not just hear the violin parts.

Another characteristic of dynamical systems, sensitivity to initial conditions, greatly impacts a musical experience. Slight change sin tempo, room acoustics, and even the mental state of the performers can make huge changes in the experience people have of the music. When devising
her Guided Imagery in Music technique, Helen Bonny (1973) recognized this when creating her listening programs. She specified not only particular pieces of music but also particular performances of those pieces. It was her great genius to recognize that a seemingly small difference - the individuals performing the music - could make a noticeable difference in client response. Musical instrument construction is another example of sensitivity to small variable in music. Instrument makers know that even a slight change in construction can completely alter the instrument's sound.

Music production, like other dynamical systems, requires iterative feedback, both auditory and muscular. Violin playing is a good example. The skilled motor behavior of performance requires immediate and instantaneous adjustments of the muscle spindles to control and time the movement needed for playing the instrument. Feedback from the auditory and muscular senses build on themselves as they are enfolded again and again to accurately execute the motor sequence needed. The intonation aspects of playing also require iterative feedback. When playing the violin, the placement of the finger on the string only approximates the desired note. The true note is achieved by input from the ear that is processed continually to maintain the proper intonation. All musical performance is dependent on the continual refolding of feedback into the on-going motor behavior.

Finally, the action of attractors is seen throughout the musical experience. Tones of the harmonic cadence act as a fixed point attractor, pulling the tones of the melody to it (Wallin, 1991). I already discussed tones with their periodic movement as limit cycle attractors, which can pull materials into specific shapes. With the coupling of tones in intervals, it is also likely that music contains multiple torus attractors.
Because of the immense complexity of movement indicative of complex sound and the combinations of complex sounds in music, it seems likely that music is itself a strange attractor. A strange attractor system has geometrical (fractal shapes like the Mandelbrot set) and, in particular, time fractal features. The most common of the fractal time patterns found in nature is the 1/f spectrum - an intermittent bursting of behavior or "noise". It is found in earthquakes, rates of cricket chirping, river flow, in animal neural firing rates, and in musical melodies. Music, in fact, is a collection of fractals in time. "All musical melodies mimic 1/f processes in time and mapping 1/f noise to sound generates a reasonable 'fractal forgery' of music because the correlations inherent in the sound mimic the meaning found in natural sounds and music" (Voss & Clark, 1975, p. 317). Music is imitating the characteristic way our world functions and changes over time. Both music and natural 1/f spectrum changes are intermediate states between randomness and predictability (Voss, 1989). And because music is a dynamical system that is intermediate between randomness and predictability, it exists at the edge of chaos, the place in our natural world of optimum vigor, information, and potential.

### Complexity and Human Functioning

Dynamical systems like the human body are examples of a self-organizing system - one whose form is relatively stable yet constantly self-renewing. We know that every cell in our body is replaced every seven year, yet the general form it takes remains the same. But to function optimally a self-organizing system must stay open to a constant flow of energy and information. They are dissipative structures, capable of maintaining their identity only by remaining continually open to the influx of information from the environment. For example, our brain's gross structure remains essentially unchanged throughout our life. Yet it self-orga-
izes by constantly changing its subtle connectivity with every act of perception in order to maintain a creative and healthy response to an ever-changing environment. Brain structure remains the same yet is ever and always changing. To stop this constant change is to die. The human body and all its systems, including the brain, is a special kind of self-organizing system. It is autopoietic or self-creating. In nature, there are many self-organizing systems but anything that creates and constantly recreates itself is a living entity. In fact, an autopoietic nature is now the new definition of life. Autopoietic processes are emergent properties of biological systems. We now know that life is not a thing, it is a process.

Human functioning on all levels of organization is a dynamical system. It shows nonlinearity, fractal patterns, emergent properties, and edge of chaos dynamics from the smallest to the largest organizational systems. Nonlinear dynamics are seen in neural firing patterns, respiration rates, hormone fluctuations, and, especially, in the rhythm of a healthy beating heart (Gleick, 1987). A beating heart is a mass of complex, coordinated movement following fractal laws. It shimmers in this complex rhythmic dance. In fact, if the heart loses this highly complex, edge of chaos beating pattern and approaches a simple beat pattern, heart failure occurs (Goldberger, et. al,1985 ). Our body structure is also fundamentally nonlinear and fractal in nature. For example, the branching of the veins and arteries of the circulatory system is based on fractal branching patterns (Briggs & Peat, 1989).

**Complexity Science and Music Therapy**

How does the science of complexity relate to music therapy practice and research? Clearly both music and human functioning are complex dynamical systems. It seems to me that the purposeful interaction of
music directed by the music therapist and human functioning is itself an immensely complex dynamical system, where the therapeutic benefits are emergent properties of that complex interaction. In music therapy, and all therapeutic intervention, we strive for our client's "health." Health is not the mere absence of problems or symptoms. From the perspective of complexity science, health implies a balanced and harmonious relationship between and within all aspects of human functioning - body, mind, emotion, and spirit (Quinn, 1989). In a state of health, this "right" or balanced relationship is a coherent state where a natural and logical connection exists as a result of being part of the whole. Coherence is not a static state, however. This right relationship of coherence is an ever-evolving, ever-changing process. Health is also a dynamical system in motion. It is constant, nonlinear movement keeping all aspects of human functioning in right relationship. This constant movement can be thought of as a dance at the edge of chaos. The edge of chaos is the place of optimum vitality and optimum creative potential. It is a place of transition, a boundary which, when crossed, creates a sudden change of state. Too much chaotic movement and all form is lost, too little and the form becomes rigid and non-adaptive. Our complex heartbeat is again a good example. Too much complex movement and the heart goes into defibrillation. Too little complex movement patterns and heart failure follows. Optimum heart health is the maintenance of the edge of chaos place of maximum vitality. When such a state is maintained, health becomes an emergent property of the human system pushed to the edge of chaos by increased complexity but stabilized by the right relationship of the four components.

Music engages all aspects of human functioning. It is a fundamental, all-encompassing human event involving the complete range of experiences. Music is a sensory, physical, and perceptual experience. It engages a
large portion of our brain influencing behavior, consciousness, and memory. Music, especially when it is performed, requires fine motor skill, muscle coordination and timing, and the sense of hearing, touch, kinesesthesia, and proprioception. It is an event of deep emotion - joy, pleasure, grief, sadness, and numinous transcendence. Music is the human experience of spirit, the sense of belonging, community, and life flow. The music itself and the intention and consciousness of the music therapist provide highly complex information to all areas of human functioning. I believe that this complex dynamical system - music and the music therapist using music with intention - brings individuals to health by supplying vast amounts of information, complexity, that keeps individuals in the edge of chaos dynamics and allows the creation of the emergent property of health. "Systems that self-organize out of chaos survive only by staying open to a constant flow-through of energy and material" (Briggs & Peat, 1999, p. 16). Music provides that constant flow-through of energy and information.

**Implications for Music Therapy Practice and Research**

If we approach music therapy practice and research from the perspective of complexity science, a number of things become immediately apparent. First, music therapy process must be addressed in its wholeness. A science of wholeness sees the world, not as a machine, but as a living, open-ended system. Therapy becomes an on-going process not an end product. Wholeness implies extensive levels of interrelated connectedness and the futility of identifying which causal factor creates a certain effect.

Secondly, complexity science tells us that small factors can have huge effects through amplified or iterative feedback. Because of this we can never prove what factor in the music therapy process does or does not
impacting the process. Nor can we predict or control the outcome of our music therapy interventions. Is the effect from a rhythm pattern, tone combinations, the musical form, or the thought of the music therapist? There is always missing information in a complex system. "Chaos, it turns out, is as much about what we can't know as it is about certainty and fact. It's about letting go, accepting limits, and celebrating magic and mystery" (Briggs & Peat, 1999, p. 7). Our current scientific model is based on proof and replicability. As music therapists we routinely assert that to be accepted, music therapy must prove that our interventions impact people in the same ways over time. As Dale Taylor (1997) wrote in response to a speech I gave in 1991, "...a way can, and indeed must be found to define music therapy in terms that objectively explain a basic domain, a common factor, or a single therapeutic focus that is applicable to all areas of music therapy practice" (p. 5). Complexity science tells us this is impossible and, in fact, not desirable. We can never completely know how and why music therapy works because complexity science implies there will always be missing information that, through feedback, may be profoundly affecting the outcome. And each time we do music therapy, even with the same client, that unidentifiable factor will likely be different. Or the feedback patterns will magnify a factor in a different way. Based on the principles of complexity science, it is impossible to find any therapeutic intervention, including music therapy, which will affect every client in the same way consistently. This does not mean music therapy is not effective, beneficial, or efficacious. It only means that our standards of "proof" are impossible and unrealistic based on the real, complex nature of the world.

Music therapy practice based on the principles of complexity science will be less concerned with predicting results of the therapy and be more involved with the process as it occurs. Music therapists will recognize
that the three-way interaction of the music, music therapist, and client has its own unique emergent property. The music therapist will respond to the subtleties inherent in the situation since small factors can have huge impact. The music therapist will respond to the on-going process creatively and aesthetically using a sense of what fits, what is in harmony, and what will grow and what will die. We will rely more on intuition - the immediate knowing or learning gained without evident input from the sense or rational thought (Borczon, 1997). Through intuition, the music therapist will perceive all aspects of therapy as possibilities. Intuition gives a holistic awareness of the unfolding process of therapy. The therapy session will be guided by this deep inner sense of what is happening and how to proceed as the session unfolds. The music therapy will then become a true creative process, a dance of interaction between therapist, client, and the music.

Music therapy research will also change. It will seek understanding rather than causes. It will aim to illuminate rather than predict and control (Harmon, 1994). Heuristic research methods that seek to discover, clarify, and understand will be employed. However, complexity science is an inclusive theory. Traditional reductionistic research has a place in giving us reasons why an effect occurs. The new music therapy research will demonstrate relationships between factors without being required to prove that one factor caused the other. It will emphasize practical rather than theoretical understanding. Emphasis will be placed on effectiveness research, which acknowledges the importance of context - the environment, client mood and emotion, intention of the therapist, musical elements, etc. Music therapy research in complexity science will require us to ask new and different research questions. More "what" questions will be asked than "why". What happens to the client during music therapy rather than why it happens.
Complexity science offers music therapy a scientific model that brings greater understanding to the immensely intricate process that occurs in our therapeutic discipline. It can help us demonstrate the efficacy of our discipline and lead us into new and more appropriate research approaches. But most importantly, complexity science will help us to be more effective therapists acknowledging the importance of both the experience of music and the overt and subtle efforts of the music therapist to positively impact our clients and their lives.


Select Bibliography


A main entry to insight in music therapy theory and practice has been the volume on Music Therapy Research edited by Wheeler (2005), in particular the chapters on Phenomenological Inquiry (Forinash and Grocke 2005:321-334), First-Person Research (Bruscia 2005:379-391), and Approaches to Researching Music (Bonde 2005:489-525). The theme of this chapter is the phenomenological approach to music listening. Phenomenological inquiry uncovers the wealth and complexity of human experience and provokes the sense of wonder (Merleau-Ponty 2002:XV, Clifton 1983:296, Ihde 2007:203, Thøgersen 2004:32). Music therapy as multiplicity: Implications for music therapy philosophy and theory. Article. Sep 2020. William Matney. Introduction The field of music therapy is diverse and complex. Authors have navigated such complexity in myriad ways, often to locate the field’s unique values and purposes. Ensuing orientations and models have been valuable, but do not encompass the entirety of current and future practices/practitioners. I introduce the multiplicity concept to highlight intricacies and promote opportunities. Philosophy of science is a branch of philosophy concerned with the foundations, methods, and implications of science. The central questions of this study concern what qualifies as science, the reliability of scientific theories, and the ultimate purpose of science. This discipline overlaps with metaphysics, ontology, and epistemology, for example, when it explores the relationship between science and truth. Philosophy of science focuses on metaphysical, epistemic and semantic aspects of science... This material is based upon work supported by the National Science Foundation under Grant No. 0844626. Also supported by a DARPA YFA grant, the Sloan Foundation, and a TIBCO Chair. 1. Computability theory and some invoke the concept of computational complexity, but no particular results from the eld devoted to it. Perhaps the closest in spirit to this essay are the interesting articles by Cherniak [40] and Morton [98]. In addition, many writers have made some version of the observations in Section 4, about computational complexity and the Turing Test: see for example Block [30], Parberry [102], Levesque [88], and Shieber [118]. In deciding which connections to include in this essay, I adopted the following ground rules Complexity theory is expanded upon and identified as providing a new perspective and a new method of theorizing that can be practiced by disciplines within the social sciences. These additions could better position the social sciences to address the complexity associated with advancing technology, globalization, intricate markets, cultural change, and the myriad of challenges and opportunities to come. Systems theory has been challenged in the recent literature due to its perceived disconnection from today’s research and practice demands.