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ABSTRACT

The Visual Thinking Strategies (VTS) curriculum was developed to engage beginning viewers in looking at works of art and has been used with children in many parts of the United States and Eastern Europe. The VTS was designed to develop critical thinking in viewing art and to enhance the function of the teacher as the facilitator of the reasoning process and aesthetic growth. To the surprise of the developers, teachers, parents, and administrators began reporting the transfer of the thinking patterns promoted by the VTS into other subjects. A study was conducted to explore the existence of transfer between the VTS program and other subjects. Data were collected from 25 experimental and 25 control subjects in 2 age groups (second and fourth grades) over 5 years and from the teachers of the students in the experimental group. The research instruments included a variety of tools, but the core of the analysis was the Aesthetic Development Interview, which studied the individual's mental constructions. A Material Object Interview, in which the subject was asked to comment on an object (natural or manmade) was developed to assess transfer. The likelihood that the VTS was increasing critical thinking skills was supported by the evidence of transfer among students in the experimental group, and improved achievement test scores for the school at which the program was implemented on the eighth-grade achievement test. Results from the study, which suggest that it is possible to develop critical thinking skills through the VTS and that such skills transfer to other subjects, appear to be more than findings of correlation; they appear to indicate causality. (Contains 5 tables, 12 figures, 31 endnotes, and 41 references.) (SLD)

Methods for Assessing Transfer from an Art-Viewing Program

by

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March 2001 AERA
Seattle, Washington

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Introduction

A little more than ten years ago, my colleague Philip Yenawine and I set out to create educational programs to significantly and meaningfully engage beginner viewers in looking at works of art. We called the early version of the program we designed the Visual Thinking Curriculum (VTC). With considerably more research, design, and fieldwork, we evolved a K-5 program called the Visual Thinking Strategies (VTS). The VTS curriculum has now been used with children all over the United States and Eastern Europe.

To our surprise, teachers, parents, and administrators involved in our art viewing program began consistently reporting that the thinking patterns developed in the VTS were showing up in other subjects. While this was not beyond our understanding of the reach of our program, it had not been the original objective. We wondered if these early reports were a honeymoon phase otherwise known as the Hawthorne effect. Yet the anecdotal, unsolicited reports of transfer grew, and around 1993, we realized that we needed to try to find evidence to substantiate the teachers' remarks. We were gathering data in most of our program sites, and had an opportunity to collect additional data to better discover whether the impact of the VTS was indeed generalizing to other content areas. I must admit that at first I was reluctant to move in this direction. It seemed far afield from our original intent, and fraught with complex methodological difficulties. And, it seemed to invite a new kind of agenda: that of using art viewing as a means to other types of academic development.

This paper is a summary of our attempts to study transfer from the VTS in our Byron, Minnesota Project (1993-98). I believe that much of what we have learned is due to the methodologies which were first devised to study the development of aesthetic understanding, which we later extended to study the question of transfer. Our conclusions differ quite markedly from others you might have heard which find no good proof that exposure to art transfers to other areas.[1] Our conclusions ultimately suggest an important role that art viewing can play in education.

Theoretical Framework

To understand the transfer puzzle we attempted to solve, it is important to understand where we began the process. Before we started research in Byron, our organization, Visual Understanding in Education (VUE),[2] had been asked to begin a program involving teacher training in VTS methods and theory, which came to include seven countries abroad. Studying transfer was not on our minds. To understand why transfer might be occurring without our focussing on it, it is important to understand a little about the nature of the VTS.

The design of the VTS. The VTS was designed to support learning and development in aesthetic understanding, that is, the reactions viewers have when they look at a work of art. The design of the program grew out of a unique and rich source of data.

Since the late 1970s, I have been studying the art viewing process. In order to do so in a consistent and measurable way, I developed three tools: an interview technique, a coding system to analyze each interview, and a scaling system to categorize interviews. The interview technique entails having viewers talk out loud in response to a specific question as they view a work of art. I call this stream of consciousness interview the Aesthetic Development Interview (or ADI). The viewer's verbalized thoughts are then typed into a transcript; and each separate thought is broken into what I call a "thought unit." Sampled thought units are then analyzed and coded according to a classification system.[3] From this process, based on the distribution of scored thought units, it is possible to place each viewer along a scale of five Aesthetic Stages: Stage I being the most naïve, and Stage V, the most aesthetically experienced. (See Appendix A for detailed Stage descriptions.)

Over the past several decades, my colleagues and I have collected over 6,000 such interviews stream of consciousness samples containing hundreds of thousands of thought units over which we have poured. Much of this data, as we shall see below, was longitudinal, coming from the same subjects in periodic observations over many years. The subjects (both within the United States and Eastern Europe) are culturally diverse, and mainly come from two groups: children, ages 5-18, and their teachers. Many of our subjects come from schools which are under-served, either financially and /or culturally.

The VTS was designed to match the developmental needs and naturally-displayed capacities of viewers at Stages I and II in Aesthetic Development. As an example of the early Aesthetic Stages, the Stage I viewer, when looking at a work or art, glances briefly at the work and then tends to either list observations or make associations with what first happens to catch his eye. He launches into storytelling based on these associations. What typically transpires in the Stage I viewing process is that the viewer seldom looks back a second time at the work of art. Lacking the concept of artist intentionality, the viewer is treating the work like an illustration in a story that he makes up.

It is not the purpose of this paper to go into the intricate design of the VTS, which appears deceptively simple, but to merely help the reader understand how the design might have supported transfer.

The use of developmental questions. The VTS attempts to meet, engage and strengthen the Stage I viewer where she is, and, at the same time, to challenge her by combining something that is easy and natural for her with something that is developmentally within reach. The VTS facilitator asks precisely crafted questions aimed a giving the learner a chance to construct meaning through viewing the work. For example, the facilitator in early lessons asks:

> *'What is going on here...?'* Responding to this is effortless for the viewer, for it invites him to begin with his natural inclination, namely to record his observations or tell a story. Followed by,
>
> *'What do you see that makes you say that...?'* This question challenges the viewer, as it call for the learner to cite evidence for his interpretative comments.

For the Stage I viewer, this kind of compound question has twin significance. First, it allows the learner to actively express and extend what he sees. This builds the motivation to not only generate multiple observations, but share them. Motivation is further built given that there is more than one right answer, and the teacher does not evaluate responses, but merely ensures that all who express ideas share the basis for their observation. On the other hand, the second question, *"What do you see that makes you say that,"* requires the Stage I viewer to do something new, namely return from a world of associational imagination, to the work itself to have a second look, to look harder, to look longer, for evidence. The learner cannot take part in a VTS discussion without themselves or someone else citing evidence. We ask that the teachers to only use the second question with very young students, when they feel that the students are ready.

The changed role of the teacher. Our research showed that Aesthetic Development was not a product of mastering facts, but a product of repeated exposure to art and an on-going experience of trying to make sense of a work of art, the learner is in a steady state of mental action, constructing and re-constructing ideas. The design puzzle was how to achieve a classroom process that has a high density of student mental action, and involves all students, not just the best and the brightest. This challenge was made all the more perplexing by the fact that our research continually showed that while the classroom teacher was expert in numerous teaching skills and informed about the diverse subject areas taught, she was often at the same Aesthetic Stage as her students, or only slightly more advanced. Educationally, we seemed to be faced with the dilemma of how to design a process in which the older but inexperienced viewer teacher leads the younger inexperienced viewer student.

The VTS solves these dilemmas by changing the role of the teacher, from presenter of information, to facilitator. In this shift we create more space for the learners to express their thinking, and at the same time minimize the teacher's challenge of teaching an unfamiliar subject area. The teacher's new role is to facilitate a process that encourages learners to look, express observations, look again and revise interpretations. The teacher builds the intensity of participation by refraining from evaluating answers, except to insist that each shared observation is supported by evidence in the work. The natural complexity and ambiguity of art, especially well chosen works (another aspect of the VTS design process) insures that many differing observations can be supported. Teachers further build the motivation to

participate by paraphrasing each learner's observation, validating that the student has been heard, and that what she has said is worthy of repetition.

The use of a social setting to support new cognitive repertoires. The VTS introduces a carefully sequenced set of cognitive challenges to learners via open-ended questions facilitated by the teacher. But the working ground for developing new patterns of thinking is a group process in which learners share their thoughts out loud. This process is significant in several ways. First, it gives all learners a structured impetus to think actively, constructing one interpretation and then another. Second, each learner hears the constructions of other learners at approximately his level. Observations are then repeated in paraphrase by the facilitator. The result is that students are bombarded by observations, but in a systematic way. Their own mind is working, but it is being stimulated by the observations of others. Like a brainstorming process, the building energy of this process sweeps all children up. Even the most reticent children become active participants. Finally, the norms of the group process become each student's models and scaffolds from which to expand his own cognitive repertoires. For example, a child learns that his interpretation has a greater chance of being accepted by the group, if he gives evidence for his remarks. In this process individual evidentiary reasoning is dramatically strengthened by the norms of the social setting.

The design of the VTS is subtle and complex, and this is not the appropriate venue for a detailed exposition. But this brief overview may be sufficient to give the reader a basic understanding of the VTS process and where the transfer puzzle began.

The Nature of Critical Thinking

When teachers kept reporting what it was that was transferring to other subjects, many cited what they called critical thinking. Since critical thinking can be seen as an element of aesthetic understanding, we knew that it was plausible that the VTS might be stimulating growth in this area. Nevertheless, I was wary. Not only is transfer an elusive phenomenon to study, but critical thinking is hard to define. While a very long line of writers, philosophers, educators, and psychologists trying to determine the nature of critical thinking makes it a most formidable task to capture, here, the writing of John Dewey, in the early part of the twentieth century, identifies many of the major issues in critical thinking. In doing so, he aligned the goal of education with critical thinking - to instill the capacity or "habits" which allow a person to examine the basis of one's beliefs:

> *While it is not the business of education to prove every statement made, any more than to teach every possible item of information, it is its business to cultivate deep-seated and effective habits of discriminating tested beliefs from mere assertions, guesses, and opinions; to develop a lively, sincere, and open-minded preference for conclusions that are properly grounded, and to ingrain into the individual's working habits methods of inquiry and reasoning appropriate to the various problems that present themselves. [...] ...if he [the individual] has not attitudes and habits of this sort, he is not intellectually educated. He lacks the rudiments of mental discipline. And since these habits are not a gift of nature, [...] since, moreover, the causal circumstances of the natural and social environment are not enough to compel their acquisition, the main office of education is to supply conditions that make for their cultivation. The formation of these habits is the Training of the Mind.*[4]

Foremost, Dewey reminds us that critical thinking is "that active persistent and careful consideration of any belief." [5] As Dewey and many others note, critical thinking – when the thinker tests the evidence for and logic of his thinking, as well as, the implications and possibilities that the thinking generates – has many of the following characteristics:

- *Active.* On going, in process, in progress.
- *Comprehensive.* Considering, reflecting, inquiring, searching, reasoning and discriminating.
- *Rigorous.* Attentive, mindful, persistent.

Critical thinking is not rooted in the first order knowing of the facts of a knowledge domain, but rather operates on that, and other, domains. It is a higher order thinking. It involves complicated applications of the mind such as speculating, evaluating, synthesizing and supporting. In her writing, Deanna Kuhn discusses how critical thinking is thinking about one's own thinking about something, treating one's own thinking as an object of attention."[6]. Kuhn notes how critical thinking requires a repertoire of strategies that can be applied to the examining of ideas. Meta-knowing, Kuhn, continues, in fact, includes meta-cognition, meta-strategy and epistemological thinking.

Although we can, to some extent, delineate the parameters of critical thinking, there are many complicating factors that make it difficult to create curricula that might foster its development.

Individual Capacity versus Social Propensity where critical thinking resides

Where one stands in the ongoing debate about how learning occurs effects discussion about critical thinking. In this debate, the question "what accounts for development and change?" is frequently answered by either "the individual" or "the culture." One school of thought sees mental actions as individual capacities in which the propensity to act in a certain way is a function of individual ability and motivation. Another, as the results of the social situation in which they are learned, as part of the social expectations of that environment, situated, context dependent, and distributed in the medium of culture.[7] One's view on this debate has implications for the teaching of critical thinking: to what extent must critical thinking programs be founded on an understanding of conceptual development of the individual within a particular domain versus an understanding of the social context?

However, the larger debate of whether learning is individually-centered or socially transmitted does not have to be an either/or question. While there are strong proponents at both ends of the spectrum, the answer is that learning utilizes building blocks formed by the individual within a social framework. In other words, both can be correct.

Two of the most cited writers on this topic, Piaget and Vygotsky, in fact spoke to both concerns. While we associate Piaget with the theory that individual children construct knowledge through their actions on the world – understanding through inventions, as he called it – Piaget nevertheless did not deny the co-equal role of the social world in the construction of knowledge. "There is no longer any need to choose between the primacy of the social or that of the intellect: collective intellect is social equilibrium resulting from the interplay of the operations that enter into all cooperation." [8]

Similarly, we associate Vygotsky with the claim that understanding is social in origin. Vygotsky is most noted for his views on the social nature and process of development: "Society is the bearer of the cultural heritage without which the development of mind is impossible."[9] In particular, Vygotsky posits that peer interaction, scaffolding, and modeling are important ways to facilitate individual cognitive growth and knowledge acquisition. Yet Vygotsky affirmed the centrality of the active construction of knowledge by the individual:

> *Activity and practice: these are the new concepts that have allowed us to consider the function of egocentric speech from a new perspective, to consider it in its completeness.. [...] But we have seen that where the child's egocentric speech is linked to his practical activity, where it is linked to his thinking, things really do operate on his mind and influence it.*[10]

Wanting Empirical Evidence

The next complicating factor is the need for empirical evidence which sheds light on the development of critical thinking.

Critical thinking needs to be exercised in a subject area, but is distinct from it. It must have an object or body of content to consider, even if that object is itself.[11] However, notably, it can also move beyond that object. While current thought sees critical thinking as both needing content and including cross-domain generality, we lack sufficient empirical investigations to chart the process of the development of critical thinking.[12]

Our insufficiency of information has a direct impact on education and the teaching of thinking strategies. Curricula require precise definitions of terms, constructs and their optimal sequencing. For example, to successfully teach critical thinking, we would need to know at what point a learner has built up a sufficient knowledge base in a particular domain, in order to begin to exercise meta-knowing on that domain.

If, in order to exercise critical thinking strategies, a considerable domain of knowledge must be built up, the development of meta-cognition and meta-strategic thinking may have to be delayed. Such delays would prevent the teaching of critical thinking from starting in the early years of schooling.

Wanting a Developmental Framework

Finally, there is the challenge of the unpredictable nature of the acquisition of critical thinking.

Many educators stress that education must take into account the developmental level of the learner and the peculiar predisposition and capacity to conceive of the domain under consideration in idiosyncratic terms characteristic of that developmental level. Only detailed analysis of the common ways of conceptualizing a domain at a given level of development can give the educator the basis for framing an inquiry process that will be natural, compelling and developmentally provocative to the learner. Dewey saw this challenge as one of the *"... most serious of all problems [...]: the problem, namely, of discovering and arranging the forms of activity."*[13]

Meta-knowing capabilities may complicate this matter in that the capacity to play out meta-knowing in its full form is a complex function of developmental level. One should not expect learners at different developmental levels to exhibit equally differentiated patterns of meta-knowing. Kuhn notes that it is difficult to predict when a cognitive strategy will be employed in the actual thinking process. She notes that over time, new strategies are used as part of a new repertoire, but the shift to a new repertoire is gradual and overlaps with the use of older ones.[14] In a later work, she writes *"...we see improvement but by no means mastery, even by adulthood. Developmentalists [who] probe children's early years in search of the origins of later-appearing competencies [...] appear to be observing the early origins of a later lack of competence, one that has profound implications for critical thinking."*[15]

Methodological Implications

Methods to Support Critical Thinking

In designing our studies of aesthetic understanding, my collaborators and I held certain attributes to be fundamental. These prerequisites, such as we understand them, are listed below. As it happens, because aesthetic development is intricately intertwined with meta-knowing, this list may have methodological implications for the development and measurement of critical thinking.

- **Lessons must engage and challenge the learner.** The learner must be captivated by the learning activity so that interest and involvement occurs spontaneously. However, the learning activity must at the same time push the learner to construct meaning in new ways.

- **High level of learner activity.** The learner must be actively engaged in the process of thinking and responding and have ample opportunity to practice new ways of making sense.

- **Practice identifying the basis of one's ideas.** The learner must make observations and interpretations based on a body of information, and must be required to identify the evidence upon which his thinking is based. Further, this on-going practice needs to extend beyond a single year: there is the need for repeated, longitudinal exposure.

- **Opportunity to revise and amend one's ideas.** The discovery of new evidence and the introduction of new interpretations continually challenge the learner's current interpretation and encourage him to extend his thinking. The teacher must allow students to master *"... the various methods to corroborate or to refute the first suggestions that occur."*[16] (For corroborating viewpoints, see footnotes[17] and[18] below.)

- **Provide models and scaffolds.** Higher order thinking does not come naturally to a young child. The teacher must set up the requirement to think in a new way and must monitor and correct the process of evidentiary thinking (as opposed to correcting content) as it occurs.

- **Building confidence and motivation.** The learner must not only build a new set of cognitive strategies but must also develop the strong propensity to use them when confronting a new body of information. The learner must come to feel secure in her ability to successfully employ each strategy, so that beyond being familiar and comfortable, she is confident about the outcome she can produce. Thus the new strategies must become the 'repertoire of choice' when the learner tries to make sense of something new.

  Bruner, on this point, observes: *"He [the learner] must have the attitude that he can use his head effectively to solve a problem..."*[19] Bruner goes on to note that lessons must get *"... a child activated so that he can experience his own capacity to solve problems and have enough success so that he can feel rewarded for the exercise of thinking"*[20]

- **Early start.** As early as possible, the child needs to develop a self-concept of 'being smart,' being capable of figuring out an answer when confronted with ambiguous information. However, with respect to critical thinking, its development requires mastery of a body of facts and information before it can be exercised. Potentially, this could cause the development of meta-knowing to be delayed into the later years of schooling. Our learner of critical thinking may lose a 'window' to develop a sense of being smart, able to use one's mind, before the onset of puberty, when issues of personal identity are primarily defined by many other social currents. Ideally, learning meta-knowing would begin as early as kindergarten. In order for this to happen, however, there is a need to introduce a 'subject matter' that can act as the basis of evidentiary reasoning before the learner has understanding of most formal school subjects and the capacity to amass information via reading. Getting an early start is thus a function of the choice of subject matter used as the basis of developing evidentiary reasoning.

- **Developmental sequencing.** For a lesson to be interesting, it must expose the learner to issues that are within his realm of comprehension. For it to be compelling, it must ask the learner to do things that he is capable of successfully performing. For a lesson to be provocative, it must confront the learner with precisely those questions that cause him to discover new dimensions of understanding, just beyond his experience, but still within reach. It would be difficult for a curriculum within a given subject matter to achieve these ends without a deep level of understanding of how cognition in the subject matter domain naturally evolves. Such an understanding allows the educator to adjust the level of issues to the learner's level of understanding, and to sequence and pace the progression of issues in a way that is likely to maximally engage learners and impact their development.

- **Social grounding.** The propensity to use a repertoire of cognitive strategies may be grounded in a social setting as well in individual capacity. Making evidentiary reasoning part of the shared norms of the learner's peer group is likely to enhance its use. Expressing one's interpretations can best be exercised in a group. And, a group that shares interpretations has a natural source of new ideas to be used as the basis of individual's revising her ideas based on the thoughts of others. Vygotsky's work on the 'zone of proximal development' provides an account of development as a description of the region of activities that individuals can navigate with the help of more capable peers, adults, or artifacts. He distinguishes this zone as the region between the level of actual development and the level of potential development that arises out of interaction between more and less capable participants.

- **Revision and extension.** The treatment process must support the learner to repeatedly "look again," and to revise and amend his thinking on the basis of additional observations that he makes. Getting used to a process of continual revision and re-articulation becomes the basis for extending one's ideas towards new and unexpected implications based on evidence. The attitude that it is always possible to "go one more step" prepares the learner to follow evidence and reasoning to implications that were not originally sought. As Dewey observes, learners must be willing to let their *"...judgment [be] suspended during further inquiry [...] acquiring the attitude of suspended conclusion."*[21]

Transfer

Jerome Bruner posited that transfer involved the capacity to go beyond the information given, calling attention to the fact that transfer extends thinking to application beyond where it was first learned. He viewed transfer as fundamental to education.

> *The first object of any act of learning, over and beyond the pleasure it may give, is that it should serve us in the future. Learning should not only take us somewhere; it should allow us later to go further more easily. There are two ways in which learning serves the future: one is through specific applicability to tasks that are highly similar to those we originally learned to perform. Psychologists refer to this phenomenon as specific transfer of training; perhaps it should be called extension of habits or associations. [...] A second way in which earlier learning renders later performance more efficient is through what is conveniently called nonspecific transfer or, more accurately, the transfer of principles and attitudes. In essence, it consists of learning initially not a skill but a general idea, which can then be used as a basis for recognizing subsequent problems as special cases of the ideas originally mastered. This type of transfer is at the heart of the educational process – the continual broadening and deepening of knowledge in terms of basic and general ideas.*[22]

In our research, we used the subject matter of carefully-chosen works of art to foster the development of aesthetic understanding. As we used several different works of art – even while keeping a consistent pedagogical approach – we found that our learners necessarily developed some meta-knowing techniques as a part of the development of their viewing (and of their accompanying aesthetic development). We gradually came to realize that we could not foster aesthetic development without simultaneously fostering the development of critical thinking techniques.

We have seen that critical thinking bears an elusive relationship to subject matter. On the one hand, critical thinking cannot be developed in a vacuum and needs a subject matter as a medium of development. On the other hand, critical thinking transcends the subject matter in which it initially develops. So, while it takes root in one area, it has the potential to blossom in others. You could even argue that this transfer is fundamental to the predicted attributes of the phenomena of meta-knowing itself. Critical thinking may not be critical thinking unless it shows signs of transfer.

Methodological Conditions for Causing Transfer

In our studies of aesthetic understanding, we found that the following conditions were important for establishing and solidifying aesthetic growth. As aesthetic growth seems to be intrinsically intertwined with meta-knowing, and meta-knowing to be characterized by the phenomenon of transfer, these conditions may also be important factors for cultivating transfer.

- **Generative and creative learning conditions.** Rich and generative learning conditions are those which provide opportunities for the learner to initiate open-ended conversations with complex material. They allow the learner to form her own questions, questions which are of intrinsic interest to her. They engage the learner with increasing levels of meanings and ambiguities – offering 'food for thought' – and allow the learner to make connections to other things she knows about.

  Works of art, well-chosen so that they can tell us many kinds of stories about ourselves, do just that: they provide us with things to think about and feel deeply about. Viewing art invites a process of responses which include noticing, thinking, sensitizing, speculating and reflecting – not only about where we have been, or who we are, but what we might be.

- **Micro-transfer.** The student learns to transfer if he is given multiple, repeated opportunities to use a familiar set of cognitive strategies when confronting new bodies of information. In the VTS, these strategies are applied in what could be seen as a circumscribed arena, namely, three different images within a given classroom lesson.[23] The initial successes in applying the same cognitive tool set to three different works of art – 'starting from square one' with a new body of information – gives the learner the repeated experience that he can invoke the learned set of cognitive strategies at will, and

that if he does invoke them, they can be successfully deployed to get to the desired end, even if the steps towards success are small. Constructing his approach as an endless sequence of new 'interpretative episodes,' the learner is not only building a cognitive skill set, but the meta-knowing capacity to decode situations.

- **Building confidence.** To employ critical thinking strategies in a new situation, the learner needs to have developed sufficient confidence in her ability to use them. She needs to feels confident that regardless of the subject matter, the repertoire can be counted on to 'work,' that is produce the desired outcome. The greater the user's confidence in her capacity to successfully perform, the greater the likelihood of repeated use in new situations.

- **Focus on process.** In most studies in schools, the focus is on subject matter. To maximize the likelihood of transfer (and the development of meta-knowing) the treatment should focus on process independent of subject matter. Ideally, the treatment should be structured to repeatedly alter the content under consideration, whereas the mental process that is applied to the changing content remains the constant. In this way, the process becomes the subject matter: that is, it becomes what is consciously figural in the learner's mind. Over time, the learner can begin to perceive this process as an object of thought. It also makes the learner more capable of discerning situations that are highly similar to those in which the cognitive strategies were first learned.

Methodological Implications for Observing Transfer

Once we are in a situation where we expect transfer to be occurring, measuring, or even attempting to observe that transfer, raises a number of vexing methodological problems that transcend the normal requirements of constructing causal proof. (We will discuss the issue of causality in a later section.)

Challenges

• *Observation timing.* The greatest problem is one of knowing where and when to look for evidence of transfer. If critical thinking is a repertoire of strategies that may be applied at unpredictable moments, how does one devise a strategy to observe the brief flicker of an unpredictable event?

• *Non-obtrusive observations.* Moments of evidentiary reasoning come and go quickly. They cannot be captured adequately, if at all, by standardized instruments. If one is to insure the likelihood of capturing such moments, the measurement method must leave the flow of thinking as undisturbed as possible, taking a natural sample of the thinking process as it occurs.

• *Multiple lines of evidence.* Since transfer can, in theory, show up at any time in a variety of other content areas, one must cast a wide net, looking not only at one measure, at one point of time, but employing a variety of strategies to triangulate a proof of transfer.

Some Guidelines for Attempting to Measure Transfer

The following constitute a variety of approaches to observe an aspect or instance of transfer. Employing the full set of such observations would seem to maximize the likelihood of finding transfer if it indeed occurred.

- **Social context transfer.** Transfer entails the use of a repertoire in a setting different than the one in which it was learned. Settings can differ in at least two ways: in social context and/or in content. In effect, we can think of these as the two primary dimensions of transfer.

  The first type of transfer, social context, can be said to occur if the learner demonstrates the repertoire in a social setting that differs from the one in which the repertoire was learned. In the case of the VTS, the social context of the classroom – where the repertoire is initially introduced – supports evidentiary reasoning because the teacher poses facilitating questions, holding learners to the norm of providing evidence. Other students perform this process and model it, and there is a social expectation that any comment made by a group member will include this method of

inquiry. If a student, who has learned this repertoire in the classroom, exhibits this method of inquiry in a very different social context – when she is alone –then we can observe this as an incidence of this first type of transfer. This is true even if she is applying the repertoire to a similar object of attention (namely, a work of art). (Related to Hypothesis 2, below.)

- **Subject transfer.** A second type of transfer is across subject matter. Here – in the case of the VTS – the learner would be said to exhibit transfer if he spontaneously used the repertoire when confronted with non-art content. Transfer would be more likely if the framing challenge surrounding the new object of attention is analogous to the one in which the repertoire was learned. In the case of the VTS, the students try to decipher what an object is (in a Material Object Interview; see below) by observing clues about it. (Related to Hypothesis 3, below.)

- **Sequence effects.** Transfer does not happen immediately. It generally appears in a new arena with some lag after the repertoire was developed in an original area. Furthermore, if one can make observations in more than one arena, some more 'distant' than others, one might see a sequence effect in which transfer first appears in arena 'A' (the closer) and then in arena 'B' (the more distant). (Related to Hypothesis 4, below.)

- **Developmental effects.** It would seem that critical thinking, which involves meta-knowing, would be more likely to flourish more frequently and in a more differentiated form at higher levels of development. Thus, we might expect to see transfer interact with age and Stage of development, with a substantial increase in transfer scores above certain developmental thresholds. (Related to Hypothesis 5 & 6, below.)

- **Meta-knowing.** If critical thinking is a form of meta-knowing, it is amenable to conscious articulation. Thus, without being explicitly told what the educational objectives of the VTS are, students who have participated for many years ought to be able to accurately report what they learned from the VTS and should report that it helps their thinking process in ways that go beyond the viewing of art. (Related to Hypothesis 1, below.)

Study Design

The Byron Study called "Methods for Museum Education," was consisted of a five-year partnership between the Byron School District, the Minneapolis Institute of Arts, and Visual Understanding in Education (VUE). This multiyear program began in September 1993 (Year I), and initially included all students at the Byron Primary School in grades 2-5, including special needs students. It grew to include all Byron students, grades K-8, as well as post-study data collection which is still ongoing.

The Byron Study was designed to provide a window into the kinds of thinking and learning that occur when elementary age students respond to works of art over an extended period. Our goal was to empirically investigate the effects of a new version of VUE's sequential curriculum, called the Visual Thinking Strategies (VTS) which included in-school discussions about art along with museum visits. The curriculum is based on my theory and research about aesthetic growth. As in past VUE studies, my colleagues and I planned to focus on growth and change in aesthetic understanding (which we understand to include more general critical thinking skills). A stable student and teacher population gave us the base for our five-year, longitudinal study in which we tracked both aesthetic growth and the transfer of VTS-learned skills.

Data were collected from twenty-five experimental and twenty-five control subjects in two age groups (2^{nd} and 4^{th} grades) for five years, from Fall 1993 to Spring 1998. In addition, data were collected from the experimental teachers. Using several different types of instruments and methods, we hoped to cross-reference several streams of information to support and explain variation, change, growth and transformation.

Observation Methods. To test the hypothesis of transfer, it is important to structure a study as a properly conducted experiment. In order to draw cause and effect inferences, it is necessary to apply typical experimental research standards to the extent possible. However, working in real schools, especially in under-served communities is quite different from working in a laboratory setting. There are many practical constraints that enable perfect designs to only flourish in non-real settings; moreover, the data

collected in laboratory settings might not imply much of value about the real world. Despite these constraints we attempted to follow common espoused design standards. Surprisingly, Winner and Hetland[24] found these standards to be imperfectly employed in all but a few of the studies reviewed, leading her to conclude that no study has ever proven the existence of transfer from an art viewing program.

- *Longitudinal study.* We arranged to conduct the VTS lessons and to collect measures every six months for five years. Longitudinal analysis allows greater opportunity to establish cause and effect relations.
- *Use of a control group.* We had a control group for each age level in our study. We are very appreciative of the control school which agreed to have data collected every six months for five years at two age levels.
- *Random assignment* to the experimental condition. Byron students were randomly assigned to the experimental group, receiving measures every six months for five years.
- *Pre and post test for the same subject.* All subjects were given a pre and post test every year of the five year study.
- *Matching of experimental and control groups.* Care was taken within the limits of practicality to insure the control group, from a neighboring school, was matched to the experimental group in terms of age, sex, SES, and type of community background. Comparable information was collected for each group at the same time every six months for five years.
- *Control group students were given a treatment.* More than a year into our study, we discovered that the control group had a treatment. The presence of a treatment is considered to minimize Hawthorne effects.

To these we added a few more requirements:

- *Quantitative and qualitative data.* Both quantitative and qualitative data were collected.
- *Appropriate measurement technique.* We used an open, unstructured method for collecting samples of thought, and sensitively coded individual thoughts (see ADI discussion below). This method was consistent with the types of behavior we were attempting to study, and open and sensitive enough to capture and trace them.
- *Full descriptions of the input and output.* We knew the curriculum taught by the teachers, as well as what comprised their teacher training. In addition, we had full and detailed description of the classes with some video footage of what was taught and how it was taught.
- *Inter-rater reliability.* Trained raters with high inter-rater reliability were used in this study.
- *Measurement requirements.* Beyond the general observation methods, there were special requirement regarding the measuring of transfer.
  - *Sampling Thinking.* Critical thinking does not lend itself to being accurately and sensitively assessed with multiple choice methods. We needed to find a way to sample the thinking process itself.
  - *Non-obtrusive.* The measuring method should create the least 'disturbance' possible while trying to observe the thinking process.
  - *Openness.* The measurement method must allow the learner to express any kind of idea in any way he desired.
  - *Richness.* The measurement method must be able to accommodate any aspect of the critical thinking repertoire that might come up and to exhaustively classify any kind of relevant behavior.
  - *Frequent observation.* Since it is impossible to predict when critical thinking strategy might be applied, one needed to make comparable observation over and over again.

Research Instruments

The research instruments included a variety of tools which allow for quantitative and qualitative analysis and the triangulating of information. The core of all the analysis, however, is the Aesthetic Development Interview (ADI). The ADI offers us an unparalleled window into an individual's ever-growing set of mental constructions. The interview method and coding measure, which trace in a detailed way what goes on in the viewer's mind while looking at a reproduction of a work of art, elicits rather than buries distinctions in aesthetic response. The ADI has allowed us to capture naturally occurring aesthetic viewing patterns, which illuminate the process of viewing, without diminishing the evolving nature of

viewing. This body of data is unique in many ways. The stream of consciousness transcripts are—by design – particularly open. The transcript records thinking in progress, and captures every verbalized thought that crosses the viewer's mind. These 'tests' are unlike most, in that they contain a broad and relatively uncontaminated swatch of mental behavior. They are extremely amenable to re-analysis with an evolved set of questions. These data are by definition longitudinal in nature, records of the evolution of individual thinking.

The data, though collected in a completely open way, are comparable because they were collected in precisely the same way, around precisely the same stimuli over the entire period of the study (in fact, across all Housen and Housen/DeSantis studies.) Each utterance, each thought, can be classified in many ways so that an ADI can be mined for Aesthetic Development, as well as for supported observations and speculations (critical thinking events).[25]

Below is a chart of our research instruments.

Table 1. Byron Study Research Instruments

1.	**Aesthetic Development Interview (ADI):** an open-ended monologue documenting a student's thoughts and reasoning skills as s/he responds to a work of art. ADI's are non-directed monologues, delivered one-on-one to a researcher. They are the central way we assess the change in aesthetic understanding that takes place in a student's thought processes. Collected bi-annually.
2.	**Material Object Interview (MOI):** a non-directed monologue focusing on an artifact such as a mortar and pestle or a set of calipers. Delivered one-on-one to a researcher. Collected bi-annually.
3.	**Demographic questionnaire.** Collected bi-annually.
4.	**Art and Museum Biographies:** these questionnaires detail the student's personal history regarding art and museums. Collected bi-annually.
5.	**Content Questions:** open-ended questions included in the questionnaire asking students about art-related content. Collected bi-annually.
6.	**Writing samples.** Compiled by the school, in school, and during museum visits. Collected throughout the year. (These include writing from Byron student journals, which Byron students begin in kindergarten and continue until the completion of elementary school.)
7.	**Teacher logs.** Teachers are asked to keep a log of their observations of student behavior with particular focus on student thinking and learning behaviors. They also observe their own teaching styles. Ongoing.
8.	**Teacher Trainer and Site Coordinator Notes.** Written Observations and notes from debriefings, including a post-study debriefing of the experimental students and their parents.
9.	**Parent comments.** Including observations and anecdotes.
10.	**Administrator comments.** Including observations and anecdotes.
11.	**Videotapes.** Some VTS classroom lessons and teacher training sessions were videotaped for analysis.
12.	**Student debriefing.** Exit-interviews.

The Material Object Interview (MOI): Developing a Measure of Transfer

In order to design an effective measure of transfer, we developed the Material Object Interview (MOI). In the MOI, the object of attention is not art, but, as the name suggests, an object from material culture (and one natural object) that has several characteristics. First, the material object is not something that the learner is likely to have encountered before. Second, the nature of the object is not obvious, but rather unclear and ambiguous: there could be any number of plausible interpretations about what it was. Third, the object, if closely inspected, contains a large number of clues as to its meaning.

Since we wanted to have objects that would support the making of observations and the generating of speculations, we chose objects that were complex, multi-faceted, and intended to be thought provoking. A different object was used each year the MOI was given. Our objects for the study years I-V included: a Danish coin, a trilobite fossil (which is a natural object), calipers, a mortar and pestle, an anemometer, and a candle snuffer.

In the MOI, the learner is confronted with the object, and is asked to "...tell me [the interviewer] about this." After this initial direction, the learner is prompted by remarks such as "Anything else?" "Uh huh," and "Okay." The "interview" ends at the point that the learner had no more to say about the object. Technically, this is really not an interview, since there is no verbal interaction between the learner and the person collecting the data. More precisely, the MOI resembles a sampling of free-ranging thought, as it occurs.

The MOI is distinct from the learning setting of the VTS in many ways. The activity does not take place in the same social setting of a group of peers in which the expectations and comments of the group, provoke, model, and entice similar kinds of comments. There is no teacher to pose questions, draw attention to the image by pointing as students speak, encourage responses and reward contributions by paraphrasing. Finally the object of attention is different in that it is not a two-dimensional work of art, but a three dimensional object.

On the other hand the MOI does bear some structural resemblance to the ADI in that both methods are stream-of-consciousness exercises, in which the student operates alone with little or no prompting except phrases such as "Uh huh" or "Is there anything else?" As with the ADI, the MOI responses could be divided into individual thought units which then could be coded. As we shall see below, the MOI thought units were coded for critical thinking.

Coding Critical Thinking as a Measure of Transfer

While it is possible to devise a large number of categories to distinguish varieties of 'critical thinking strategies,' experience suggested that we should use basic, face-valid distinctions and see if these distinctions would accommodate the remarks that students naturally made on the MOI. We decided to code two types of thoughts which intuitively seemed representative of critical thinking and also are frequently mentioned in the literature on critical thinking:

• ***Supported Observations.*** These are observations or interpretations in which the viewer cites the basis for the observation in terms of some specific physical attribute in the object. Supported Observations indicate the use of evidentiary-based reasoning, in that the viewer specifically cites the basis of his newly emerging beliefs. For example:

> *"I think they welded the handle onto it. Because it kind of looks like the metal kind of melted and then hardened."*

• ***Speculation.*** Part of critical thinking is the capacity to "go beyond the information given," in Bruner's words. Here, we find students often following several implications from evidenced-based observations, to their logical conclusions. Remarks coded as 'Speculation' entail the generation of a hypothesis of some kind. Students' remarks reflect a reasoning structure of 'it could be..." For example:.

> *"And there's a little slot for it to lay on in the side. Probably to crush stuff, too."*

While it can be argued that Speculation is a higher order strategy than making Supported Observations, we decided that there was no meaningful way to determine the relative weighting between these two kinds of remarks. Rather, we simply tallied the sheer number of each kind of remark. We also created a combined index by summing the counts for each type of remark. These then became our admittedly rough, but straightforward measure of incidents of critical thinking as displayed in the MOI.

Hypotheses

We had multiple, related hypotheses to test in Byron regarding the teaching of critical thinking skills and transfer. Table 2 shows these hypotheses, and the related measure and observation periods we used in our analysis.

Table 2. Hypotheses and Related Measures

[See end of document for all Tables and Figures not embedded in text.]

Results

Baseline Comparison of Experimental and Control Groups. The core set of hypotheses in this study revolves around the belief that the VTS would cause cumulating differences in critical thinking skills between the experimental and control groups. Because we are looking for differences due to the treatment, it is important to examine whether the groups differed before the treatment began. Table 3 shows the comparisons between the experimental and control groups at both ages. We have compared all the initial measures (Fall 1993,Year I) used in this study: Critical Thinking Score (in the ADI); Critical thinking Score (in the MOI); and Aesthetic Stage. Only one of these differences were significant, indicating that the groups were well matched in terms of these dimensions when the study began. In the case where we did find a difference in ADI scores, the older control group was higher than the older experimental group. This, of course, is a kind of handicap against eventually finding stronger transfer in the experimental group.

Table 3. Comparison of Initial Measures by Group
(Fall 1993, Study Year I)

Eliciting Critical Thinking. (Hypothesis 1) The first hypothesis was that the VTS would successfully elicit critical thinking. There are several ways to test this hypothesis. Of course, one could determine if critical thinking scores are higher for the experimental group as coded in the ADI. But, because we also want to test a hypothesis about transfer with the ADIs, we were forced to use other evidence. Our means of assessing this hypothesis is the most anecdotal or circumstantial, and the least subject to statistical analysis. We have several sources of data:

- ***Teacher remarks and journals.*** These individual records tell us about the behavior of VTS participants. Overall, the teacher journals and remarks reported an increased capacity on the part of the students for making supported observations and generating speculation as exposure to the VTS increased. Other, more specific observations include:

  Years I and II: teachers start noticing changes in their students' performance with respect to : written and verbal performance; length of spoken sentences; use of whole, complete sentences; longer descriptions in writing text; use of symbolism in written and verbal presentation; more overall involvement in writing projects.

  In Year III, teachers notice: more observations in class; students clarifying and supporting observations more frequently; more hypothetical thinking; students writing, talking and listening more in class. Further, they comment on students': respect for multiple viewpoints; listening more carefully to one another; being more willing to accept multiple viewpoints. Finally, they note that their students are applying critical thinking strategies to visual images in textbooks, readers, etc. and that they see students transferring "think, look, and listen" skills to other curricular areas.

In Year IV, teachers express that they are surprised by the quality of student writing. A middle school science teacher observed noteworthy problem-solving skills in his VTS students. Teachers continue to notice a high incidence of "I agree/disagree with because..." comments.

In Year V, the teachers' comments include: "student writing [is] fantastic"; teachers note the length of time students can write, as well as the fact that the writing is more descriptive, more detailed, and uses a more sophisticated vocabulary. Teachers observe that while the change in student writing is the most notable, there is "lots of incorporation into other curricular areas."

• ***Videotapes* of the VTS process.** By coding videotapes for critical thinking (e.g. Supported Observations and Speculations as described above), it was possible to test this hypothesis in a general way. We could see if the VTS process evolved a high frequency of Supported Observations and Speculations. If the VTS is eliciting critical thinking, the percentage of such remarks should be high. (See Table 4a.)

• ***Student reports.*** These responses tell us about what students learned from the VTS. These open-ended self-reports were collected at the end of the study period. We interviewed Byron students who were not in the experimental group (Study Year V). Since the VTS was presented as a curriculum associated with art, it is interesting to see what percentage of learners describe its impact not as being non-art related but rather in terms that sound more like critical thinking. Interestingly, a smaller percentage of students described the VTS as having taught them to look at art (26%) compared to those that described the VTS thinking skills (39%). Thirty-five percent described the VTS as teaching both. (See Table 4b, below.)

Table 4b. Student Self Reports of Learning from the VTS
(Byron non-experimental students) (Spring 1998, Study Year V)

What did you learn (from the VTS curriculum)?

"Different people have different feelings and different ways *of looking* at art."
"I learned how to *think better.*"
"I learned to *look more carefully.*"
"I learned that art is important to all cultures."
"I learned how to reach way into the back of your mind. And how to view all different aspects of the story."
"I think this year especially made me focus on the art itself and *think of better questions."*
"I learned that there are different ways to look at art."
"I have learned to work together to figure out a piece of art."
"I liked learning about the art because I know that when I go to the museum *I can feel smart."*
"I learned that all artists have different views on life. That sometimes *things have more to them than meets the eye."*
"I learned *how to put what I see into expanded words.* How to look deeper into the pictures."
"I enjoyed all the *discussions* with the class and how *nobody would make fun of your comments."*
"I learned how to have an *open mind* on art work and *not just see the obvious."*
"I learned that art is special."
"I learned that art isn't as boring as I thought it was."
"I learned *how to look* at art."
"The way I think about things is different now. I can apply the VTS to things in everyday life."
"I learned how to ask questions."
"I learned to say what you see, not what others see."
"Now that I know *how to look* at art work, *I will analyze other things better."*
"I have a more open mind."
"I have learned to respect art more and realize how important it is in life."
"I learned that art is cool."

Transfer Across Social Context. ***(Hypothesis 2)*** The second hypothesis is that critical thinking scores (as measured in the ADI) would be significantly higher for both the younger and older experimental group than for their corresponding control groups.

The use of the ADI allowed us to allowed us to keep constant the behavior of the learner (in terms of making supported observations etc.) as well as the content (namely art works), while altering the social context in which the learner showed this behavior. The ADI is conducted alone, while the VTS is a group process. In the ADI the learner has none of the supportive cues from the class discussions that might trigger learning behaviors. Absent are the teacher questions and facilitation techniques (such as paraphrasing, pointing to the image, linking response) and student peer modeling (such as listening, looking, responding to the questions, generating diverse and provocative observations).

To test this hypothesis we simply counted the number of Supported Observation and Speculation for each subject on each of the ten ADIs given every six months (Fall and Spring) over the five-year study period. If the experimental and control groups were well matched, one would expect the initial critical thinking scores (collected before the VTS program began at the beginning of Study Year I) to be low and that there would be no statistical difference in scores of the two pairs of groups. This in fact proved to be the case. There was no difference between experimental and control group's critical thinking scores in either age group (see Table 3).

Since one would not expect critical thinking scores to transfer immediately, we then compared scores in the Spring of Study Year II. Figure 1 shows the mean critical thinking score for the two experimental and control groups. The mean scores showed a difference for both age groups ($p<.01$) for the younger groups and $p<.08$ for the older groups. The younger groups (who were in the third grade in Study Year II) showed a greater difference than did the older groups (who were in the fifth grade in Study Year II). We later discovered that the fifth grade teachers of the experimental students had stopped teaching the VTS lessons less than half way through the year, a probable cause of relatively weaker gains that year.

Figure 1: Critical Thinking Score (ADI) by Group
(Spring 1995, Study Year II)

Over the next three years the differences in the level of critical thinking found in the ADI continued to increase. Figure 2 shows the same mean scores for the treatment groups collected at the end of the study period in Year V. While all groups show a gain over the period, the experimental groups shows a much larger gain. ($p< .0004$). Differences continued to be greater for the younger group, who were in the sixth grade, than for the older group, who were in the eighth grade at the end of Study Year V.

Figure 2. Critical Thinking Scores (ADI) by Group
(Spring 1998, Study Year V)

It is important to note that these differences were found despite two unanticipated conditions that could not be controlled, but which could have diminished differences between the experimental and control groups.

First, the experimental and control groups were not perfectly matched. They were well-matched in terms of demographics such as age, sex, income and community background. For example, both were in rural communities with little exposure to art. However, the older age control group had fewer special needs students and more gifted students. This difference appears to have arisen by chance. In both schools we could select students randomly without constraints. We were fortunate in that the entire experimental school was taking part in the VTS, which gave us the chance to select randomly for our experimental students using the entire pool students in grades 2 and 4. This school participation allowed us to avoid some of the more problematic issues of sample selection faced in longitudinal studies. Such as, the longitudinal design of our study which required that the experimental students be able to meet yearly to take the VTS classes for 5 years, did not mean that they had to meet as a group for five years. Since in the end the experimental group showed significantly more gain in critical thinking scores, it is fortunate that

these uncontrollable factors favored the control group or they might have cast some doubt on our findings.

A second unexpected finding emerged as a kind of unplanned experiment, and frankly, surprised us when we learned about it. While both schools had an art teacher, the programs were not comparable. The year that the Byron study began, the control school Art Teacher was beginning her fourth year of teaching at the control school. In Year III of our study, we found out that she was trained in the Getty's Discipline-Based Arts Education theory and methods. In 1998, she won the State's Art Teacher of the Year Award. In contrast the Byron School which did not have any art teacher for several years prior to our program, went through a series of four art teachers during our study. Ironically, Winner and Hetland suggest that well-formed studies about the impact of arts education should do something extremely hard to plan: they should include an alternative art education program for the control group.[26] This is not an easy condition to satisfy in practice-based research. Our goal was to try to have matched experimental and control schools, with the experimental school differing only in terms of the VTS program. We felt fortunate that our Site Administrator, Catherine Egenberger was able to find a matched control school that was generous enough to allow us to interrupt classes to collect data twice a year for five years. Imagine our surprise when we learned that we actually had an unplanned treatment for the controls, and probably the most appropriate one to have had we carefully planned it in advance.

Our conviction that we were in fact observing evidence of transfer was reinforced by the fact that the experimental students showed early and sustained differences in critical thinking scores in a different social context, when compared with more advanced students in the control group, who had yearly exposure to the DBAE in their weekly art classes.

Transfer Across Content ***(Hypothesis 3)***. The third hypothesis is that critical thinking would not only show transfer across social context, but across content as well. Our measure of 'content transfer' was the MOI, which elicited supported observations and speculation, not about art, but about objects from material culture. As with the ADI, we summed counts of Supported Observations with counts of Speculation in the MOI. A simple test of Content Transfer was to combine both age groups and compare mean critical thinking scores of the experimental group to that of the control group. Figure 3 shows that the mean score of the experimental group at the end of Study Year V was over twice that of the control group ($p<.01$).

Figure 3 Mean Critical Thinking Score (MOI) by Group
(Spring 1998, Study Year V)

A closer comparison can be made by looking at the two age groups individually. Figure 4 shows the final Critical Thinking scores (MOI) for each group. In both age groups, the experimental group shows a significantly higher score ($p<.047$ and $p< .024$, for the older and younger groups, respectively).

Figure 4. Critical Thinking Scores (MOI) by Group
(Spring 1998, Study Year V)

Sequence Effects ***(Hypothesis 4)*** A fourth hypothesis was that there would be sequence effects. This means that we would not expect to see transfer occurring immediately and that different types of transfer might occur with lags in time. In short, we would expect to find some time ordering in transfer, in which different types of transfer appear at different times.

To test this general hypothesis it is necessary to look at a pattern of differences over time. For example, the time sequence of differences in 'context transfer' (ADI) scores is important. We would expect the differences to be non-significant at first and then, after a period, to be significant in a continuing fashion. 'Content transfer' differences might be non-significant for a period of time, and later become significant as well. One would expect some kind of lag between the points at which each kind of transfer "kicked in."

This is, in fact, the kind of pattern we observed. 'Context' transfer was not visible until one and one-half years into the project (Spring of Year II) for both age groups. But 'Content transfer' differences did not appear reliably until much later, essentially at the very end of the study.

Table 5 presents this pattern for both kinds of transfer effects for each age level. Non-significant differences now become an interesting part of the puzzle. For example, Table 5 shows that the 'content transfer' differences were non-significant in both age levels well into the later years of the study, and well past the point at which both age groups were showing significant differences in 'context transfer'.

Table 5 Timing of Differences in Transfer by Group
(Spring 1994-1998, Study Years I-V)

Developmental Effects *(Hypothesis 5)* Studies on the relation between developmental levels and critical thinking have mixed findings. While, one might expect to see critical thinking more frequently displayed as well as more differentiated and complex (learners who are more likely to 'pick it up and employ it more consistently' as well as more diversity) with an increasing level of development, Kuhn notes that such a shift is gradual and overlaps with the use of less complex forms of reasoning.[27] She notes that the expectation of 'content transfer' occurring more frequently at higher levels of development have not been fully borne out.[28] It may be that a developmental level is a necessary but not sufficient prerequisite for demonstrating consistent critical thinking. Further, it is possible that critical thinking must be broken down more precisely into strategies that can be applied to different developmental levels. In order to explore developmental differences, it is necessary to have a relevant developmental measure. As mentioned, the VTS grew out of the use of my measure of Stages of Aesthetic Development (see Appendix A). Aesthetic Stage is distinct from critical thinking, and constitutes a relevant developmental construct to explore developmental differences. In our analysis here, we would expect to find more instances of Supported Observations and Speculation at higher levels of development.

The hypothesis here is that mean scores in 'content transfer' should increase with developmental level. In its most raw form, this hypothesis does not refer to the VTS treatment: it should be true of all observed cases whether or not they have had the VTS. Figure 5 presents an initial analysis that combines experimental and control groups to look at MOI scores at the end of Study Year V by Stage of Aesthetic Development.

Figure 5 'Content Transfer' (MOI) Scores by Stage
(Spring 1998, Study Year V)

The patterns in Figure 5 suggest the presence of developmental effects in two ways. First, there is a clearly patterned progression of mean scores on the MOI by Aesthetic Stage. Stage appears to 'organize' the MOI scores in an orderly fashion. Secondly, there is an accelerated increase in mean score at the higher Stages as predicted. These differences are statistically significant ($p < .0031$).

If one collapses the stages into relatively 'early' Stages (Stages I and I/II) and relatively 'later' Stages the differences in MOI scores by Stage become even more apparent (see Figure 6). These differences in mean MOI score are strongly significant ($p < .0015$). The later Stage group shows a mean score that is roughly four times greater.

Figure 6 Mean MOI Score by Stage
(Spring 1998, Study Year V)

Now, if these are the general patterns across the treatment groups, what is the impact of the VTS? We can first address this question by examining differences in MOI scores within the experimental group as a whole, combining the younger and older groups. Figure 7 shows mean MOI scores at the end of Study

Year V by 'early' and 'later' Stages within the total experimental group. Here we see that the difference in mean MOI scores between the groups is even more pronounced, with later Stages showing mean score that are roughly six times greater. ($p<.032$)

Figure 7 Mean MOI Scores by Stage (combined Experimental Groups)
(Spring 1998, Study Year V)

The impact of the VTS is most clearly revealed in Figure 8, which compares MOI mean scores for experimental and control groups across Stage levels. There are small but significant differences in MOI scores at the early Stages; the experimental group shows higher scores ($p<.03$). However differences at the later Stages are larger. Mean MOI scores of the experimental group are roughly double that of controls in the same Stage range.

Figure 8 Mean MOI Scores by Stage and Group
(Spring 1998, Study Year V)

These patterns suggest that the while the VTS is impacting 'content transfer' at all developmental levels, 'content transfer' and measures on the MOI appears to interact with developmental level. At Aesthetic Stages II and above, scores on the MOI are much higher for the experimental group.

There is one additional pattern that appears related to the issue of development. In Study Year V we can examine the interaction between VTS treatment and Stage on mean MOI scores by separating the experimental group by age. Is the interaction effect the same for the two groups? Figure 9 presents the results. While both age groups show higher mean MOI scores for the higher Stage learners, the younger group at higher Stages shows much higher mean MOI scores than its older high Stage experimental counterpart. The mean scores of the younger experimental group at higher Stages are more than double those of its older counterpart and these differences are statistically significant ($p<.05$).

Figure 9 Mean MOI Scores by Age and Stage (experimental group)
(Spring 1998, Study Year V)

Thus it appears that 'content transfer' is greatest for the experimental group. However, in terms of transfer, the impact of the program is heightened, if the learner starts in the second grade, as opposed to the fourth. Furthermore, the impact is increased still more if the learner has achieved at least Aesthetic Stage II by the end of the study period.

Change in Aesthetic Stage *(Hypothesis 6)*. In order to understand the dynamics of the transfer process, it is important to track the final hypothesis of the study, that the VTS causes increase in Aesthetic Stage as well. The VTS was designed in the first place to support and develop growth in Aesthetic Understanding. Previous studies have shown that Aesthetic Stage increases with age, but that exposure to the VTS increases the pace of development.[29] So it is reasonable to expect that the VTS would produce greater Stage development in the experimental group, given this previous research.

The relative growth of the two age groups can be shown in a number of illustrations. Figure 10 shows the mean aesthetic Stage of each group across the five-year period of the study. In this case, the mean Stage scores are plotted by grade.

Figure 10 Mean Aesthetic Stage by Group and Grade
(Study Years I-V)

In this graph it is possible to compare the mean Stage level of various groups at the time in which they were in the same grade. While the younger groups begin at approximately the same mean level ($p<.739$, n.s.), the older control group began stronger than the older experimental group ($p = .0325$). However, by the Fall of Study Year II, the experimental group shows a lead that appears to grow over time. By Fall 1995, the experimental group begins to show statistically higher mean Stage than the control group at both age levels. Another pattern is that the younger experimental group begins to show greater mean scores at any given grade than the older group. These differences achieve statistical significance by Spring of Study Year III ($p<.001$) This again suggests a developmental effect. The VTS program appears to have more impact on Aesthetic Stage if it is begun earlier, that is by grade 2 instead of the grade 4.

One way to depict the cumulative impact of the VTS on Aesthetic Stage is to look at the distribution of learners by Stage at the end of Study Year V. Figure 11 compares the number of subjects at each Stage for the experimental and control groups.

Figure 11. Aesthetic Stage Distribution by Group
(Spring 1998, Study Year V)

Both groups began with similar Stage distributions (control group being slightly higher). However, by the end of Study Year V, the experimental group shows a much higher distribution. This difference is significant ($p<.0001$). It is worth noting that while the control group shows a greatest concentration at Stage I/II, the bulk of the experimental group is in the Stage II range. In short, the experimental group has grown above the threshold (Stage II) at which we have already seen that Supported Observations and Speculation are more likely to flourish. This fact will become important in the following section as we reflect on the implications of the various findings to attempt to construct a model of how the transfer process appears to operating.

Results Epilogue

Research cannot anticipate the unanticipated. From time to time, unplanned events lead to unplanned aspects of an experiment. In our case, we had not one, but four unplanned aspects in the experiment, each one adding strength to our arguments.

Control school art teacher. We had intended to compare the Byron School students who had VTS exposure to control school students who were not in any "special" art or art viewing program. More than a year into the study we discovered that the control school Art teacher was practitioner of Discipline Based Art Education. This art teacher's competency allowed us to compare Byron School students who had ten lessons spread throughout the school year to DBAE students who met with an art teacher weekly.

Interruption of teaching. During a program assessment, we discovered one of the worst fears on the part of the researchers: our program was interrupted. How can one measure the effects of a program it the program stops? This hapless situation happened in our second year of the study when the fifth grade teachers (of the older experimental group) from the Byron School stopped teaching the VTS midway through the year. We discovered this through our Year II Spring data analysis. The following year we were fortunate that the sixth grade teachers agreed to teach the lost fifth grade lessons as well as the new sixth grade lessons. What we were able to witness is the older groups' regression, but not to their baseline measure, and subsequent recovery with measurable growth and gains the following year.

Independent replication. Replication of findings in the social sciences is rare. The ideal scenario is for an independent group of researchers to study the same treatment with different measures but similar hypotheses and have the same results and conclusions. Without our planning, we discovered that another group had replicated our findings.

My colleague, Philip Yenawine, and I began working together in 1988, when the Museum of Modern Art's (MoMA) Department of Education was under his guidance. There we developed a curriculum

called Visual Thinking Curriculum (VTC), which, like the VTS and our Starter Lessons, was informed by his experience in museum education and based on my Aesthetic Stage research. First introduced in1991, its goal was to attempt to support and to produce development in the Stages of aesthetic understanding. In 1993, Mr. Yenawine left MoMA so we could work together to focus on the new curriculum we were evolving, the VTS. The VTS extended the methods and materials of the VTC, and applied them to a full curriculum from kindergarten to grade five, which has been field tested in the U.S. and in many countries in Eastern Europe. Building on methods first introduced in the VTC, the VTS is a much more advanced, better researched work, with new components such as a K-5 lesson sequence with teacher training materials and a website. Essential to both the VTC and the VTS are the two primary questions which ask the naïve viewers to explain what is going on in a work of art and to cite evidence for their interpretations based on the work. These anchoring questions are specifically designed to meet the needs of beginner viewers. The questions provide those viewers with a task which they can perform, but also one which brings their attention back into the work, provoking them to make more observations that lead, with practice, to the discovery of such picture viewing concepts as the idea of artist intentionality.

MoMA continued to use our VTC which is "centered around a methodology that has remained more or less consistent for a decade."[30] MoMA engaged Harvard's Project Zero to assess the VTC curriculum. The Harvard team's conclusions about the impact of the VTC curriculum are nearly identical to the findings of this study. They concluded that our VTC did produce a significant increase in evidentiary reasoning and that the skills appeared to transfer to the interpretation of a science image. It is unfortunate that these findings were not included in Winner's review of arts education studies of transfer.

The Harvard study was begun after we completed the data analysis in this study. It seemed to us to be a remarkable replication study. The report concluded that having found gains in the VTC assessment activity and the transfer activity [which] are

> *... roughly parallel [...] It is possible to view this as evidence of the cross-domain power of the core VTC methodology. It appears to teach an integrated set of skills that cohere naturally in the minds of students.... According to [students] VTC methodology can be used in other areas to help you figure things out, explain things, get information and understand things. [emphasis not added] These comments suggest that students see the VTC questions as addressing thinking and learning challenges that commonly occur in their lives.*[31]

The replication value of this study is all the greater because there was no interaction between the Harvard Project Zero and the VUE research teams; they chose completely different measurement approaches, and they arrived at essentially identical conclusions, which in themselves are unusual.

General transfer. The older experimental group began the VTS in the fourth grade (Fall 1993) and completed the process in the eighth grade (Spring 1998). At the end of 1998, eighth graders in Minnesota were required to take a state test of achievement. Every community in the state is ranked annually, by percentile, on the basis of the scores of its eighth graders. This test was first introduced the previous year, at which time only 54% of Byron 8th graders passed. In the following year, 1998, Byron 8th graders, who had been taking the VTS since 1993, took the test. Seventy-seven percent of the Byron 8th grade students were at or above the state's passing score. (The state score was 68%; the control school was 71%) This gain of 23 points is 2.5 times the state average gain of 9 points, which is also the control school's gain: enough to warrant a congratulatory call from State Commissioner of Education Robert Wedl, and a mention in the editorial column of the *Rochester Post-Bulletin*.. Byron School, along with other schools in the state, had been preparing for the test very seriously. Yet, when asked by reporters what was behind the jump in scores, the principal, teachers and the PTA, added an unexpected dimension. Many administrators, teachers and parents were of the opinion that another factor contributed to Byron's achievement. They believed that the school district's participation in the five year pilot program (of the VTS), contributed to Byron's placement in the top 8% of Minnesota schools. Janis Tanner, Byron School Board member, affirmed that "[t]his year's 8th grade students are the first ones to take the Basic Skills test after having been in our VTS arts program. For the past five years, these students have learned critical thinking skills that they are able to then apply to other areas. I attribute some of our increase in reading skills to this program. I feel there is a direct relationship between our participation in this program and our increase in reading test scores." Karen Roos, Byron Elementary Principal, stated: "The VTS has allowed students to think at a higher level because [in the VTS discussions] we continue to ask the question 'Why?' This was transferred to the test, I think, because the test also asks ... the reasons and rationale 'Why?'" Bruce Johnson, a Byron 4th grade teacher,

also maintained that the VTS classroom discussions contributed to these changes. He, among others, noted that the use of the VTS has produced more descriptive and detailed writing and a more sophisticated vocabulary. The following year, 1998-'99, 82% of the Byron eighth grade students were at or above that years passing score. (The state's score for passing that year was 75%; the control was 74%)). The next year, 1999-'00, 88% of the Byron eighth grade students (our younger experimental group) was at or above that years passing score. (The stage average for that year was 80%; the control was 81%). Year 2000-1 test results are not yet available.

Discussion

The VTS and Critical Thinking. We have seen that there are numerous ways in which the design of the VTS is consistent with the theory and literature on critical thinking. Put another way, the design of the VTS meets a large number of the theoretical requirements for a treatment that is likely to produce a shift in evidentiary reasoning. For these reasons, it is plausible to expect that the VTS might produce such shifts, that merely on the basis of face validity, such a an outcome would not be unlikely.

Thus, consistent reports from teachers that the VTS was producing shifts in the capacity for Supported Observations and Speculation do not appear surprising. Videotapes of the VTS show the frequency with which this kind of behavior is elicited. Teachers report the ease and predictability with which the VTS works with all students, appearing to inevitably elicit this behavior from all participants. Notably, when students are asked to explain what the VTS taught them, most spontaneously refer to the fact that it 'taught them to think' without being prompted. This is all the more unexpected because the program is labeled as an exercise in viewing art.

Transfer. The likelihood that the VTS is teaching critical thinking skills is further underscored by the fact that there is evidence that such skills transfer more frequently for the experimental group. There is evidence that supported observations and speculation transfer along at least two dimensions. First, these behaviors occur significantly more frequently for both experimental groups when the social context is changed. The experimental learners spontaneously show more evidentiary reasoning, even when they move out of a group setting in which the teacher prompts for those behaviors, peers model and provoke similar responses, and group norms or teachers positive feedback, support such behavior. Furthermore, when the content is shifted from art to attempting to understand an artifact, the experimental groups outperform the control group. We take this as evidence of 'content' transfer.

The plausibility that we are observing real transfer is increased by the appearance of sequence effects. Evidence of transfer does not occur immediately, but after a time lag in the experimental group. Furthermore, evidence of the two kinds of transfer is itself offset in time. In our study, evidence of 'social context transfer' appears first, with strong evidence of 'content transfer' occurring two years later.

Finally, the data reported here appear to corroborate another set of predictions that evidentiary reasoning should flourish more easily at higher levels of cognitive development. Content transfer measures appear to show a complex relationship to developmental level and do so much more strongly for the experimental group.

In short, all the hypotheses we had in this study were confirmed by statistically significant differences. It seems that it is possible to develop critical thinking strategies (as defined here), and that such strategies do appear to transfer, at least to some extent, across social context and content area.

Correlational or Causal Association. The results from our study appear to be more than merely findings of correlation; they appear to indicate a pattern of causality. Winner and Hetland's review of the research on academic outcomes of art education found that most studies could establish only correlational patterns, and could not prove causality. That is to say, they found that art programs had not caused shifts in other areas. We believe that we have met the criteria of the above authors, and others, for making the proper observations required to establish causality. These include experimental design, controlled observations, longitudinal observation, random assignment, and a control program. In addition, causality is indicated in our study in a number of other ways.

Identification of more than one kind of transfer. We have attempted to show that there was more than one kind of transfer. We developed two ways to measure two kinds of transfer. They

must be distinct types of transfer because the same subjects in the experimental group in the early years showed a significant increase in one type but not the other. However, the significant increase in both types appearing in the experimental group at towards the end of study, provides strong evidence that the VTS was the joint cause of the former.

Sequencing effects. Correlational association is typically hard to distinguish from causal association when one has an observation in only one point in time. But with longitudinal observation, it becomes possible to establish what precedes what, typically a necessary condition to argue causality. Causality is easiest to establish in situations in which during an early time period there is a treatment but no immediate outcome, followed by a subsequent period in which the outcome becomes visible. We not only had such an option, but found such a pattern. We followed subjects throughout ten, six-month observation periods, repeating measures at each point. This allowed us to identify distinct periods, based upon when different types of outcomes became detectable. Given the fact that these measures were of a completely unstructured type, and thus capable of capturing the most subtle shift in thinking behavior when it occurred, we were in a good position to observe the 'chain reaction of change.' Put another way, by establishing the timing of the appearance of changes, there is a very strong basis for inferring causality. The fact that there are plausible lags between treatment, and the onset of outcome effects such as 'context transfer' and 'content transfer' respectively, further reinforces the likelihood of causality.

Evidence of the process of transfer. It is more likely that the data are evidence of a causal process if they also contain compelling signs of how that causal process may actually operate. Below, we will argue that the data here give a strong basis for understanding some aspects of the process by which the VTS has its impact.

Fitting a predicted set of patterns. Assertions that findings are correlational in nature and not causal, directly imply that there is a whole different way to explain the relation of observations in our study. Often this entails arguing for a reverse pattern of causality: 'a' does not cause 'b,' rather 'b' causes 'a.' Or, alternatively, both 'a' and 'b' have a joint hidden cause.

In our case, we entered the study with a variety of inter-related hypotheses. The fact that virtually all of them were confirmed with statistically significant data suggests that there is theoretical coherence in our arguments. The tenet underlying all of them is that the VTS caused the growth of evidentiary reasoning and enabled its transfer to other contexts and content. If the findings here are merely correlational in nature, what is the corresponding plausible argument that the casual patterns here are either reversed, or that the patterns belie some other hidden joint cause?

The process of transfer. What do our findings tell us about the process of transfer? How did the VTS produce these transfer effects? The evidence we have reviewed points to a complex pattern of causality.

Two paths of causality. The VTS appears to produce its impact on 'content transfer' along two causal pathways. These are depicted in Figure 12 below. First effects might be termed the "Performance Effect." The VTS appears to increase the frequency of supported observations and speculations in the experimental group by providing an environment which supports the performance of evidentiary reasoning. It gives both practice and support for the exercise of critical thinking strategies.

But there is a second causal pathway as well, one that might be called a "Developmental Effect." We have seen that the VTS causes learners in the experimental group to move to higher Stages in a more accelerated way. Furthermore, the VTS process does not seem to have the same outcome for all learners. There appears to be a developmental threshold, at Aesthetic Stage II. Those at this level or higher seem to display the critical thinking strategies more frequently. Thus, the VTS appears to have its impact by both, raising Aesthetic Stage in the experimental group, and by making those at any Stage, but especially at higher Stages more amenable to evidentiary thinking.

Figure 12. How Transfer Works

Age Effects. Stage, critical thinking and content transfer all seem to increase if the VTS is started earlier, beginning in second grade as opposed to fourth. There are several apparent effects of beginning the program earlier. First, Stage level increases at a faster rate, putting more learners at or above the Stage II threshold where it appears that critical strategies flourish with more regularity. But the earlier learning strategies of evidentiary reasoning also appear to be associated with their more frequent use in content transfer. When compared to the older experimental group at or above Stage II with equivalent years of exposure to the VTS program, the younger experimental group shows significantly higher mean 'content transfer' scores on the MOI ($p<.0507$ See Figure 9). This is true even though the older group was two grades (eighth grade vs. sixth grade) ahead at the time of this comparison, and should have been exposed to subjects and course demands that were more likely to call for critical thinking strategies.

It is important to note that there are alternative possible explanations for this finding. The first two are simple explanations related to time and exposure: the fourth grade curriculum was more refined by the time the second graders became fourth graders. Secondly, the fourth grade Byron teachers were more experienced teachers of the VTS by the time they taught it to the former second graders. While the first observation is certainly a given, the second one is less clear cut. Granted, the fourth grade teachers were more experienced VTS teachers, having taught the VTS for two years. However, at Study Year III (the year the experimental second graders entered the fourth grade class), the fourth grade teachers were actually teaching the fourth grade curriculum for the first time. This is because, during Study Years I and II, they were teaching a transition curricula to their then-fourth graders.

There are other related possibilities. One is that beginning the program earlier insured that evidentiary reasoning became an accepted norm earlier, increasing the likelihood of more frequent use. A parallel possibility is that the impact of the VTS on children's self-conception is greater at younger ages. It is noted by all observers of the VTS that the curriculum fosters the participation of all students, even the least able and most reticent. Their meaningful contributions to the discussion often shock teachers, who rapidly change their estimation of the child's capacity. Many students remark that the VTS process makes them feel smarter, that they have something meaningful to say to which others will listen. These patterns often increase all learners' propensity to use evidentiary strategies when confronted with the need to make sense of something unfamiliar. These arguments essentially imply that when the social setting expects evidentiary reasoning as the norm, and when the children feel a propensity to use these strategies because they are confident of their capacity to use them effectively, children transfer the strategies more rapidly, using them in multiple settings. This possibility is supported by another finding: at the end of Study Year II, the younger experimental group showed a higher level of 'context transfer' (on the ADI) than did their older counterpart. Essentially, they were using the strategies more frequently in another social setting than the older experimental group. This was true even though the older group at that point had a higher distribution of Stages, with a higher percentage at or above Stage II. (see Figure 1.)

The power of art. We seem to have arrived at a paradox. Our evidence suggests that critical thinking and its transfer are best developed as early as possible. Yet the literature stresses that in order to reason about a domain of content one has to be old enough to amass an understanding of that domain. Since critical reasoning cannot be developed in a vacuum, and needs a subject to act upon as an object of thought, how can it be developed at really young ages, especially if children have only begun to master reading skills? Must the development of critical thinking be delayed until middle school years and beyond, when students have mastered enough of an understanding of various subjects and their related facts to begin to reason about them with accuracy and power? If so, does this mean that slower learners, who do not see themselves as powerful thinkers, will change their self-concepts in middle school? Will the onset of adolescence, with all its distractions mean that only a small percentage of learners in adolescence will feel motivated to think critically? Certainly it seems desirable to start using evidentiary reasoning as early as possible, but how can this be done, practically speaking?

Our data shows that fourth graders can outperform sixth graders. But we have not reflected on why this is apparently true. What was it that made it possible for children in the second grade, in a rural community, just learning to read, to begin to exercise their evidentiary reasoning?

The answer is that we were using art as the object of attention. It is so natural to take this for granted, that it is easy to overlook all the subtle, yet significant ways that art can act as an ideal medium for the development of critical capacities when framed with the right kind of process. One observation that we

have heard repeatedly from several VTS project sites in the U.S. and abroad helps to make the puzzle of art more obvious: that children as young as the second grade can discuss a single work of art for as long as one hour without the teacher forcing them to do so. While it is not the intention of the VTS process for the discussion of a single work of art proceed for such a length of time, one must still ask a simple question: How is this possible? How is it possible for second graders to fill an hour with their observations about a single work of art?

The answer, in part, lies in the nature of art itself. Good, well-selected art, has several remarkable attributes that allow children to immediately exercise their thoughts. (VUE's selection and sequencing of images for the VTS is the result of a rigorous methodology that is subject to constant updating.)

- *Art is accessible.* Children can 'read' a picture a long time before they can read print. Art can speak to all viewers, allowing them to enter its space easily.
- *Art is ambiguous.* Art has more than one right interpretation. Art is crafted to support many ways of making sense of it. Its crafting contains carefully shaped clues. Its ambiguity invites speculation. There is something in a work for many kinds of viewers.
- *Art is compelling.* Art can captivate attention. Well-selected art can sweep up the viewer in narratives laced with intrinsically meaningful content. Grasping that there is more than one way to look at work can engage the viewer in the hunt for new clues. Seeing the work's meaning change as interpretations grow can rivet attention.
- *Art viewing unfolds.* The more one looks the more one sees. The interpretative possibilities in art keep unfolding, literally 'before one's eyes'.
- *Art touches timeless issues.* Art can take the viewer as deep as the viewer has a capacity to go. There are timeless issues that touch all humans' lives in any work. Even children can find a way to their issues in a work.

But probably most important from the point of view of eliciting critical thought, a well chosen work of art can be a self-contained world. It has all the information one needs to begin to interpret it. It does not take years of background preparation for the first encounters. It is simply there in front of the viewer. And its presence is a challenge of meaning making. The viewer is enticed into making sense of what he sees, turning small pieces of evidence into new observations, collecting observations to generate speculation, abandoning one way of looking at things and picking up a whole new way of making sense of the information given.

Each new work is a new episode, an invitation to begin the spiral of meaning making all over again from the very beginning. The viewer learns to recognize the feeling of starting from scratch, being initially puzzled, being unsure of how to proceed, perhaps, feeling that, this time, those immediate connections are not surfacing. But with each new moment of noticing, the work begins to invite the viewer into its world. With each step, connections are made, the learner grasps more and is drawn another step forward in understanding. Thus, exposed to new works, the viewer repeatedly experiences that moment when something he was about to turn away from, (believing 'there is nothing here' or this is 'too hard for me,') becomes something he is curious about and has the capacity to see and to understand.

Novice viewers, given the support of the VTS process, can meet this challenge. The VTS is now routinely begun in kindergarten. Given the support of the VTS process, groups of beginner viewers, some starting at very young ages, can decode much of the meaning of a work, as docents and curators in our museum programs have often noticed. (Several museums have good demonstrations of this on videotape, including the Detroit Institute of Art; The Museum of Fine Arts, Boston; and the Philadelphia Museum of Art.)

It should be noted that art, by itself, does not always achieve these ends. Art appreciation programs have a very mixed history of success. So another critical and necessary component in our findings is the VTS process itself. As noted before, this process looks deceptively simple. But it is based on the analysis of thousands of samples of naïve viewer's reasoning and on painstaking field research and experimentation for 10 years in eight countries. The VTS helps learners access the power of art by focusing attention and actions at a level that is accessible *and* provocative to the learner.

In this process the teacher is also empowered by following a few simple principles. With the VTS, any teacher can become effective in leading discussions about art, even though the teacher may also be a beginner viewer. The VTS also helps a teacher include the practice of critical thinking strategies in her lessons in a way that is nearly subliminal to students and requires no special preparation on her part.

Finally, the VTS is remarkably compact, requiring about ten hours of classroom time per year. (This was the level of exposure in this study producing the effects reported here.)

Much has been made of the methodology, in the sense of proving causality of transfer, by using proper experimental method. But this methodological emphasis misses two major areas of method that are even more fundamental than experimental design. The first is the methodology of measurement itself. This study has shown the value of using a completely open method of sampling thought as it occurs. Without this stream-of-consciousness method, sensitive enough to capture the phenomenon being studied, and the 'thought unit' methodology that coded each thought, it well might have proven impossible to test the transfer hypothesis, despite a perfect experimental design.

The second area of methodology is addressed even less seldom. This is the methodology of designing a curriculum from a developmental point of view. The results reported here would have been impossible to produce if the treatment, in this case the VTS, was not exceedingly well-crafted and potent. It is easy to assume that all programs are equally well designed and likely to produce results. I do not believe this to be the case. While it is not the purpose of this study to go into the design, or design methodology of the VTS, I would be remiss not to point out that this vital area of method is often overlooked in methodological discussions and I believe that it far outweighs the relatively more simple and better established issues of experimental design.

Conclusion

Dialogues about art can easily become exaggerated. One school firmly supports "art for art's sake," – avoiding any deference to art's practical uses; another promulgates the long-standing American suspicion that art has no use; a third values art only when its uses are made plain.

Our past tells us that no single claim is correct: all hold truths together, the arts are not isolated and never have been. The potters' jugs we carried our water in are now housed in a museum in the Ancient Greek gallery; the music guiding the steps of those who marched in triumphal processions echo in our symphony halls; the dances that ritualized a new cycle of life are the movements we recognize in performance halls. The arts will always be a part of our daily rites. We might even ask if there is really a way to define where art begins and the rest of life ends.

Art tells us who we are; it helps us understand what it is to be human. Believing that art is integral to our lives, my primary interest is in supporting the naïve viewer in her early interactions with art. I began by identifying those elements that the naïve viewer brought in these interactions. This, in turn, led to the development of a model of aesthetic understanding. I planned to stop there, mining and refining my understanding of the beginner viewing process. However, as noted above, reports of the development and transfer of critical thinking strategies appeared in our projects too often to be ignored. My colleagues and I took on the challenge of documenting and trying to understand the transfer that teachers were witnessing in VTS classes.

Our Byron study convinced us that reasoning about art may be one of the best ways to pursue one of education's most elusive goals: the development of critical thinking. In fact, while art should not have to be justified by improvement in other subjects, certainly, we should not feel compelled to disregard any of the ways art can impact our lives.

In a world that increasingly prepares students to pass standardized tests, there is little time left in the classroom to go beyond what schools currently see as the ' basics.' But, there are strong arguments for art to remain a part of the educational landscape. If an art program can serve a dual role, developing the capacity to respond to art, while supporting a critical educational goal, then that is fortuitous for the art program as well as for the students.

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Appendix A

Abigail Housen's Stages of Aesthetic Development

Stage I
Accountive viewers are storytellers. Using their senses, memories, and personal associations, they make concrete observations about a work of art that are woven into a narrative. Here, judgments are based on what is known and what is liked. Emotions color their comments, as viewers seem to enter the work of art and become part of its unfolding narrative.

Stage II
Constructive viewers set about actively building a framework for looking at works of art, using the most logical and accessible tools: their own perceptions, their knowledge of the natural world, and the values of their social, moral and conventional world. If the work does not look the way it is "supposed to"—if craft, skill, technique, hard work, utility, and function are not evident, or if the subject seems inappropriate—then these viewers judge the work to be "weird," lacking, or of no value. Their sense of what is realistic is the standard often applied to determine value. As emotions begin to go underground, these viewers begin to distance themselves from the work of art.

Stage III
Classifying viewers adopt the analytical and critical stance of the art historian. They want to identify the work as to place, school, style, time and provenance. They decode the work using their library of facts and figures, which they are ready and eager to expand. This viewer believes that properly categorized, the work of art's meaning and message can be explained and rationalized.

Stage IV
Interpretive viewers seek a personal encounter with a work of art. Exploring the work, letting its meaning slowly unfold, they appreciate subtleties of line and shape and color. Now, critical skills are put in the service of feelings and intuitions as these viewers let underlying meanings of the work—what it symbolizes—emerge. Each new encounter with a work of art presents a chance for new comparisons, insights, and experiences. Knowing that the work of art's identity and value are subject to reinterpretation, these viewers see their own processes subject to chance and change.

Stage V
Re-creative viewers, having a long history of viewing and reflecting about works of art, now "willingly suspend disbelief." A familiar painting is like an old friend who is known intimately, yet full of surprise, deserving attention on a daily level but also existing on an elevated plane. As in all important friendships, time is a key ingredient, allowing Stage V viewers to know the ecology of a work—its time, its history, its questions, its travels, its intricacies. Drawing on their own history with one work in particular, and with viewing in general, these viewers combine personal contemplation with views that broadly encompass universal concerns. Here, memory infuses the landscape of the painting, intricately combining the personal and the universal.

In addition to the above five Stages, transitional Stages occur when patterns of thinking from two Stages co-exist. For example, in Stage I/II idiosyncratic Stage I behaviors occur simultaneously with more object-centered Stage II behaviors.

Significant to understanding Aesthetic Development is that, while growth is related to age, it is not determined by it. In other words, a person of any age with no experience with art will necessarily be in Stage I. An adult will not be at a higher Stage than a child simply by virtue of age or education. Exposure to art over time is the only way to develop, and without time and exposure—Aesthetic Development does not occur.

Over the course of these studies, I have found that most interviewees are beginner viewers, ranging from Stages I to II or II/III (transition Stage between Stages II and III). Even among frequent museum-goers, there are relatively few people who have had sufficient interaction with art to have developed beyond the understandings of Stage II/III.

Tables and Figures

Table 2.
Hypotheses and related Measures

Hypothesis	Observation/ Comparison	Measure	Observation Period
1. VTS elicits Critical Thinking	• Younger Experimental • Older Experimental • All Byron students	• VTS Videos • Teacher reports • Student self reports	Study Years 1 to 5
2. Critical Thinking transfer across social context (Transfer I)	• Younger Experimental vs. Younger Control • Older Experimental v. Older Controls	• ADI (coded for Critical Thinking on all thought units)	Study Years 1 to 5 (Spring and Fall each year)
3. Critical Thinking transfer across content (Transfer II)	• Younger Experimental vs. Younger Control • Older Experimental v. Older Controls	MOI (coded for Critical Thinking)	Study Years 1 to 5 (Spring and Fall each year)
4. Transfer shows sequence effects	• Younger Experimental vs. Younger Control • Older Experimental v. Older Controls	ADI and MOI (coded for Critical Thinking)	Study Years 1 to 5 (Spring and Fall each year)
5. Transfer shows developmental effects	• Younger Experimental vs. Younger Control • Older Experimental v. Older Controls	ADI (coded for Stage) MOI (Coded for Critical Thinking) Critical Thinking by Stage	Study Year 5
6. VTS causes increase in aesthetic stage	• Younger Experimental vs. Younger Control • Older Experimental v. Older Controls • VTS vs. DBAE	• ADI (coded for Stage on sampled thought units)	Study Years 1 to 5 (Spring and Fall each year)

Table 3.
Comparison of Initial Measures by Group
(Study Year I, Fall)

Measure	Younger Experimental	Younger Control	p value	Older Experimental	Older Control	p value
Critical Thinking Score (ADI)	.304	.190	p <.57 (n.s.)	.500	1.208	p <.40 (n.s.)
Critical Thinking Score (MOI)	.083	.083	p <.99 (n.s.)	.056	.458	p <.28 (n.s.)
Aesthetic Stage	1.208	1.250	p <.74 (n.s.)	1.409	1.833	p<.03

Table 4a.
Various Indices of Critical Thinking Shown during VTS Classes
(Coded from Videotape Samples)
Study Year V

Site	San Antonio, Texas, Gr. 4	Urbana,Ill. Gr. 5	Bryon, MN. Gr. 6	Bryon,MN Gr. 6
Lesson and VTS Year	Lesson 1 VTS Yr II	Lesson 1 VTS Yr I	Early lesson VTS III	Early Lesson VTS Yr III
Number of student responses given	120	95	89	129
Percent Critical Thinking Comments	60%	75%	34%	46%

Table 5.
Timing of Differences in Transfer by Group
Sequence of Transfer (Context and Content)
(Study Years I to V, Spring)

		Year I		Year II		Year III		Year IV		Year V	
Young		Score	p<	Score	p<	Score	p<	Score	p<	Score	p<
Context	*Experimental*	0.783	**.011***	1.545	**.020***	2.100	**.0006*****	2.091	.24	7.480	**.002*****
	Control	0.000		0.190		0.217		1.682		2.050	
Content	*Experimental*	0.000	.856	0.403	.107	0.450	*.08~*	0.762	.880	1.350	**.024***
	Control	0.050		0.190		0.174		1.455		0.619	
Older											
Context	*Experimental*	1.590	.378	1.304	*.087~*	1.864	**.018***	2.818	**.026***	4.435	**.004*****
	Control	1.230		0.750		0.682		1.621		2.091	
Content	*Experimental*	0.261	.284	0.273	.341	0.600	.620	1.227	.173	1.419	**.047***
	Control	0.095		0.208		0.682		0.828		0.251	

Table 5.
Timing of Differences in Transfer by Group
Sequence of Transfer (Context and Content)
(Study Years I to V, Spring)
Associated Graph: Younger Students

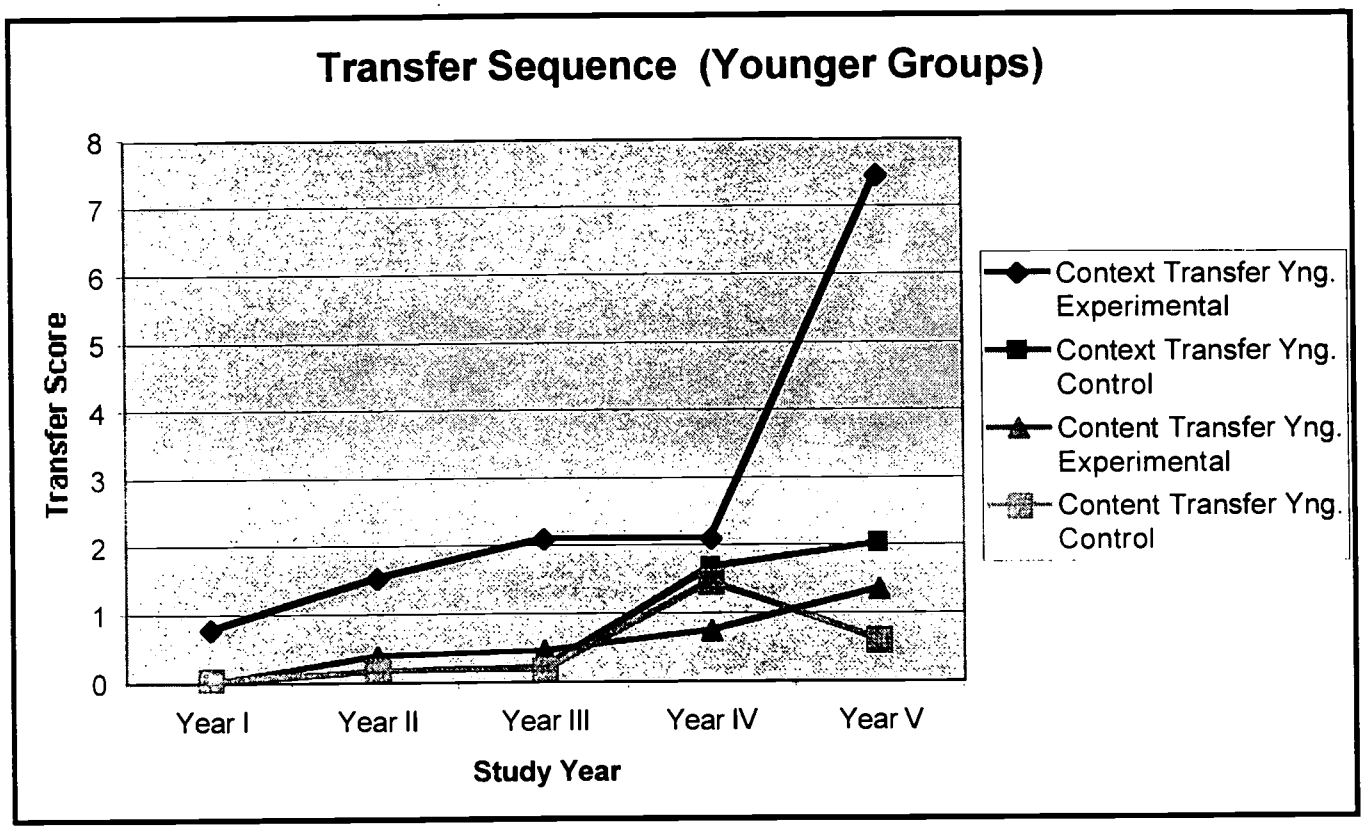


Table 5.
Timing of Differences in Transfer by Group
Sequence of Transfer (Context and Content)
(Study Years I to V, Spring)
Associated Graph: Older Students

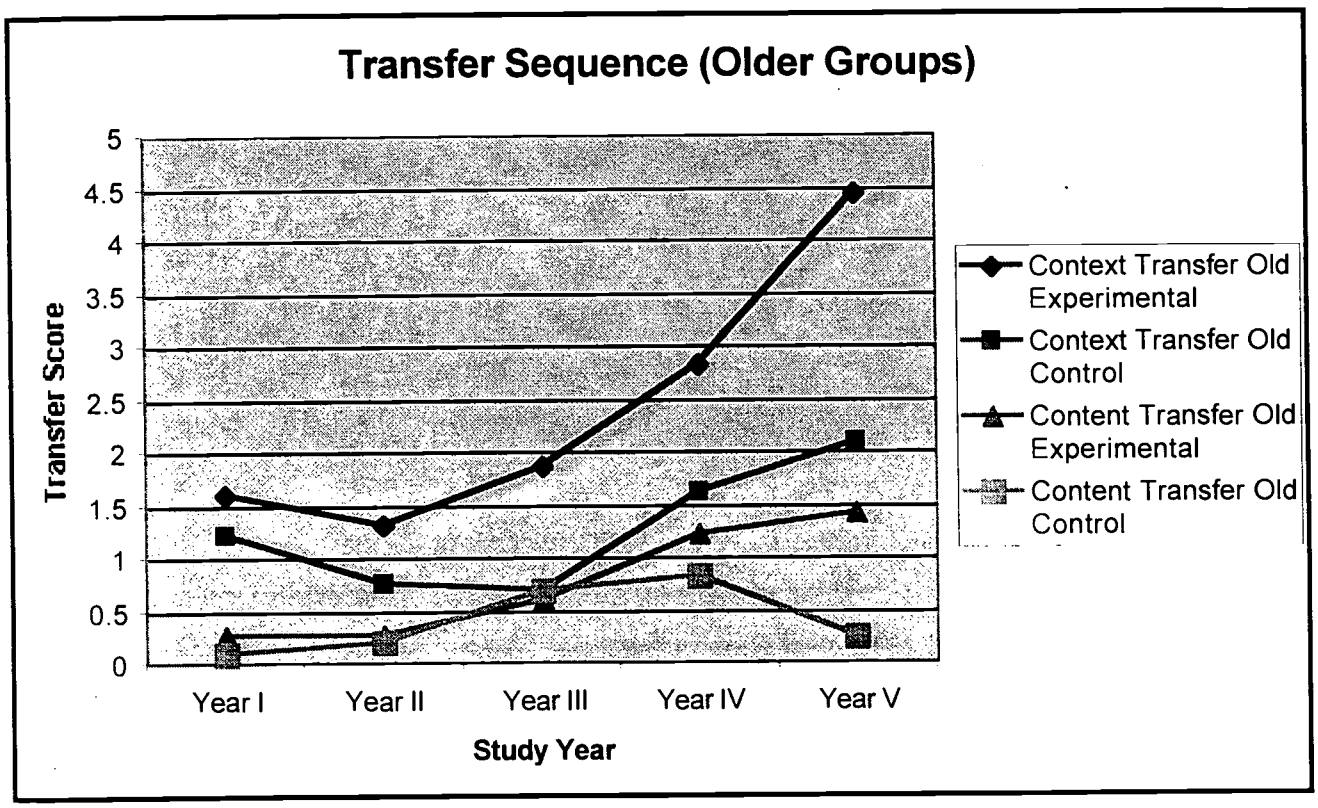
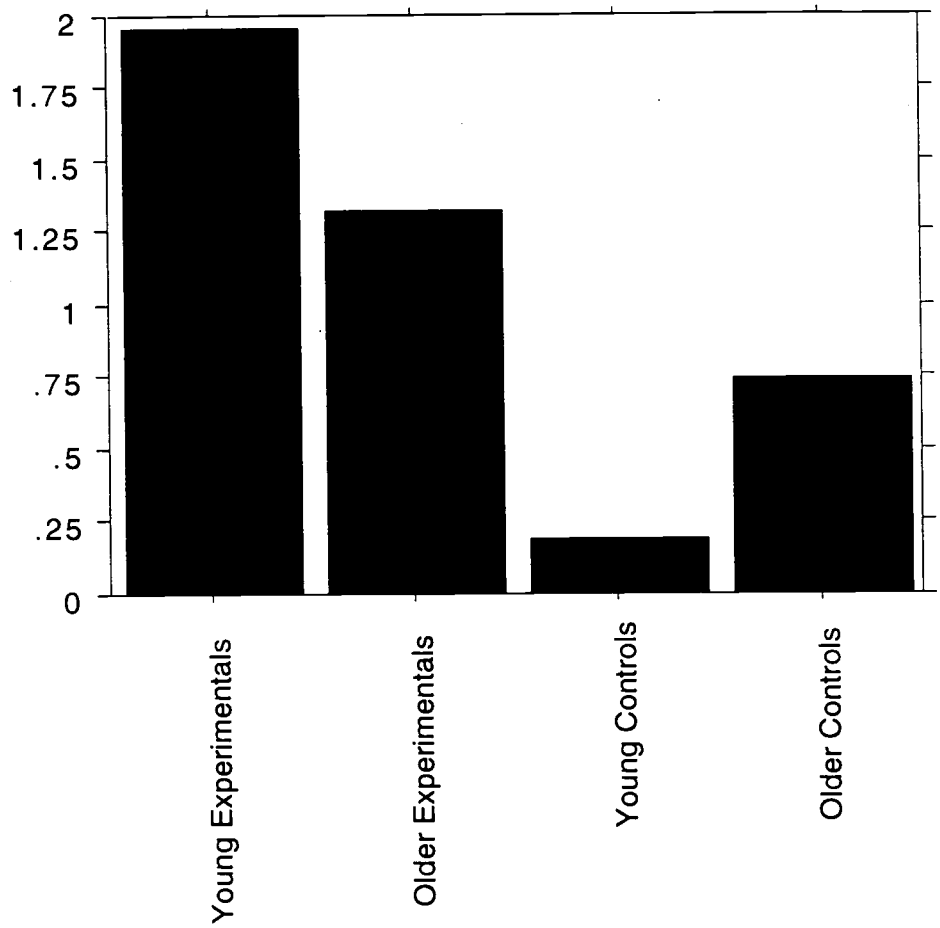
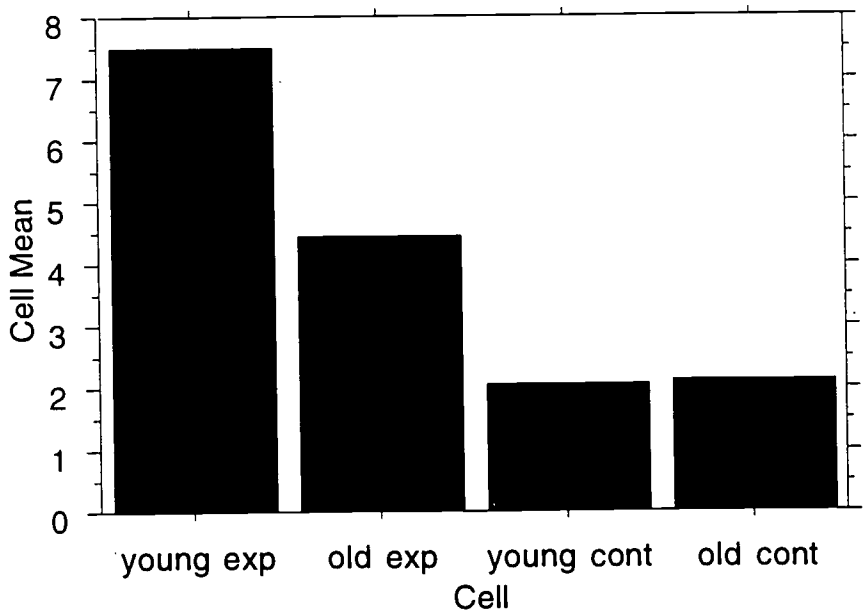


Figure 1.
Critical Thinking Score (ADI) by Group
(Study Year II, Spring)



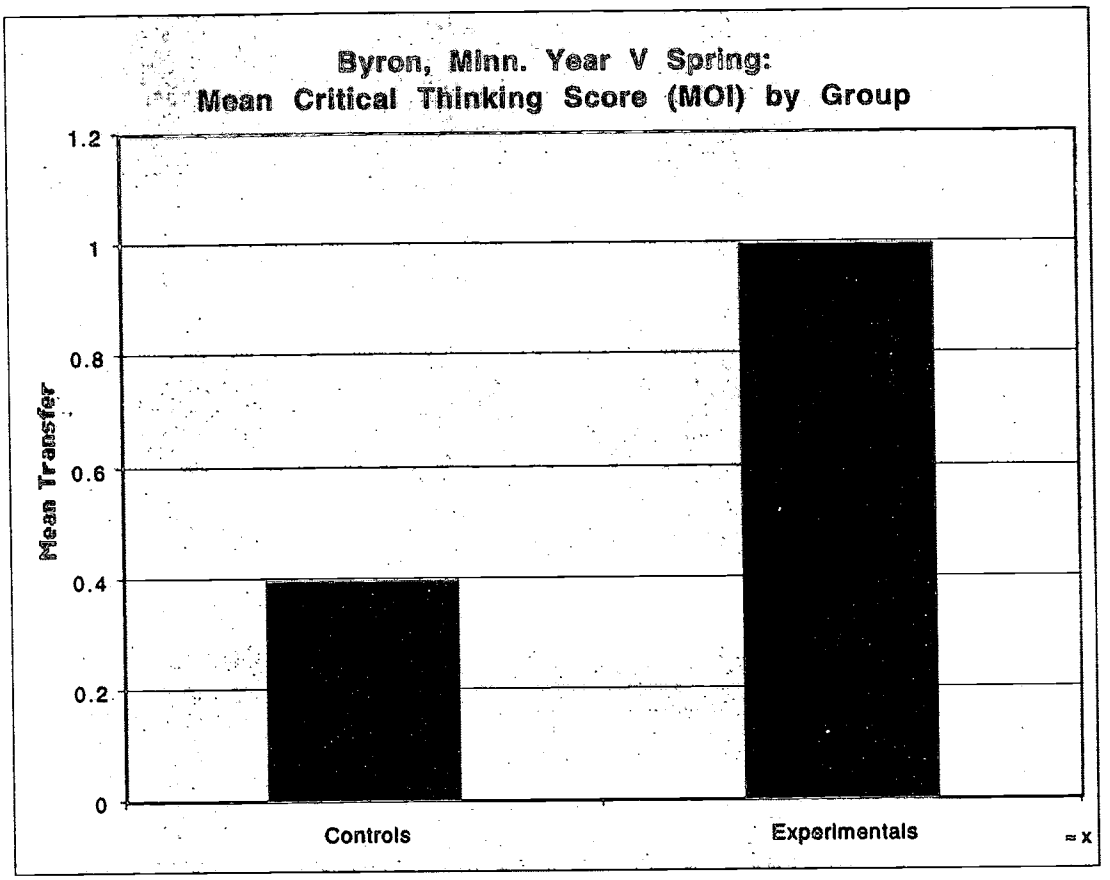
	DF	Sum of Squares	Mean Square	F-Value	P-Value	Lambda	Power
age/grp	3	37.160	12.387	3.175	.0282	9.524	.716
Residual	86	335.562	3.902				

Figure 2.
Critical Thinking Score (ADI) by Group
(Study Year V, Spring)



	DF	Sum of Squares	Mean Square	F-Value	P-Value	Lambda	Power
age/grp	3	422.489	140.830	6.712	.0004	20.136	.978
Residual	83	1741.465	20.982				

Figure 3.
Mean Critical Thinking Score (MOI) by Group
(Study Year V, Spring)



	DF	Sum of Squares	Mean Square	F-Value	P-Value	Lambda	Power
exp/cont	1	7.267	7.267	6.409	.0132	6.409	.710
Residual	84	95.256	1.134				

Figure 4.
Critical Thinking Scores (MOI) by Group
(Study Year V, Spring)

Figure 4.
Critical Thinking Scores (MOI) by Group
(Study Year V, Spring)
Associated Statistics

Unpaired t-test for # moi sup& specV
Grouping Variable: Older
Hypothesized Difference <= 0

	Mean Diff.	DF	t-Value	P-Value
Older Experimentals, Older Controls	.470	43	1.712	.0470

Group Info for # moi sup& specV
Grouping Variable: Older

	Count	Mean	Variance	Std. Dev.	Std. Err
Older Experimentals	23	.652	1.419	1.191	.248
Older Controls	22	.182	.251	.501	.107

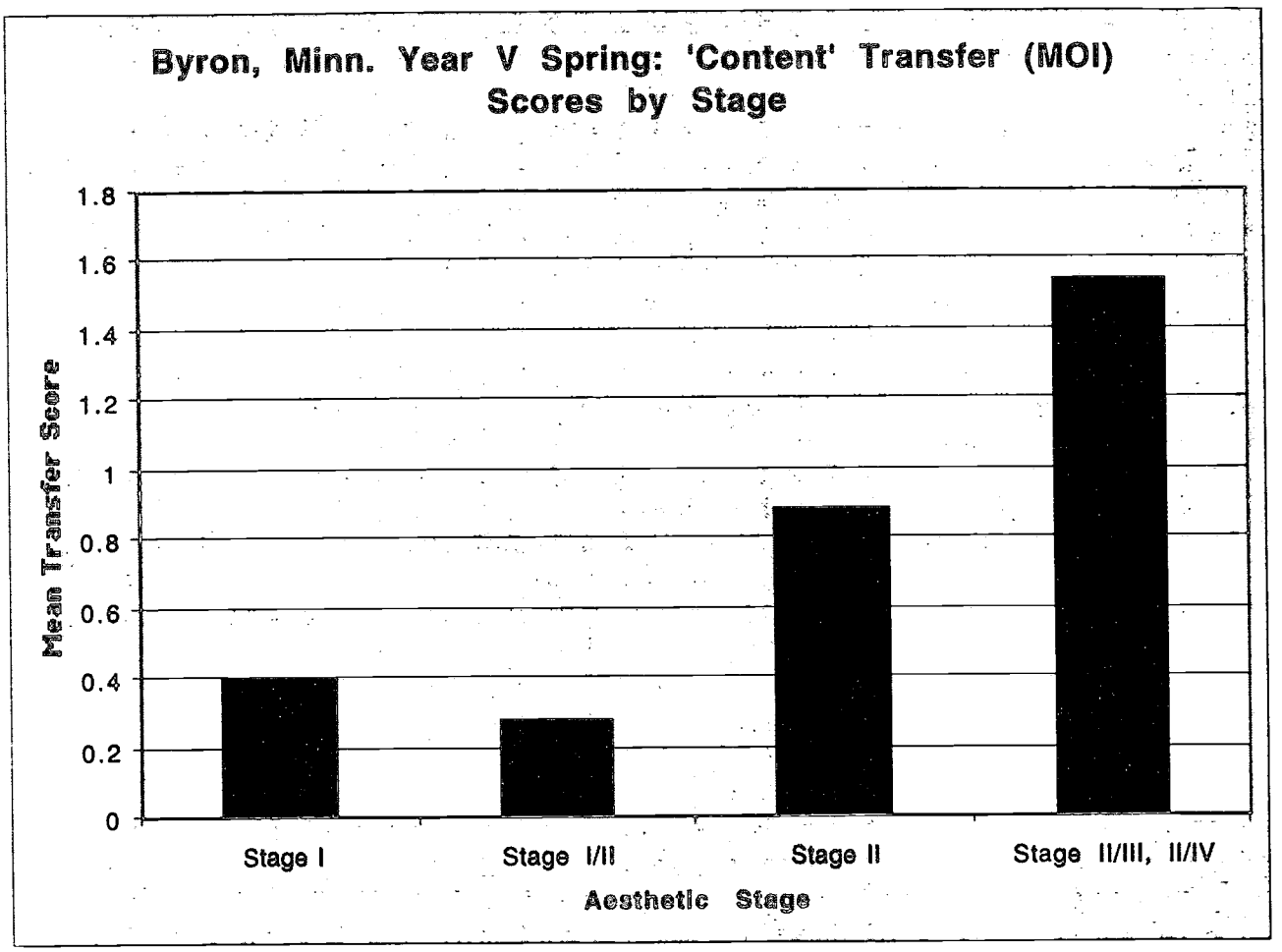
Unpaired t-test for # moi sup& specV
Grouping Variable: Younger
Hypothesized Difference <= 0

	Mean Diff.	DF	t-Value	P-Value
Young Experimentals, Young Controls	.731	39	2.036	.0243

Group Info for # moi sup& specV
Grouping Variable: Younger

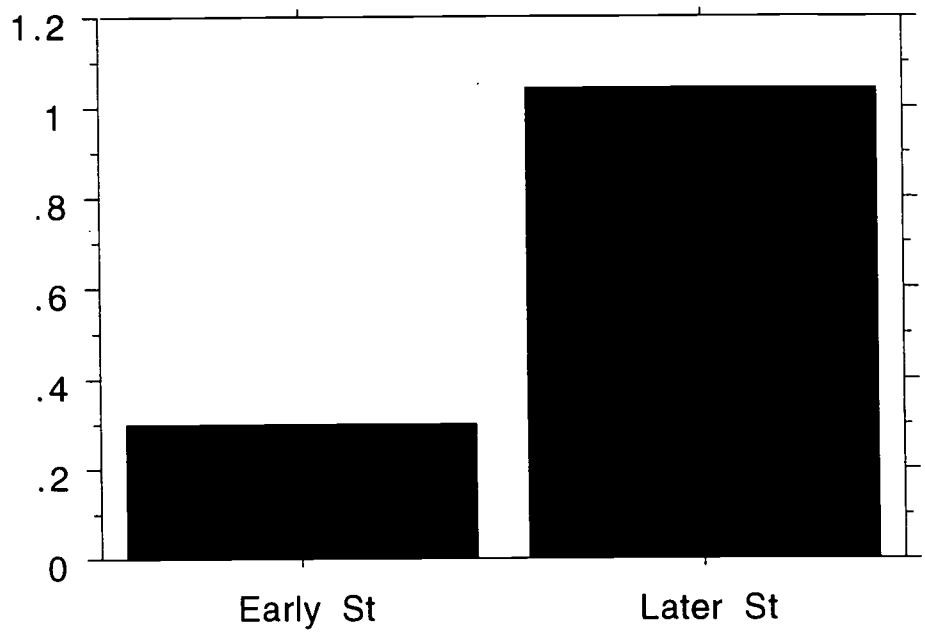
	Count	Mean	Variance	Std. Dev.	Std. Err
Young Experimentals	20	1.350	1.924	1.387	.310
Young Controls	21	.619	.748	.865	.189

Figure 5.
'Content Transfer' Scores (MOI) by Stage
(Study Year V, Spring)



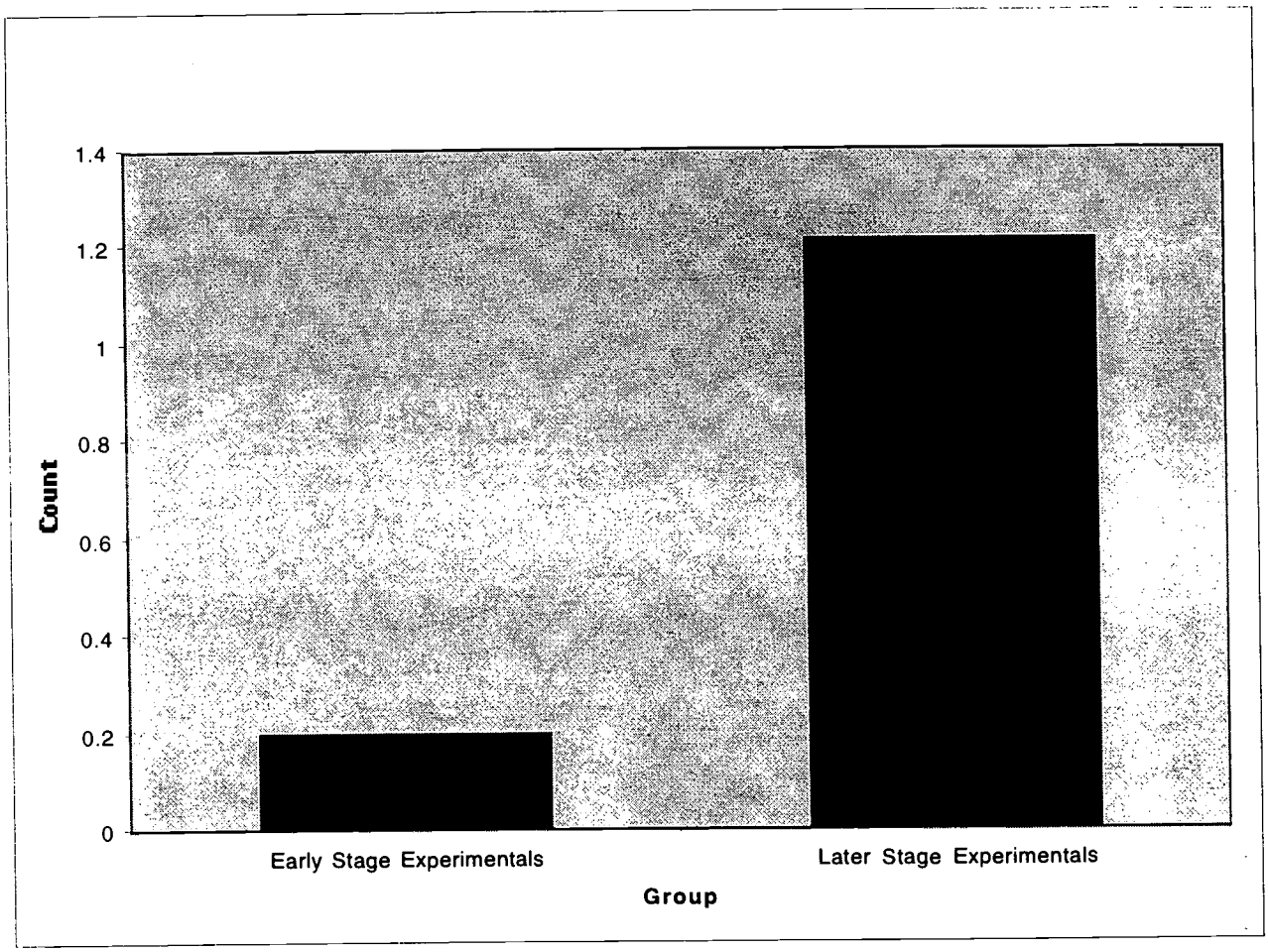
	DF	Sum of Squares	Mean Square	F-Value	P-Value	Lambda	Power
podst cl 98	3	15.844	5.281	4.996	.0031	14.989	.913
Residual	82	86.679	1.057				

Figure 6.
Mean MOI Score by Stage Grouping (Early and Later)
(Study Year V, Spring)



	DF	Sum of Squares	Mean Square	F-Value	P-Value	Lambda	Power
Hi/Lo Stage	1	11.736	11.736	10.786	.0015	10.786	.920
Residual	83	90.311	1.088				

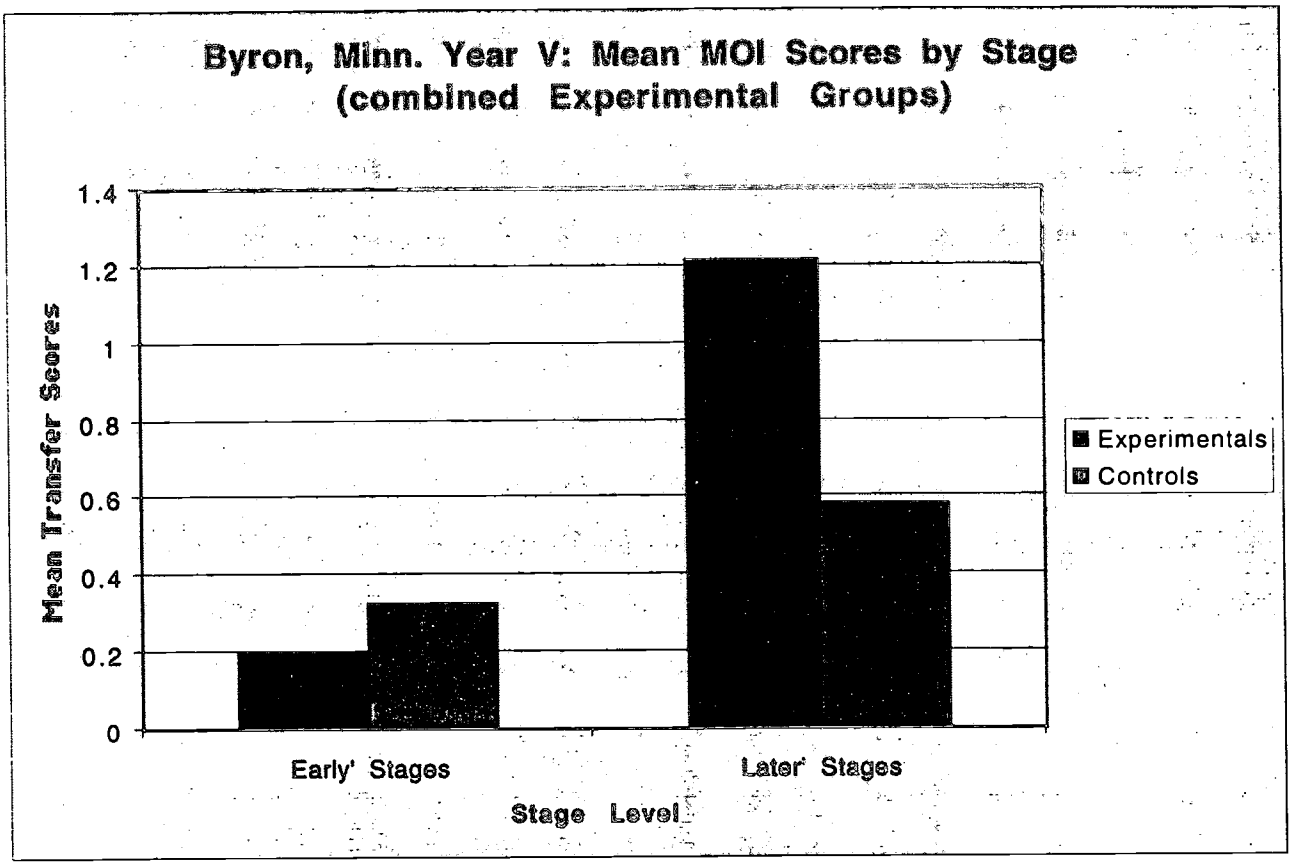
Figure 7.
Mean Critical Thinking Scores (MOI) by Stage (combined Experimental Groups)
(Study Year V, Spring)



ANOVA Table for #moi expsup&specV

	DF	Sum of Squares	Mean Square	F-Value	P-Value	Lambda	Power
V post exp grp hi/lo	1	7.862	7.862	4.950	.0317	4.950	.577
Residual	41	65.115	1.588				

Figure 8.
Mean Critical Thinking Score (MOI) by Stage and Group
(Study Year V, Spring)



	DF	Sum of Squares	Mean Square	F-Value	P-Value	Lambda	Power
yr V postmoi Exp/Cont early /later s	3	15.349	5.116	4.780	.0041	14.340	.898
Residual	81	86.698	1.070				

Figure 9.
Mean Critical thinking Score (MOI) by Age and Stage (Experimental Groups)
(Study Year V, Spring)

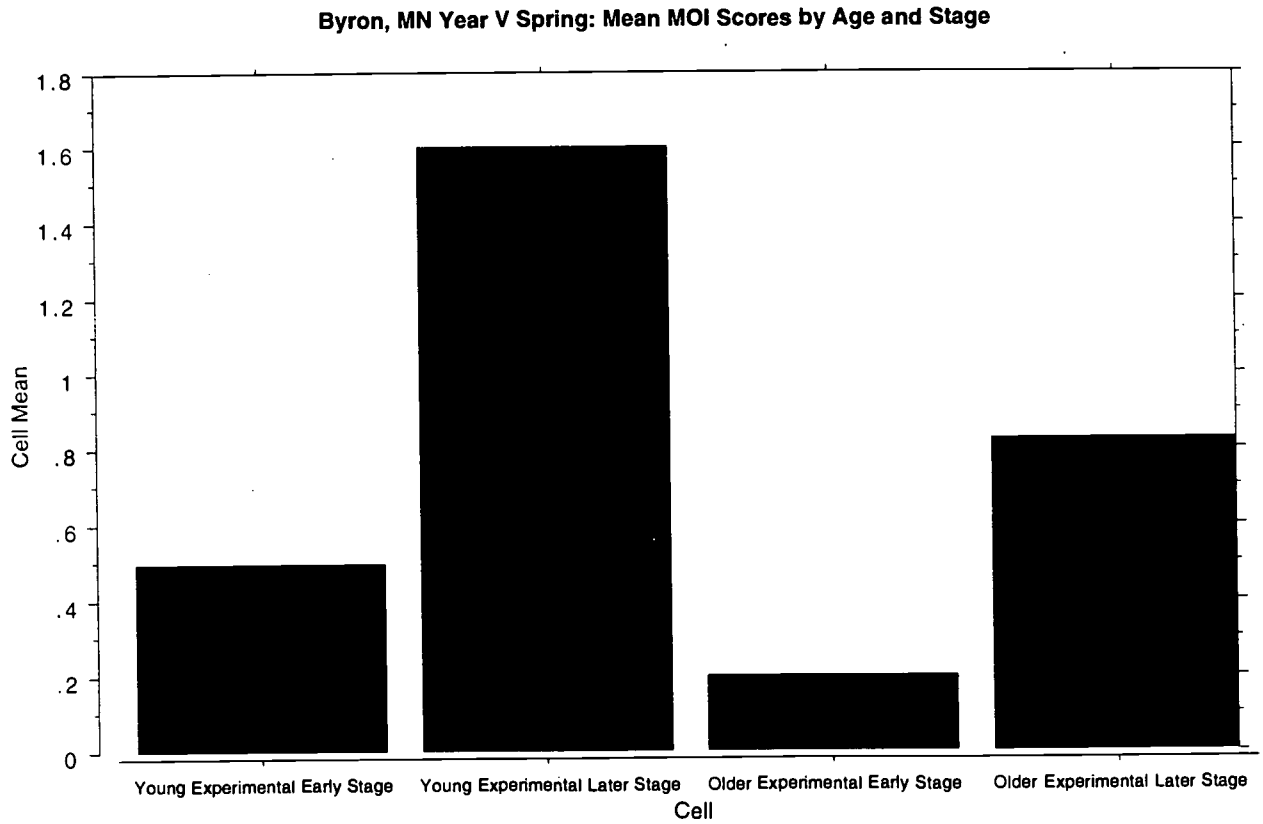


Figure 9a

Unpaired t-Test X_1: yearV yng/old exp hi/lo stage Y_1: #moi expsup&...

DF:	Unpaired t Value:	Prob. (1-tail):
30	1.575	.0628

Group:	Count:	Mean:	Std. Dev.:	Std. Error:
Young Experim...	15	1.6	1.454	.375
Older Experime..	17	.824	1.334	.324

Figure 9b

Unpaired t-Test X_1: yearV yng/old exp hi/lo stage Y_1: #moi expsup&...

DF:	Unpaired t Value:	Prob. (1-tail):
19	-1.725	.0504

Group:	Count:	Mean:	Std. Dev.:	Std. Error:
Young Experim...	6	.5	.837	.342
Young Experim...	15	1.6	1.454	.375

Figure 9c

Unpaired t-Test X_1: yearV yng/old exp hi/lo stage Y_1: #moi expsup&...

DF:	Unpaired t Value:	Prob. (1-tail):
20	-1.013	.1615

Group:	Count:	Mean:	Std. Dev.:	Std. Error:
Older Experime..	5	.2	.447	.2
Older Experime..	17	.824	1.334	.324

Figure 10.
Mean Aesthetic Stage by Group and Grade
(Study Years I- V)

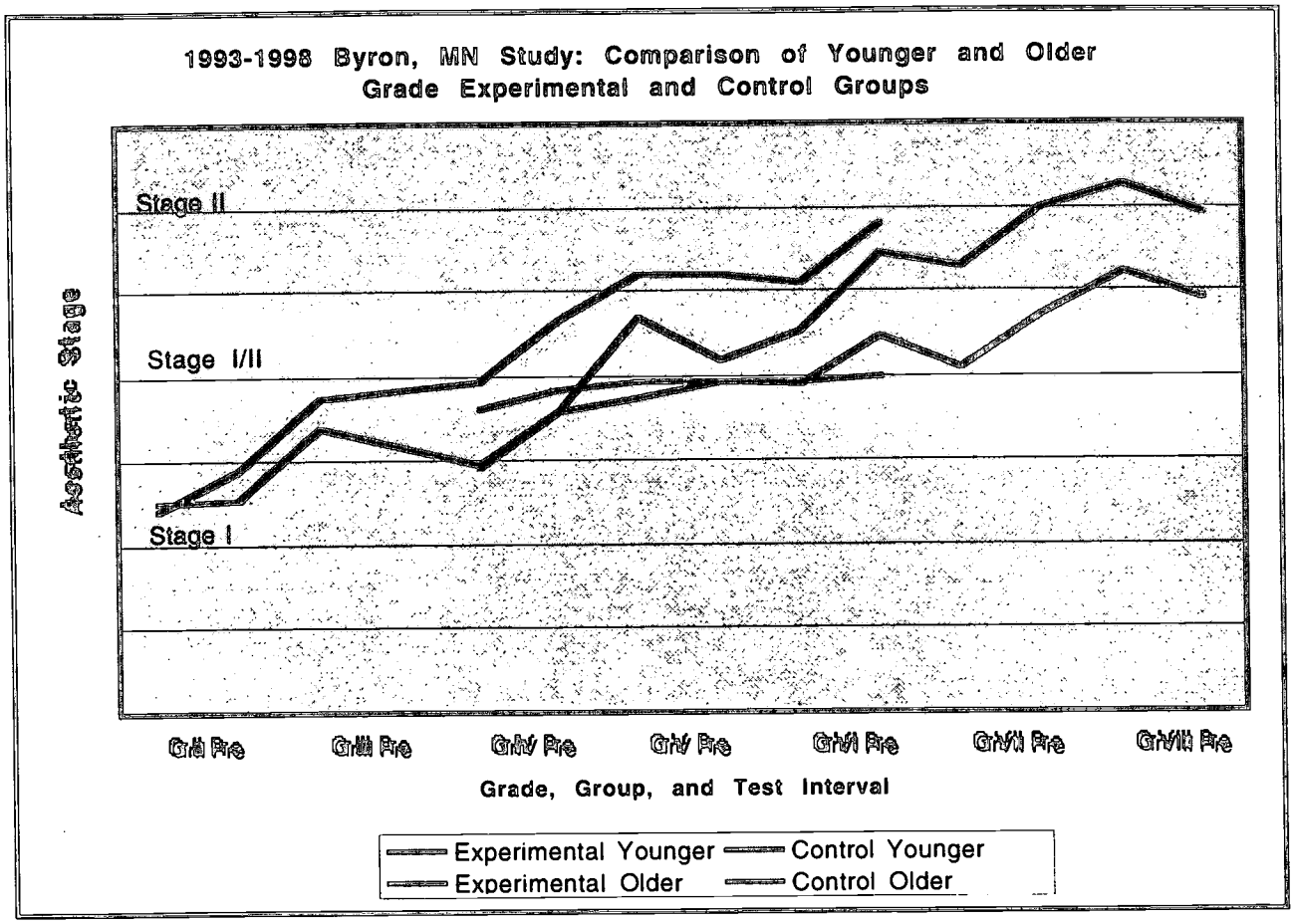


Figure 11.
Aesthetic Stage Distribution by Group
(Study Year V)

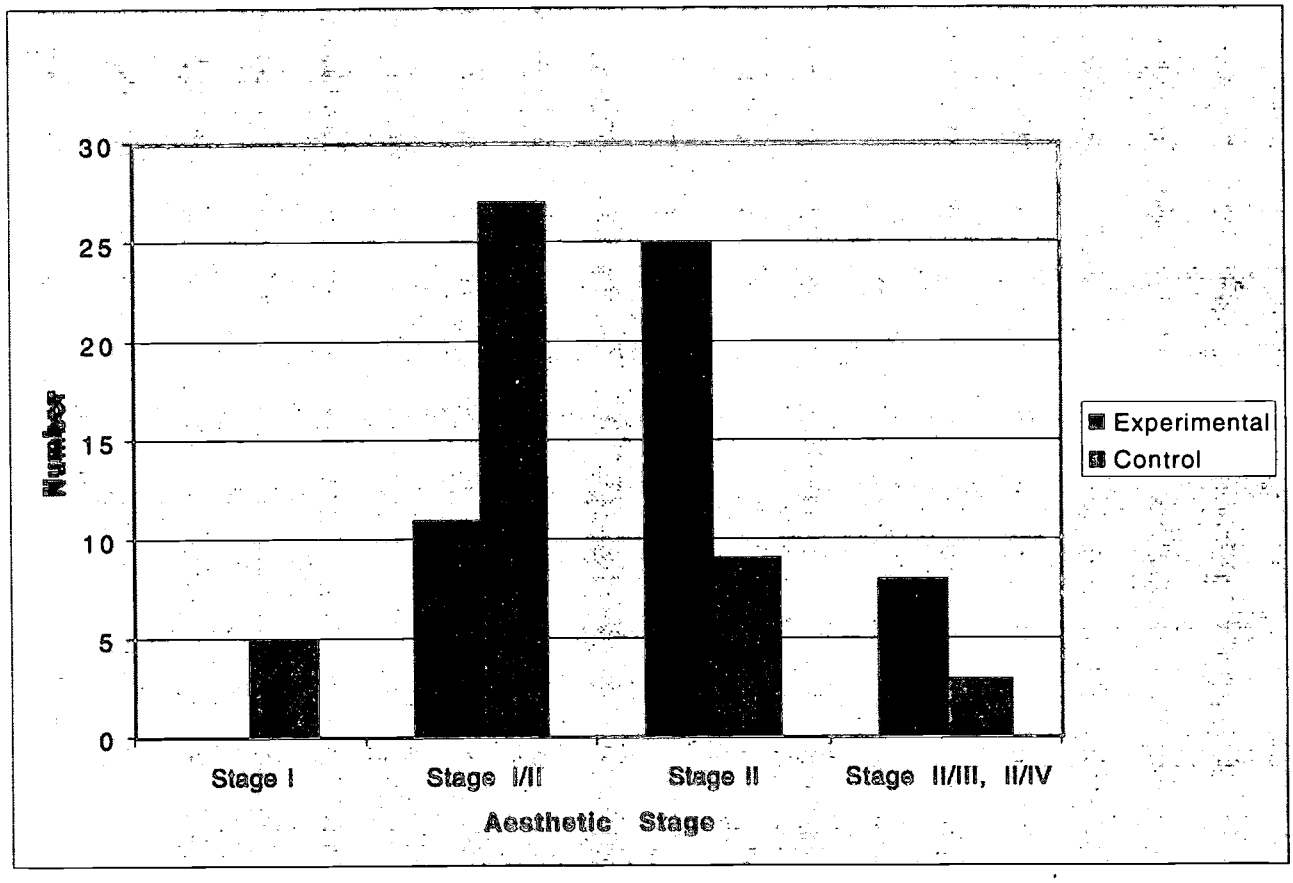
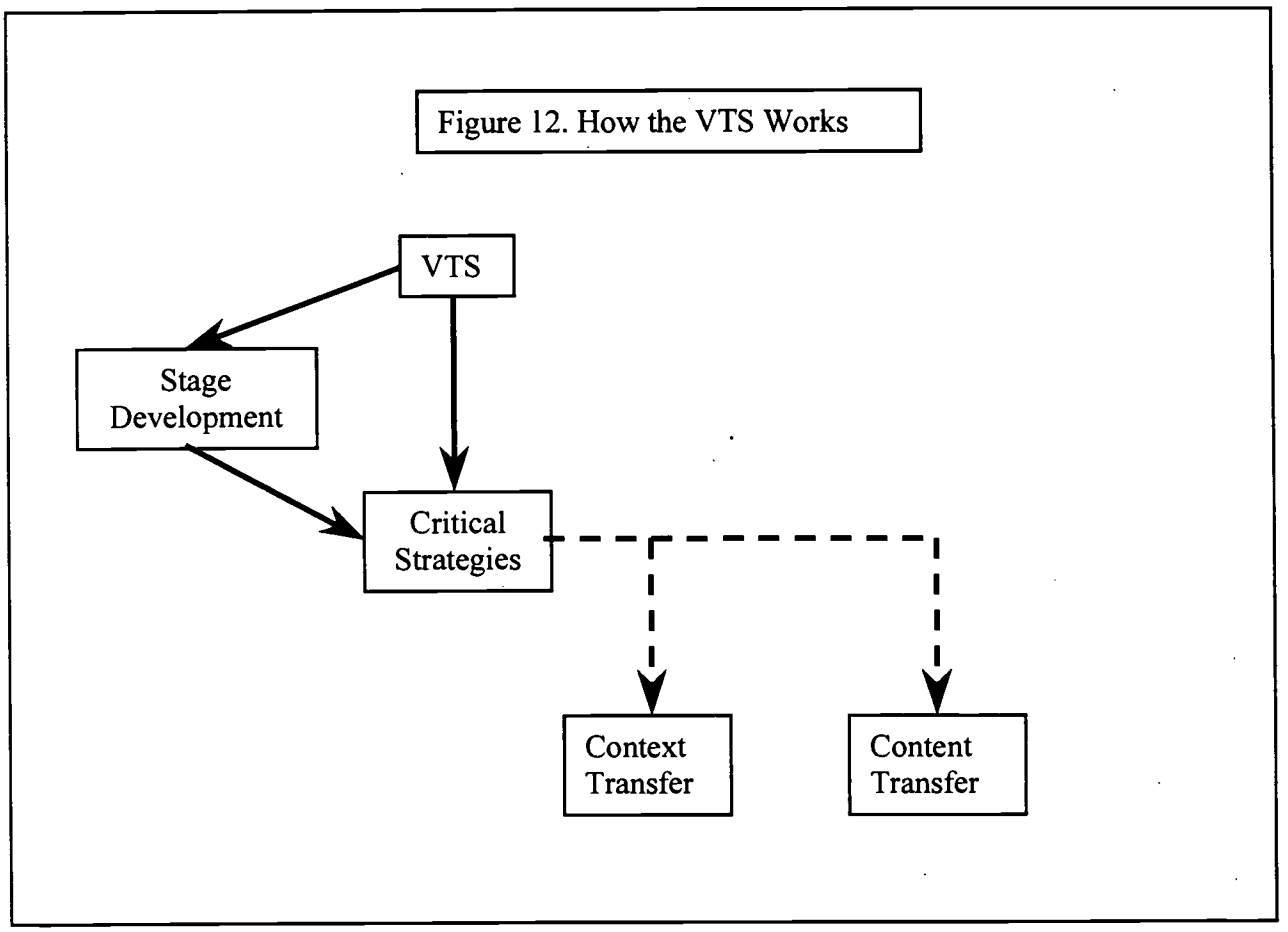


Figure 12.
How Transfer Appears to Operate



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15 Kuhn. "A Developmental Model of Critical Thinking." p. 21.

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17 "Possibly critical thinking can be developed best when pupils are taught in such a manner, throughout their school experience, that they must constantly use information in problem-solving situations and in such a manner that they are constantly forced to make tentative conclusions as a result. In other words, it is just possible that the way to teach critical thinking is to give pupils long-term practice in it." Osborne, W. (1939). "An experiment in teaching resistance to propaganda." Journal of Experimental Education, Vol. 8, p.1-17.

18 "The rational powers of any person are developed gradually and continuously... [...] There is not evidence that they can be developed in any other way. They do not emerge quickly or without effort..."National Endowment for the Arts, "Report to the Central Purpose of American Education."

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20 Ibid.

21 Dewey. How We Think, p. 13.

22 Bruner, J. (1960). The Process of Education. Cambridge, Harvard University Press, p. 17.

23 It is worth noting, that while three different works of art can be construed as similar, and therefore comprising a "small" or circumscribed arena, in point of fact, each well-chosen work is replete with ambiguity and clues and is in that sense, extremely rich and mine-able.

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Abigail Housen
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