

## Transdisciplinary Emergence and Constructive Consilience

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**Abstract:** Humankind hungers to share its various culturally-generated perspectives, or “worldviews”, most obviously expressed in alternative languages (Nisbett, 2005). Depending upon our views, we each construct a basic foundation of thought that our upbringing, environment, and educational system then hone into a disciplinary framework. Twenty-first century educators will succeed best when they at once encourage the emergence among learners of a shared, “consilient” (leaping up and together), creative set of thought pattern styles (Wilson, 1999) and promote the construction of abstract bridges through language that cross cultural and disciplinary boundaries. Coastline Community College online learners of French language and culture have achieved a new *transdisciplinary consilience* by learning effectively how to deploy eight particular patterns of creative thought that at once typify the traditional francophone schooling goals of argumentation and analysis and define the mental cross-fertilization that underlies a unity of knowledge.

### Introduction

Constructivist education entails a focus upon the learner as a builder of his own known world; it comprises “learner-centered” instruction, in which the teacher serves to guide the student to create, to construct, his own foundations of understanding. And in *Consilience: The Unity of Knowledge*, biologist E.O. Wilson (1999) has proposed that the multiple competencies and multiliteracy demanded in twenty-first-century occupations can be engendered best through application of at least three traditional eighteenth-century European Enlightenment-style values. That is, Wilson proposes, a metaphorical leaping up and together, *consilient* unity of knowledge can be shared if we unleash our naturally insatiable human curiosity, our powers of abstraction, and our ability to reason mathematically so as to understand our world and our fellow beings. Further, in a similar epistemological vein, the European notion of *transdisciplinarity* calls for modern schooling to instill in us a desire to create worldviews at once individually-conceived and group-shared, over-arching and pluri-generated (Nicolescu, 1996).

Psychologist Richard Nisbett (2005) has demonstrated that humankind hungers to share culturally-generated perspectives, usually through language; depending upon our worldview, Nisbett claims, we select from among various internationally alternative, creative thought-pattern styles to consider domains as diverse as art, engineering, physics, philosophy, and zoology, those fields defined in American academia as disciplinarily distinct. Our language and culture tint the images we create of our surroundings and they

direct our concentration. In the twenty-first century, new technologies are permitting, if not promoting, an intercultural, cross-disciplinary dialogue, a cross-distillation of worldviews; in the United States, this dialogue has broken into and broken down previously distinct disciplines, advancing, for example, schemes such as “Humanities 2.0”, the notion that “...technology is changing our understanding of the liberal arts” (Cohen, 2010: 01). Exploitation of these concepts might lead in a logically natural way to a reason-based mental leaping together, a *consilience*, a new mode of cross-disciplinary, or *transdisciplinary*, dynamic “whole” learning.

Indeed, Gay (2002) has noted that modern educators are faced with new challenges that arise from an increasingly socially networked, “pluri-cultural”, “humanistic-scientific” society, in which students are blends of their backgrounds and those of everyone around them; learning will proceed most effectively, Gay proposes, if a set of “creative thought patterns” can be deployed that first encounter students where they are academically and mentally and then guide them toward achieving a goal.

At Coastline Community College, in Fountain Valley, California, students in an online program of French language and culture have for sixteen years been participating in the sort of humanities 2.0 consilience and transdisciplinarity that result from the integration of what might be considered to be francophone reason-based, “scientifically creative” thinking styles into their digitally-delivered, individual, self-customized courses of study.

The Coastline students of French language and culture have found that, as Gay (2002) has summarized it, their richest success emanates from their own application, sometimes without realizing it, of eight particular scientifically creative thinking techniques, not just in French, but across the curriculum. At Coastline, students’ worldviews are enhanced through integration of these eight thinking styles into their French subject matter. And this subject matter in turn promotes traditional Cartesian French patterns of discourse. That is, an interrogative, analytical logic is applied to each stage of concept development, exploiting the typical francophone *vermicular*, or oblique, mode of reasoning to a broad range of topics. And not entirely serendipitously, *transdisciplinary consilience* has been the result.

### **The concept and method: Eight qualities of creativity proposed**

Greg Gay, of the Toronto, Canada, Inclusive Design Research Center, has cited alternative perspective-seeking, “divergent thinking” as an underlying precondition to creative risk-taking, which motivates critical thinking, in turn an aspect of the dynamic interplay defining both *consilience* and *transdisciplinarity*. Gay sets forth eight features defining the creative mind, whether it be that of the theoretical physicist or the choreographer, the research scientist or the writer.

It is notable that much twenty-first-century American schooling, from Kindergarten through college, has come to accept that these eight attributes of creative thinking must be fostered (Gay, 2002) if students are to become the sorts of lifelong learners who will be able to make effective decisions in a multi-faceted, unpredictable world. But it is

perhaps more significant in a globalized, electronically boundaryless world that students enrolled online in a California community college course in foreign language and culture have absorbed these thought patterns and then exploited them to reason through essays and ideas that have defined French tradition. These sixteen hundred or so California community college students, more than half of whom have already earned at least one four-year college diploma and at least 40% of whom have worked in the exact sciences, learn how to make the most of logic-based thinking, applying it across what are commonly understood to be academic disciplinary boundaries. In this way, they see the emergence of something unusual in an American education system that would define ever more specialized major fields of study: They create *transdisciplinary consilience*. Often without realizing it, these enrollees in a humanities 2.0 program are honing their skills at Gay's eight (2002), summarized as follows:

1. *Fluency*: The ability to produce multiple responses to any open-ended question or problem, such as "identify as many uses as you can think of for a paper clip"
2. *Flexibility*: The ability to generate unconventional ideas or to view a situation from diverse perspectives.
3. *Originality*: The ability to produce unique, unusual, or novel responses, relative to one's reference group.
4. *Elaboration*: The ability to add rich, elaborate detail to an idea, and the ability to develop and implement it.
5. *Visualization*: The ability to imagine and mentally manipulate images and ideas, so as to see them from alternative internal and external perspectives.
6. *Transformation*: The ability to change one thing or idea into another, to see new meanings, applications, and implications of something already in place.
7. *Intuition*: The ability to see relationships or make connections based on partial information.
8. *Synthesis*: The ability to combine parts into a coherent whole.

### **Fluency described and exemplified**

*Fluency*, commonly understood as the flux, or flow, of material in a quick, smooth manner, is often associated with linguistic loquacity, but its neurological representation suggests a cerebral side to all organized thought. Thus, just as phonemic awareness facilitates fluency in language, it is maintained, so can *number sense* be seen to generate the "declarative knowledge" underlying the fluent mathematical conceptualization that is the basis for effective thinking in the sciences (Gersten and Chard, 1999). That is, as Whitehurst (2003) has reported, people who have "automated" the sub-processes of basic arithmetic and mathematics are expressing "fluency in thought"; they can conceive higher-order concepts without restriction and are thus also able to participate in creative problem-solving without having to wallow in the mire of the mere. Indeed, as Delazer (2003) has demonstrated, those of us who have been able to automate certain simple mental processes and calculation techniques can squirrel away these brain behaviors into a special automatic-retrieval area of our gray matter, leaving the remainder of our cerebral thinking zone more available to complex rumination. In the interest of mental efficiency, then, our brains are partitioned, stockpiling in an easy/automatic access spot

certain basic facts of calculation and their results; these facts and results are cerebrally “flagged”, so that we do not have to re-reckon them each time they seem necessary, thereby simplifying even our everyday acts. The resultant *math fluency*, therefore, is a necessary precursor to successful higher-order thinking. As Whitehurst (2003), among others, notes, such higher-order thinking comprises a significant component of creativity, and hence, of mental enrichment.

At Coastline Community College, more than half of the sixteen hundred students who have enrolled in online courses in French language and culture during the past sixteen years have been current or former workers in mathematics-based scientific or technical fields, including engineering, computer services/sciences, communications technology, and medical technology. Forty per cent of them have worked full-time in domains requiring degrees in the exact sciences. As post-adolescents experienced with schools and schooling, they have learned how to learn; they have in most cases developed the automatic-retrieval techniques characteristic of fluent thought, at least in their workaday lives. In their virtual classroom, they are able to exploit systems with which they are comfortable to approach something new.

Coastline online learners of French language and culture learn at the beginning of each sixteen-week term what are the course objectives; all assignments, including exams and term papers, are viewable online throughout the term, just as is done in francophone educational institutions. Part of becoming fluent in a language means becoming fluent in its cultural framework, its sociopolitical scaffolding, its societal expectations. Students demonstrate *fluency* in a culture’s socio- and psycholinguistic sheathing when they don a new mantle, pacing themselves in accordance with novel expectations and not questioning at every turn the utility of a structure alternative to the traditional American one. Too, Coastline online learners of French hone their linguistic skills to increase their fluency in the commonly understood sense: They are encouraged to speak and write freely. Electronic live chat sessions are scheduled for at least five hours at least twice weekly and have no set topics; students are invited to “talk about” coursework, political, social, or personal matters, broadening their vocabulary as they have to use it; their linguistic contexts are immediate, useful, and rich, unlike the linguistically context-reduced formats defining standard language course matter, in which the typically French editing pattern of *toilette du texte* takes place only after having produced draughts. Modern (technology-based) media encourage speed, and this, in turn, prompts twenty-first century secondary-language learners to speak and write readily, with a flow. Interestingly, since nearly half of the sixteen hundred or so students who have participated in the French program during the past sixteen years have had careers in mathematics or the exact sciences, they have acquired fluent declarative knowledge quickly, and they have been able to apply their experience in scientific concept formation to the construction of new concepts in a new language. Students have remarked that “learning this language is like doing math”, and that “a lot of this is like applying formulas”, giving evidence that fluency in one field may be mapped into fluency in another.

### **Flexibility fostered in a world of diversity**

Our human mental flexibility permits us to exploit fluency in a creative manner. That is, it is not just the rapid flow of ideas, simple prolixity, that counts, but qualitative diversity; the flexible thinker can conceive of multiple options, diverse alternatives; he can draw inferences. In modern societies enriched and infiltrated with manifold languages' worldviews, the flexible thinker can often call easily upon the complementary.

Creative *flexibility* in Gay's sense characterizes those of us who will succeed best, who will best weigh options and select the most suitable. By contrast, the learner who becomes used to a single practice becomes "routinized", blind to alternative methods, inflexible, and uncreative. While the aforementioned United States Institute of Education Sciences Director Grover Whitehurst (2003) would have us automate certain mental practices so as to free our minds for fluency, he would not have us engage in perpetual, routine loops of mindless processing, failing to escape into flexibly fluent creativity. As Brooker and Brooker (2010) have stated, "People *require* flexible thinking to flex between logical, structured thought and the creative."

In Coastline Community College's online French program, students are frequently called upon to give reasons for their responses, to explain to one another their stances on certain controversial topics, and to argue and debate as if from a point of view opposing their own, usually after having read and written on a subject, demonstrating an understanding of vocabulary and structure. Their linguistic skills are thereby strengthened, their critical thinking tested, and their cognition flexed. In addition, Coastline onliners are given tools, or patterns, to automate mentally, and then they are asked to deploy these in the interest of "reasoning like a French person." That is, instead of arguing in an American rhetorical way from thesis through examples and into conclusion in a linear, top-down manner, they are invited to *flex* their thinking muscles by entertaining numerous antitheses to each thesis, questioning each example, and arriving, in the typically francophone vermicular manner, at a conclusion that is a synthesis comprising what precedes.

### **Originality: The shock of the new**

*Originality* takes the capabilities defining flexibility and runs with them, dashing off away from the pack. That is, after the original thinker has been able to see a problem from alternative "flexible" perspectives, he then generates a novel response. Naturally, the response may entail abstraction and generalization, two essentials to the language learner.

Notably, as Maas (1982), among others, has pointed out, "original thinking" dovetails in many multiple-language-defined cultures into what social anthropologists might call *divergence*. That is, as Maas reports, those whose multiple languages offer varying lenses through which to see the world and to define its problems are more often than not also those whose "...thinking processes have diverged from the (external, English-language) tried and true into the creative and original" (1982:42). Multilinguals are also, Maas claims, the ones who have become the most successful, creative scientists, artists, and

leaders. Original thought, it therefore follows, can be stimulated in the increasingly globalized twentieth-century classroom through the construction of multi-cultural, multi-linguistic learner groups who can at once question the American classroom tendency to “converge on an already determined solution” (Maas, 1982) and generate new ways to look at data, just as Coastline online students of French language and culture have been doing.

At Coastline, online learners of French language and culture must be ready to react to varying sociolinguistic contexts, cultural demands, and needs; they must respond to what the National Education Association (NEA) of the United States’ *Route 21 Partnership for 21<sup>st</sup> Century Skills* (2010) has cited as an immediate need to “integrate cognitive and social skills with content knowledge”, so that analytical and critical thinking might unite with “life skills such as flexibility, adaptability, and self-reliance” in student coursework that will induce original thought. It is clear that the NEA-stated “needs” dovetail with the sort of “theory of inventive (or creative) problem solving” (TRIZ) generated during the 1950’s (cf. Altshuller, 1984) that has characterized “practical” and “conversational” language courses for more than half a century. In this system, *algorithmic problem-solving* is practiced, in which learners face a situation, define the problem(s) it presents, and then proceed to solve the problem through questions and answers, each leading to the next in a kind of flowchart manner.

In conversational language courses, the TRIZ system offers the added benefit of training learners in linguistic pragmatics, that process by which they become competent in turn-taking, recognition of another, the use of paralanguage, and other social practicalities. Interestingly, Coastline’s onliners have learned in their electronic live chat sessions the francophone systems of “texto” (text messaging) abbreviation, the most-used emoticons, and the importance of interruption to French conversation; these aspects of their new language acquisition are particularly twenty-first century. In addition, online learners have the advantage to do research while they interact; they may surf the Internet for academic and linguistic resources as they exchange ideas, in real time. Coastline online learners of French acquire research and reporting skills, evaluation techniques, and francophone discourse patterns as they communicate in their new tongue; they are required to take quick, objective interactive quizzes on grammar and subject matter, and they must also argue a stand on a topic that has no right or wrong. Indeed, language learning in the real world comprises the paragon of “real-world problem solving.” He who can talk his way out of a problematic situation succeeds, and he who cannot is left in a linguistic lurch.

### **Elaboration: The last detail**

Once a novel solution to a problem has been generated, the creative individual will be able to add rich, *elaborate* detail to it, fleshing it out, readying it for implementation, often across domains. Indeed, the aforementioned “theory of inventive problem solving”, or TRIZ, began with the finding that only one per cent of “inventions” are truly original, while the rest represent simply alternative applications of the ulterior (Altshuller, 1984). The earliest TRIZ notion was that optimal solutions to problems therefore arise most

serendipitously when groups of thinkers pool their mental energies to examine those problems. The notion was that the most elegant solution is achieved when a problem is examined from the perspective of ideal elucidation. An algorithm for analysis is imposed, and details are discussed at each step of its imposition. Multiple ways of grouping things or ideas are set forth, and the defining attributes of each group are specified.

In language learning, steps toward effective elaboration often begin with brainstorming, an endeavor to come up with many ideas that was shunned by Altshuller. But brainstorming can be exploited in concert with algorithmic thinking; brainstorm breaks can be taken at each stage of algorithm development, promoting fruitful ideational elaboration. At Coastline, students in language courses are called upon to give reasons for their reasoning processes or to give details about their theories or thoughts, fleshing out a notion that they may have conceived of initially in only outline form. Often, the need to explain to “outsiders” can lead the effectively creative thinker to see variables that he might not have seen previously and to define controls for those variables.

Indeed, explanation, or circumlocution, is a necessary step in the path toward linguistic competence. Linguists note that *interlanguage*, the learner dialect of a new tongue that mingles the first language with the second in a kind of Spanglish or Korglish or Chinglish or franglais pidgin, accompanies a process in which interactivity depends upon elaboration, detailing, explaining so that another will understand. Linguistic fleshing-out will often transpire spontaneously; the wise language instructor will not aim to squelch it but will instead paraphrase or re-phrase it, couching non-threateningly in the correct.

At Coastline, French language learners online have been able to expedite their progress from L1 (native language) through interlanguage and into L2 (in this case, French). Since their coursework demands much more reading, writing, and understanding in their new language in a greater variety of contexts than does the work in traditional language courses, these learners write thousands of words in French per week; the sheer quantity of required work is effective to promote prolixity, and interaction with native speakers of French online then hones their accuracy.

### **Visualization: Do you see what they see?**

As has been noted, the most effective creative thinkers have learned to define problems in terms of their ideal solutions, as TRIZ developer Genrich Altshuller (1984) put it. The creative thinker can picture graphic images in his mind, manipulating them mentally so as to see them with his mind’s eye from alternative internal and external perspectives. This thinker has learned to isolate form from content, to operate with structures of relationships, processes, and connections. Too, he can identify opportunities and free his mind to imagine concrete ways to take advantage of them, *visualizing* each next step he takes.

For their part, psycholinguists and psychologists have honed an ability to encourage mental freedom by using *visualization* in the form of “guided imagery”, urging us to develop the very natural human capacity to dream, to liberate the mind. The idea is that

we are each more creative than we might think, and that we can all visualize, whether *associatively* or *dissociatively*, using emotion, experience, and engagement or independence, control, and analysis. Mason (2010) invites us to exploit our *association* skill by entering into an imaginary “lemon-eating exercise”, for example, and our *dissociation* talent by conceiving of a line that we can curve into a circle whose middle we can then press mentally to form a peanut shape. Practice can strengthen our visualization expertise, no matter our linguistic or cultural background; Mason suggests that we can use visualization to concentrate, to solve problems, to ponder effectively, and ultimately, to improve our proficiency in thinking creatively, whether in the arts, humanities, or sciences.

Both the associative and the dissociative are necessary to the successful language learner, as Coastline Community College French language and culture students have found. Like mathematicians, they learn the formulae of word- and sentence-formation; they deploy structure in the interest of engaging their fellows in a shared (linguistic, mental) experience. Like psychologists, they then incite one another to imagine, painting pictures with words that they share online, inviting others to append commentary in a wiki, a course bulletin board, and a blog. Web 2.0 and social networking are gifts to the language learner that encourage electronic visualization and then expedite learning.

### **Transformation**

*Transformation* in the linguistic sense alters the sequence of ideational elements, usually sentence parts, while retaining core meaning; “interpretable” linguistic features may be moved about to match “uninterpretable” ones, for instance, so that subject-verb agreement might occur or tense-marking elements might match. In the broader sense, *transformation* alters the context of a process or an idea; the *transformative thinker* takes things or ideas that are already extant and then sees new meanings or applications for them, new implications for what we already have around us.

Transformative thinking calls for an alternative application in a new context. For instance, the field of human factors science seeks to develop harmonious interaction between humans and what they create, improving operational performance across the board. Indeed, human factors engineers aim in general to debunk statements such as those made sardonically by George Bernard Shaw: “The reasonable man adapts to the world. The unreasonable one makes the world adapt to him. And all progress depends upon the unreasonable one.”

Human factors engineers promote reasonable adaptations that harmonize the connections between people, machines, and the environment. Order and symmetry affect our appreciation of well-engineered design and of things artistic; mathematical designs often underlie the beautiful. The transformative thinker “...creates a new way of ordering experience that allows (him) to generate types of feeling, forms of object-relatedness, and qualities of aliveness that had previously been unimaginable” (Ogden, 2010). Linguists consider the process of transformation to entail the exploitation of a finite set of “rules”, or culturally language-based patterns, to generate an infinite number of utterances.



Transformative thinkers take ownership of what they have learned; they know how to embed their knowledge into varying domains, profiting from the neural plasticity that permits re-examination of ideas when they are seen in diverse contexts from alternative perspectives. Adult students who have learned how to learn, who have spent two decades of their lives in school and more time at work know how to analyze systems, how to apply what they have learned in the past to new contexts. Coastline learners of French online are almost exclusively adults over 40; fewer than 12% of the sixteen hundred who have participated in these courses have been under 25. These students master, sometimes almost automatically and without realizing it, the bringing forth of empirical data to support psychological and other social scientific claims; they ask questions about the human condition, deciding on what sorts of statistics or other objective analyses might be applied to their new studies from their past.

Perhaps most importantly, transformative-thinking students must discover how most effectively to place themselves in the contexts of varying academic worlds, seeing from alternative perspectives; discussion and debate among class members are essential to transformability. Indeed, happily enough for Coastline Community College online French language and culture students, many of whom have worked in technology and the sciences, seeking out empirical justification has been a lifestyle; these learners are encouraged through a course wiki, through electronic live chat, instant messaging, and e-mail in French to ask questions, to distill their thoughts, querying not to threaten, but rather to incite ideational transformation, a sort of Cartesian *modus operandi* in which (linguistic or conceptual) action is taken after having considered alternative consequences.

Too, as learners of a new language, Coastline students of French language and culture online perform the usual language course sentence transformations of the sort described above. That is, they learn native-like syntactic structures by organizing and re-organizing sentential elements, establishing that, for instance, French adverbs stay close to the verb rather than moving as freely as they do in English; these learners discover the critical nature of articles and other determiners as well as the subtleties of verbal aspect, all by transforming sentences into different tenses or aspects or moods. After performing these linguistic exercises, the Coastline students are asked to select the structures most apt to express their own stances on particular subjects, transforming their maternal-language-based thoughts into new ones bathed in a new language. Once again, the idea that is transmitted most clearly is that “correctness” has often to do with not only linguistic context but with the socio- or psycholinguistic frame surrounding that context, transforming it to fit.

**Intuition: Just imagine...**

*Intuition* is that elusive trait inherent in the individual who can make connections between one thing and the next, one concept and another, even though the data are sparse. Intuition permits the thinker to recognize when a result fits a theoretical framework, when a conclusion follows with reason from a proposition. The intuitive thinker can “think in pictures”, as Poincaré called it (1905); he “sees in space”, realizing the need for “a

counterpoise or antidote to logic.” The intuitive thinker takes his mind’s eye visualizations and then conceives of relationships between them and something else; often, that which is intuited falls out of only a limited data set. The broader consequences are imagined.

Intuitions, as Felder and Henriques would remind us, “...involve indirect perception by way of the sub-conscious---accessing memory, speculating, imagining” (1995: 22). The intuitive learner often infers underlying principles from facts presented to him and observations that he has made; because he has conceived of these inferences himself, they are customized to his mental mapping process and therefore easy for him to retain. The online environment requires a certain degree of intuitiveness, and in language learning online, intuition is especially important; it requires the development of effective insightfulness, either in small, incremental sequential steps or in large, holistic jumps of the mind.

But intuition’s counterpart, deductive reasoning, must also be deployed in effective learning of language. That is, when students learn morphological or syntactic rules, when they learn how to use which words in which contexts, they are honing their deductive skills, which they will have to use, to apply in new contexts. In Coastline Community College’s online French language courses, objective quizzes in vocabulary and grammar ensure that the rules are engrained and free-ranging live chat sessions require instantaneous applications of those rules to practical, current, real-time contexts.

Online learners of French language and culture at Coastline Community College take grammar and vocabulary practice as the operational skills development that must precede intuitive, higher-order thought. The language learner must automate the phonological and syntactic patterns of a tongue before he can conceive semantic nuances, presuppositions, or entailments. In an online course, it is serendipitously useful that these patterns may be automated both externally—in campus computerized systems---and internally---in students’ minds. As has been suggested, the human brain can partition itself, placing the automated in an easy-retrieval zone and leaving open an alternative area for the imaginatively intuitive. And happily enough for students of French, this last might be said to derive from the sort of typically French Cartesian notion that our only real, indubitable knowledge is that which we gain from thought, analysis, and subsequent use of the mind to intuit. Coastline students practice not only grammatical patterns and vocabulary formation, but cloze testing and the structured form of French literary analysis, *explication de texte*, laying out the reasoned before presenting the arguable.

### **Synthesis: What’s new?**

Once relationships and connections have been intuited, no matter the breadth or depth of data used to perceive them, a *synthesis* of thoughts can emerge, a combination of entities, a formation of something new. No matter its academic, philosophical, or practical sense, an effective *synthesis* profits from the other seven of Gay’s creative thinking abilities, and perhaps most particularly from *intuition*. That is, as the two traits have been summarized,

*synthesis* entails an ability to put together into a coherent whole those elements that are found through *intuition* to have relationships.

Synthesis has been classed *a priori* as a higher-order cognitive skill; clearly, it has been concluded, the student who is to become a self-directed learner must develop the tendency to synthesize (Bloom, 1956).

In a number of European educational institutions, the field of *transdisciplinarity* has come to define the sort of cognitive synthesis that Gay might classify as the academic *nec plus ultra*. This transdisciplinary program is more than American-style “math across the curriculum” or “writing across the curriculum”-style; rather, it comprises mathematical models seen from a humanist’s point of view, writing and literature analyzed from the perspective of a physicist, art imagined by the engineer, or chemistry described by the painter.

Coined by Jean Piaget in 1970, the term *transdisciplinarity* is aimed to signify at once that which operates between disciplines, across disciplines, and over/above disciplines. As Romanian-born French theoretical physicist Basarab Nicolescu has defined it, transdisciplinarity recognizes that we will achieve full understanding of our modern world only when we realize that there is a unity of knowledge, of awareness, of perception. A classical division of academic study, claims Nicolescu, is restrained, limited; transdisciplinarity fills in the spaces between disciplines, producing a dynamic tension between the varying views of reality that each discipline engenders. Moreover, Nicolescu continues, transdisciplinarity is nourished through research performed in individual disciplines, study which is then in turn enlightened by complementary examination. Disciplines are not considered antagonistic in the transdisciplinary model; rather, they are complementary, enriched by the bounty of alternative perspectives (Nicolescu, 1996). The *Manifeste de la Transdisciplinarité*, published in 1996, cites the need to instill in learners three principal skills, so that they might be able to: contextualize, concretize, and globalize. Learning proceeds, asserts the manifesto, through dialogue and discussion, carried out with scientific rigor and openness. Comprising a true *synthesis* of thought, then, transdisciplinarity finds its roots in physics and engineering, using mathematical models to treat social, artistic, and intellectual domains.

Exemplarily, students at France’s Ecole des Hautes Etudes en Sciences Sociales, a part of the Centre National de la Recherche Scientifique (CNRS), study the social and economic impact of information technology, the aptitudes necessary for effective integration of that technology into society, and the concepts of intellectual v. territorial “wealth.”

Alternatively, the role of individual v. collective beliefs is examined in conflict; computer simulations are exploited to clarify and place in parallel, objective formats of the various clashes in Afghanistan, Chechnya, Somalia, and Sudan, among others. Notably, the Ecole invites international outlooks; students from around the world are encouraged to debate alternative perspectives in person and via computer. Younger students preparing to compete for entry into the Ecole learn about “Angels and Bosons”, for instance, studying the philosophy and applications underlying the CNRS’s high-energy physics Large

Hadron Collider from the perspectives of art, religion, Aristotelian philosophy, Galileo, and Newtonian physics, for example. The CNRS motto, “dépasser les frontières”, has been translated as “advancing the frontiers”, in fact dissolving the boundaries commonly imagined to exist between the exact sciences and the humanities. Coastline Community College students who have joined the CNRS’s electronic “multi-logue” participate in transdisciplinarity, a unified consilience, a synthesis of thought that would generate a fruitful cognitive shift from the uninspired and the standard to the ingenious, imaginative, and creative; they can see and interact with innovative accomplishments, synthesized *faits accomplis*.

At Coastline Community College, learners whose background may have been in mathematics or science, social work or the arts, traverse disciplinary boundaries in the interest of sharing ideas, communicating their own stances on things, and discussing, entertaining the alternative, “jumping together”, as *consilience* means, literally, either via instant messaging, E-mail, electronic live chat, a course wiki, or a blog. Although Coastline students may learn in the course of their study of French thought the perennial significance of René Descartes’s theories to francophone thought, their participation in real-time, live dialogue across time zones and geographical borders cannot help but engage them in what modern sociolinguists call “social practice.”

### **Conclusion: Across disciplinary boundaries in eight ways with language**

As Williams (2005) has pointed out, *language awareness* is critical to promote the engagement and interaction that define the twenty-first century’s transdisciplinary communities of practice in the knowledge economy. We have to be aware of each other’s meaning, not just in terms of Spanish or French, English, Chinese, or Arabic, but also with respect to chemistry or physics, music, math, history, philosophy, or the arts. In a century in which art may be done with technological tools and history may be redefined through chemistry and physics, modern students---indeed, modern human beings---each have an identity that is no longer separate, of self alone, as Williams has put it; instead, our identity “...pertains to how the individual is transformed” (2005:05). Neither are the new century’s virtual learners any longer what Williams calls the “centered rational subjects of Cartesianism”; rather, they are post-Cartesian beings whose “existence (arises) through engagement with discourse within which (they) become the subject” (2005:05). These students are active, interactive participants in a new kind of dynamic educational process, and their teachers must embrace this process alongside them. Everyone engaged in education, no matter our linguistic or disciplinary background, must collaborate in the most effective execution of Gay-style creativity. Indeed, it has been demonstrated that we can achieve a new synthesis resulting from intuiting the connections that fall out of ideas transformed from visualized elaborations of original ways of doing things, flexing our mental muscles into fluency. And notably, at Coastline Community College, learners have come to realize that successful communication in a new tongue requires more than vocabulary or syntax. In fact, understanding need not be presupposed by agreement, since, as consilience advocate E. O. Wilson holds, the arts, sciences, and humanities all retain the common goal of understanding. And given that Language with a capital L is something that is at once human, social, and imbued with

understanding, its study might comprise the paradigmatic bridge of transdisciplinary consilience in which the each science will speak its mind.

## References

Altshuller, G. (1984). *Creativity as an Exact Science*. New York, NY: Gordon & Breach.

Bloom, B. (1956). *Taxonomy of Educational Objectives*. Boston: Allyn and Bacon.

Bowd, A., McDougall, D., and Yewchuck, C. (1998). Educational Psychology for Canadian Teachers. Retrieved 19 October, 2010, from

<http://iv.csit.carleton.ca/~awhitehe/pubs/FP-EducationalHarmony.pdf>

Brooker, J. and Brooker, K. (2010). Yes and. Retrieved 12 October, 2010

<http://www.yesand.biz/flexible-thinking>

Cohen, P. (2010). Digital keys for unlocking the humanities' riches. New York Times, 16 November. Retrieved 21 January 2011

<http://www.nytimes.com/2010/11/17/arts/17digital.html>

Felder, F. and Henriques, E. (1995). Learning and teaching styles in foreign and second language education. *Foreign Language Annals* 28, no.1, North Carolina State University. Retrieved 26 January 2011

<http://www4.ncsu.edu/unity/lockers/users/f/felder/public/Papers/FLAnnals.pdf>

Gay, G. (2002). About creativity. Learning Disabilities Resource Community, University of Toronto, Canada. Retrieved 10 July 2010

[http://www.ldrc.ca/contents/view\\_article/147/](http://www.ldrc.ca/contents/view_article/147/)

Maas (1982). Creative thinkers : A valuable asset in a developing country. Part Two. Retrieved 10 January 2011

<http://www.directions.usp.ac.fj/collect/direct/index/assoc/D769959.dir/doc.pdf>

Mason, D. (2010). Hypknewsis. Wellington Hypnotherapy. Retrieved 10 January 2011

<http://hypknewsis.com/Visualization-Techniques/LV6-Guided-Visualisation-Exercises.php>

Nicolescu, B. (1996). *La Transdisciplinarité: Manifeste*. Paris: Editions du Rocher.

Nisbett, (2005). *The Geography of Thought*. New York: Free Press.

Ogden, T.H. (2010). On three forms of thinking: Magical thinking, dream thinking, and transformative thinking. *Psychoanalytical Quarterly*, 79(2):317-47.

Poincaré, H. (1905). Intuition. Translated, excerpt retrieved 10 January 2011

[http://www-history.mcs.st-and.ac.uk/Extras/Poincare\\_Intuition.html](http://www-history.mcs.st-and.ac.uk/Extras/Poincare_Intuition.html)

Route 21. (2010). A plan of action. National Education Association. Retrieved 8 October 2010

[http://www.p21.org/route21/index.php?option=com\\_content&view=article&id=48&Itemid=44](http://www.p21.org/route21/index.php?option=com_content&view=article&id=48&Itemid=44)

Rutgers University. (2008). Notes on the nature of flexible thinking. Online Reports. Montclair, NJ. Retrieved 10 October, 2010

<http://csam.montclair.edu/mathsci/maa-nj/RutgersMeeting/flexibility.pdf>

Whitehurst, G. (2003). Strengthen teacher quality. White House Conference on Preparing Tomorrow's Teachers. Department of Education. Retrieved 21 September, 2010

<http://www2.ed.gov/admins/tchrqual/learn/preparingteachersconference/whitehurst.html>

Williams, G. (2005). Multimedia, minority languages, and the new economy. *Noves SL. Revista de la sociolingüística*, winter. Retrieved 30 January 2011

<http://www6.gencat.net/llengcat/noves/hm05hivern/docs/williams.pdf>

Wilson, E.O. (1999). *Consilience: The Unity of Knowledge*. New York: Vintage.