Journal of Research Practice
Volume 5, Issue 2, Article M3, 2009

ISSN: 1712-851X

Main Article:

Where to Begin? Eye-Movement When Drawing

Bryan Maycock
Foundation Studies, NSCAD University, 5163 Duke Street, Halifax, CANADA
bmaycock@nscad.ca

Geniva Liu
Department of Psychology, Dalhousie University, Halifax, CANADA
geniva.liu@gmail.com

Raymond M. Klein
Department of Psychology, Dalhousie University, Halifax, CANADA
ray.klein@dal.ca

Abstract

For over a century, drawing from observation, at least at the introductory level, has been integral to many secondary and most post-secondary art school programs in Europe and North America. Its place in such programs is understood to develop an ability to see and interpret on a flat surface the real, three-dimensional world; this skill, in turn, provides support to related mental processes such as memory, visualization, and imagination. Where an artist looks when drawing from observation may not be arbitrary and can be observed, quantified, and analyzed. Our interest in examining the first few minutes of the drawing process takes its lead from the novice's question, "Where should I begin?" Attempting to understand these first few minutes led to a collaborative study between art educators and cognitive-perceptual psychologists: the former interested in implications for practical pedagogy, the latter in applying expertise in eye movement and scientific methodology in service of a specific real-world question. The stated purpose of the study notwithstanding, contrasting histories and practices in art and science provided contexts for discussion beyond the collection and interpretation of data. This article seeks to report upon and further that discussion.

Keywords:attention; drawing; observation; interdisciplinary collaboration

Suggested Citation: Maycock, B., Liu, G., & Klein, R. M. (2009). Where to begin? Eye-movement when drawing. *Journal of Research Practice, 5*(2), Article M3. Retrieved [date of access], from http://jrp.icaap.org/index.php/jrp/article/view/179/177

1. The Beginning

In 2005, colleagues from the Nova Scotia College of Art and Design (NSCAD) University and Dalhousie University undertook to combine their disparate experiences for the purpose of studying how students view and scan a scene when they are about to draw it from observation. As research and collaboration, the study promised to blur the boundaries between art and science, and to challenge practitioners in visual arts and perceptual psychology to work outside their respective comfort zones. For visual artists, the comfort zone entails posing open-ended questions, often working in ways that risk the failure of their materials, creating without recourse to imitation, using intuition as a deciding factor, etc. The comfort zone of a perceptual psychologist entails operational definitions, quantification, logic, and the application of conventional scientific methods to discover general underlying principles.

In *drawing now: between the lines of contemporary art*, the editors/curators recognize this challenge of collaboration, suggesting that “investigation might or might not benefit from a more scientific approach to understanding the cognitive nature of the artistic operation of drawing,” but then proceed to the more provocative notion that “the drawing process provides exactly the ambiguous arena that might challenge scientific methodology” (Downs, Marshall, Sawdon, Selby, & Tormey, 2007, p. xx. While not the focus of this research, this second notion has, throughout the 4-year project, played a role in our conversations.

Research, in common practice, is a systematic process of inquiry in order to discover facts, generate and test theories, and examine applications of theories. This process is most readily recognized as integral both to science and commerce, and is invariably organized in a manner that anticipates replication. Its aims are defined, its methods are systematic, and its outcomes are reproducible. As in scientific research, art practice both probes, problem-solves and has the goal of discovery; therefore, art practice can be considered as research. But art research tends to be open-ended and is rarely, if ever, aimed at generating reproducible results. As Strosberg (2001) stated, “science, working towards collectively recognized and precise objectives, tries to remove ambiguities, which art accepts and even emphasizes as inevitable in the realm of subjective experience” (p. 13). While this can be considered an overstatement of the case, it reflects some truth in that scientists gravitate towards seeking general explanatory principles, whereas artists gravitate towards differentiation in individual experience.

Much is written about the cultural convergence of art, science, and technology (Wilson, 2002), but the notion of the artist as researcher is relatively new. NSCAD University, for example, published its first strategic research plan in 2003. Indeed, appropriation of the research mantle in art may have as much to do with politics, in particular the politics of funding, as it has to do with shared intellectual aspirations with scientists. But the two worlds do occasionally collaborate with mutual benefits; although, such collaboration can pose intellectual and practical challenges, some of which are discussed in this article.

There also exists a commonly accepted model for collaboration wherein individuals and/or organizations seek to blend experience, skills, and interests in order to arrive at an end that is useful and, often, original. In commercial endeavors, such division of thought and labor provides for efficiencies and, for the most part, scientific practice also assumes this model. In visual arts, such examples of collaboration also exist, from teamwork in Renaissance ateliers where artists, artisans, and their students divided tasks according to discipline and level of competence, to more contemporary activity such as that of performance artists Gilbert and George, for whom collaboration is the very essence of their work. Gilbert Proesch and George Passmore came to prominence in the late 1960s using themselves as raw material to make living sculpture. Since that time they have continued the collaboration in a variety of media.

Cross-disciplinary collaboration where scientific or technological experience is co-opted by the artist is also well established; a stellar example is the work of British painter Harold Cohen, whose work at the computer labs at the University of California, San Diego began in 1968 and led to the 1972 birth of Aaron, a machine that Cohen taught (programmed) to make drawings (Cohen, 1982). Emerging communication technologies have also attracted the attention of artists and much of the resulting activity has been attributable to artists' willingness to share control over the creative process. Nonetheless, in visual art, the solitary practitioner remains the norm and collaboration, if not the collaborator, may even be subject to suspicion.

2. The Question

Thus, there exist both complementary and competing practices and purposes in art and science research. This served as background for us to expose the artistic process to scientific measurement and analysis in a manner that acknowledges the somewhat uncomfortable fit between the disciplines. With the support of a grant from the Social Science and Humanities Research Council (SSHRC) of Canada, cognitive-perceptual psychologists and artists established the NSCAD Drawing Laboratory to study eye-movements while drawing from observation and to do so in a manner that was clearly empirical.

As artistic activity, drawing has evolved from being a mere investigatory or planning tool occurring at the earliest stage in the development of a more "major" work, such as a painting or sculpture, to an end product in and of itself. However, for purposes of this study, the definition of drawing is necessarily narrow with procedures and outcomes that reflect historical rather than contemporary approaches to drawing. Participants would be asked to "tell it like it is," and to be "truthful" in providing "the most accurate possible recording of what they see" (Feldman, 1970, p. 277). For over a century, introductory level drawing from observation has been integral to many secondary and most tertiary art programs in Europe and North America (Dinham, 1989). Its place in such programs is intended to develop an ability to read the real world and to interpret it on a flat surface--a skill that, in turn, provides support to related mental processes (e.g., memory, visualization, and imagination) that underscore artistic creation. Put simply, in art education at all levels, drawing has been understood to be "the basic component of visual research from which most . . . visual ideas must ultimately stem" (Simpson, 1987, p. 9); additionally, "the most fundamental discipline in drawing is learning to record what ones sees . . . Drawing is a matter of seeing, rather than of 20/20 vision and deft fingers" (Mendelowitz & Wakeman, 1988, p. 32). Therefore, knowing whether artists' looking behavior is arbitrary or predictable ought to be of interest to educators in the arts. This question of where an artist looks when drawing from observation was the focus of our collaborative research.

3. The Method

Like the artists, the scientists in our collaboration were interested in what the artist sees when drawing from observation. Additionally, the scientists were looking to explore real-world applications of eye movement research. Cognitive-perceptual psychologists provided the scientific side of our collaboration, bringing a focus on observable actions (i.e., eye and hand movements) to the research. Traditionally, British Empiricists such as Locke asserted that "all knowledge comes from experience" (Locke). In psychology, this idea was captured in the words of James:

> Everyone knows what attention is. It is the taking possession by the mind, in clear and vivid form, of one out of what seem several simultaneously possible objects or trains of thought. Focalization, concentration, of consciousness are of its essence. It implies withdrawal from some things in order to deal effectively with others. (James, 1890, pp. 403-404)

However, we did not attempt to measure attention and perception directly in our collaboration. In contrast to the British Empiricists, contemporary psychologists put *action* at least on an even footing with *perception*. Indeed, some theorists have argued that perception (or much of it) is in the service of action (Milner & Goodale, 1998). Thus, we focused on action (i.e., eye movements and hand movements [drawing behavior]) as a window on the working of attention in the drawing-from-observation process and on how that process is influenced by training and practice.

It has been our experience throughout this study that asking artists where they look when they draw from observation, and whether such behavior should be subjected to measurement, has been met with skepticism as well as interest. Kovats' reading of William Blake's painting Newton (Blake, 1804), where she describes the work as comment on "romantic drawing versus scientific drawing, inspiration versus measurement" (Kovats, 2005, p. 46), appears to mirror much contemporary thinking and tension regarding the value, purpose, and approach to drawing instruction. Yet, it may still be informative to know more about the process of seeing (i.e., measuring eye movement behavior) for the purpose of drawing, which is an affirmation of scientific method. Nonetheless, concern remains that exposing art practice to measurement may lead to a standardization of approach, or a denial of inspiration. But curiosity and the possibility for advancing educational practice prevailed, and a study was undertaken to record, measure, and analyze that part of the drawing process that is often the most difficult for the novice: Where and how does one begin a drawing? To answer these questions, the researchers undertook to record and compare where (a) expert artists and (b) novice artists look and draw during the first few minutes of the drawing process.

Others have attempted to capture the drawing process as it unfolds. From time to time, artists have been filmed or otherwise documented as they work. Often, these have been recordings made over-the-shoulder (Scheidegger & Munger, 1966) or by viewing the artist working on a transparent canvas (Clouzot, 1956). In these instances, there may have been a generalized sense of where the artist is looking, but it was the development of the image that was really the object of consideration. Studies have also been made of art students at various skill levels drawing under controlled conditions (Beittel, 1972). But no precise record of the artist's eye movements or, more importantly, record of fixations was possible until the development of eye-tracking technology, which has advanced greatly in the past decade. Thus, our study utilized this technology to capture the eye's behavior during the drawing process. Practical experience with this technology, as well as experience with analyzing the resulting data, shaped the contribution of the scientists/psychologists. The artist's role was to imagine a task that would replicate particular aspects of activity in the drawing studio and to draw upon practical experience as an educator in order to frame questions that could inform analysis of data. At the same time, the scientist's role was to constrain this imagination to conform to the methods of natural science. In natural science, tightly controlled conditions are maintained so that carefully made measurements can be attributed with some confidence to variables under the control of the scientist. As described by Ebbinghaus (1885), in a natural science experiment, both control and measurement are necessary.

> an attempt is made to keep constant the mass of conditions which have proven themselves causally connected with a certain result; one of these conditions is isolated from the rest and varied in a way that can be numerically described; then the accompanying change on the side of the effect is ascertained by measurement or computation. (p. 7)

Planning the task for the participants was a collaborative compromise in which there was an effort to make the drawing experience as close to studio drawing as possible while allowing for recording of accurate and measurable information about the artists' eye movements and drawing behavior (and to yield a manageable amount of data). Essentially, ideas about artistic practice needed to be translated into testable hypotheses and measurable behaviors. A task was designed in which participants were given 3 to 5 minutes to draw a three-dimensional scene of nine simple geometric objects (see Figure 1). Eye and hand movements were captured with an eye tracker and video camera.

Our study was less “experimental” than it was “observational.” That is, we were not so much manipulating a variable (cause) to determine how it would affect behavior (effect), as we were simply setting up a controlled situation intended to elicit the natural processes of drawing from observation so that we could observe, record, classify, measure, and analyze our participants’ eye movements and drawing behaviors. The noted compromise was of the essence because naturalistic observation involves the twin goals of making the drawing experience as close to studio drawing as possible while allowing for the accurate recording of information about the drawers’ behaviors (i.e., eye and hand movements).

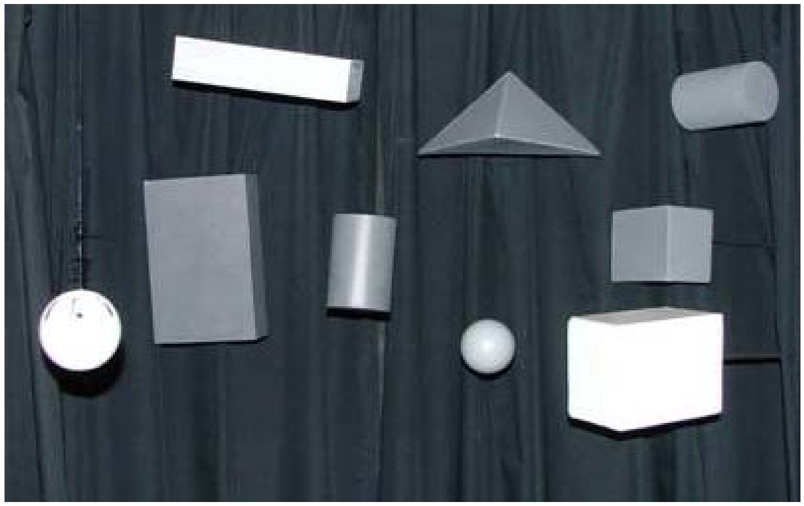


Figure 1. Photograph of the 3-D scene of 3-D objects that our participants were instructed to draw. Note that the three-dimensionality of the objects and scene (e.g., the sphere on the left was in a relatively “near” plane compared to the other objects) is less apparent to readers of this article who are viewing a photograph than to our participants for whom cues to three-dimensionality (such as binocular vision and parallax) were available.

The design of the task sought to examine the basic challenges normally experienced by a person making a line drawing from observation; information about tone and texture was not part of the task. Therefore, the emphasis was on: (a) reading the relative size and placement of objects within the scene, (b) working with information contained in the space between the objects, and (c) reading and recording the scene as a whole (i.e., looking beyond the particular to the panoptic). To the reader not engaged in such tasks, such behaviors may appear obvious. One might ask, how else can we make sense of a scene if we do not consider and incorporate all stimuli? However, early intellectual development, which includes how we learn to read visually and categorize the world, tends to favor looking “at parts rather than at the ways those parts interact with each other” (Eisner, 2002, p. 68). “Teaching the arts is very much concerned with helping students learn how to see the interactions among the qualities constituting the whole” (Eisner, 2002, p. 76); in effect, it is teaching that aims to override what feels like the natural way to approach the task of drawing from observation. In our study, measurement concerning the transitions between objects is paramount. Novices and experts alike experience a common array of possible transitions (Figure 2). But it is the order, rate, frequency, and repetition of these transitions that differentiate one scanning strategy from another. If Eisner is correct about the effects of learning how to see, expert looking behavior should be discernibly different from that of the novice. For the purpose of this study, an expert is one who is familiar with strategies and practices that apply to drawing from observation, and who also teaches the subject of drawing. By contrast, a novice is one who is unfamiliar with such strategies and practices, and is currently enrolled in drawing courses at a tertiary level institute.

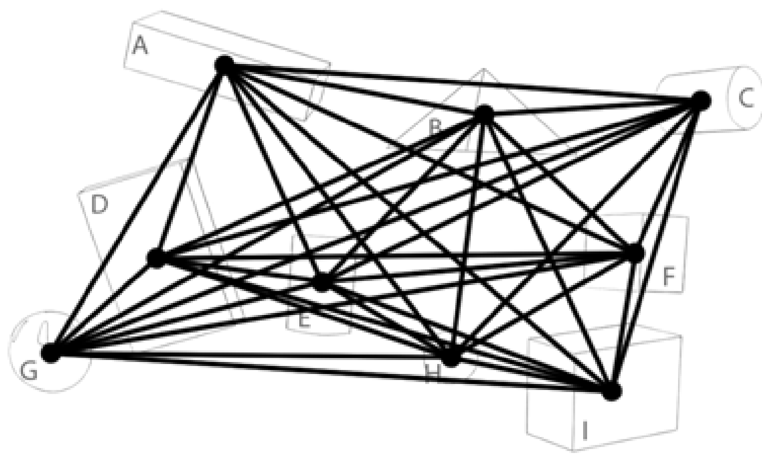


Figure 2. A schematic illustration of all the possible object-to-object transitions.

4. The Results

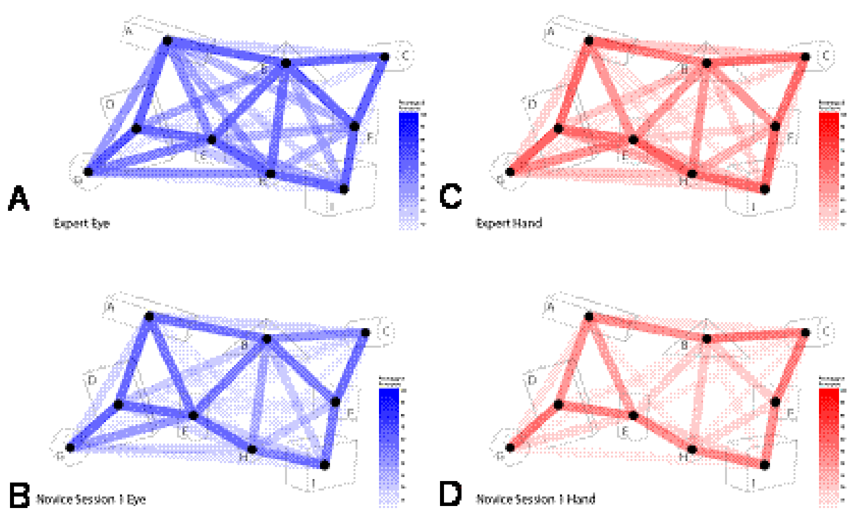
It was, in part, the experience of working with the technology that prompted the psychologists to suggest restricting the eye and hand movement analysis to the first 3 minutes of drawing. The volume of data collected by the eye-tracker and the demands of frame-by-frame analysis of both this data and the video-recordings of the movements of the drawing hand are such that the time required for analysis becomes prohibitive with multiple participants (our study started with 20 expert and 40 novice participants). For the art educators, restricting data analysis to 3 minutes was acceptable as most novices will commit very quickly to mark making and experts can adapt their approach to drawing in accordance with available time. Eisner underscores the point when he reports a teacher's efforts to counter the tendency, to "help the students escape the traditional habits of daily perception" by moving them from "what Dewey referred to as 'recognizing,' in contrast to 'perceiving' the slowing down of perception in order to explore and savor the visual qualities of form" (Eisner, 2002, p. 76). In other words, art educators believe that students should spend more time exploring the relationships between the objects in the whole scene before committing to actual mark making.

> Connecting with things is part of the training of an artist. The first lesson is to slow down and look, to lend yourself to time and the world around you. "It is harder to see than it is to express," Robert Henri, the painter and celebrated teacher, used to tell his students at the New York City's Art Students League. Seeing takes time; it requires patience. (Steinhart, 2004, p. 66)

It is also the experience of the art educators that novices read and record a scene as if the elements within that scene are isolated rather than in particular relationships. As a result, the drawing develops as a *visual list* rather than as a coherent whole. Simpson suggests:

> If one concentrates too much on one particular section, there is a tendency to see and draw in a manner different from the rest of the subject, and one of the first things to learn in the development of observation is that your eye must be kept active. (Simpson, 1987, p. 20)

Many analyses were conducted on the recordings we made of the eye and hand movements of experts and novices as they drew the scene displayed in Figure 1. These were described in detail in a scientific presentation (Liu, Hutchinson, Maycock, & Klein, 2007). Here, to illustrate something of our process, we will focus on one of many ways of looking at the data. All of the possible object-to-object transitions are illustrated in Figure 2. By collapsing the eye data from experts (Figure 3A) and comparing it to that of the novices (Figure 3B), we can see that expert behavior involves a richer exploration of the scene The overall number of paths taken is greater, as is the frequency of the return visits indicated by the greater color density in particular paths. Likewise, the expert hand (3C) is more active than that of the novice (3D), resulting in a pattern of transitions comparable to the expert eye. Novice eye and hand drawing behaviors also create similarly structured transition records (see Figures 3B and 3D). Novices tend to favor transitions around the scene (predominantly clockwise covering the outermost objects) rather than, as was found with expert behavior, across and around the scene. It is the higher frequency of return visits in expert behavior that suggests that greater experience in drawing from observation encourages behavior that makes complex rather than simple comparisons within the scene.



> *Figure 3*. One way to look at the data. (A) Actual transitions made by all experts with density of the lines proportional to the frequency of the transition it represents. (B) Same as (A) but for all novices in their first session. (C) and (D) are transitions of the drawing hand as it moves between objects for experts and novices (in Session 1), respectively.

In the artist Alberto Giacometti's drawings and paintings, for example, a portrait of Diego (Giacometti, 1953), evidence can be seen of such activity where lines move about the surface in a manner described as "energetic and searching" (Smagular, 2002) or "organizational" as a "construct, not actually existing to be directly observed" (Rockman, 2009, p. 60). Is Giacometti's hand and drawing tool mimicking the artist's eye movement? Is this what we see in Scheidegger and Munger's (1966) film *Alberto Giacometti* where the artist *draws* on the clay surface, his penknife, eye, and hand moving between discontiguous elements as he seeks to establish the form?

Letters between John Berger and James Elkins discuss Elkins' notion that drawings often reveal themselves to have a ghostly life and Berger wonders if he sees evidence of the phenomenon in Giacometti's work (Berger, 2005b). Referring to a portrait of Isaka Yanaihara, Berger suggests that the richness of surface resulted from the artist "working quickly . . . looking back and forth between his marks and their points of reference" (Berger, 2005b, p. 114). For Berger, such behavior is essential to those who "study and question the visible," where:

> lines on the paper are traces left behind by the artist's gaze, which is ceaselessly leaving, going out, interrogating the strangeness, the enigma, of what is before they eyes, however ordinary and everyday this may be. The sum total of the lines on the paper narrate a sort of optical emigration by which the artist, following his own gaze, settles on the person or tree or animal or mountain being drawn. (Berger, 2005a, p. 47)

To give the reader a concrete picture of the task we set for our participants, two actual drawings from our study are presented in Figure 4. Participants were asked to spend 3-5 minutes (our time limit) on each drawing, but only the first 3 minutes were analyzed in order to keep the data analysis manageable; the two movies of looking and drawing behavior generated in the first 3 minutes of a session each required, on average, 6 hours of highly demanding frame-by-frame analysis.

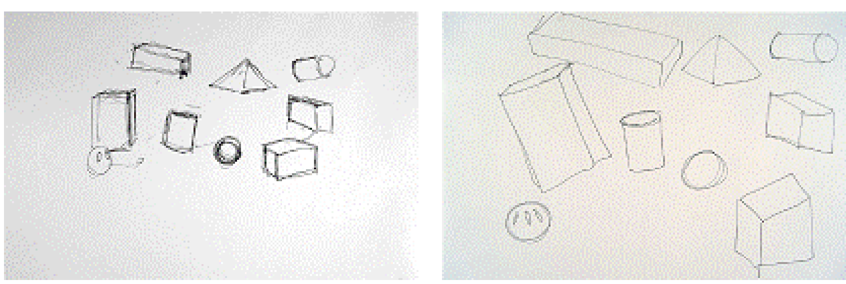


Figure 4: Two drawings from our study. Can you guess which is the expert drawing and which is a novice's? (Answer at the end of the reference list.)

5. The Interpretation

Berger's description of drawing resonates with our own expert discussions regarding the nature of observational drawing where traces do indeed have a direct and meaningful relationship to gaze. But the often-enigmatic elements that cause artists and some researchers to doubt the efficacy of empirical measurement remain, and we would be remiss not to acknowledge such concern.

Beittel, having studied drawing behaviors, recounts how a "noted developmental psychologist visited the ‘drawing laboratory’ and commented that a phenomenological ‘running time-sample record’ was not ‘where it’s at’ as ‘important occurrences (in the drawing process) were covert, internally mediated’” (Beittel, 1973, p. 14). Beittel understood, as do we, that there is more to drawing than can be demonstrated through mere observation of the process. But, as Beittel concedes, “observations of overt behavior [are] far from useless” (p. 14).

Beittel’s concerns and apparent pessimism regarding the effectiveness of an empirical study of drawing has everything to do with his interest in understanding the entire process, the “stream of covert events in the drawing situation.” In our study, beyond a simple anecdotal record of years of experience, there is no attempt to identify elements such as the artist’s history and motivation. Participants are treated as “subjects” and we also speculate upon whether, as individuals and groups, they are “representative of types” (Beittel, 1973, p. 18). We are interested only in the behavior of eye and hand as overt indicators of the mechanics of process, a process that appears to evolve and a process about which educators strive to enlighten their students.

Prior to our investigation, NSCAD University drawing instructors discussed what such a study might reveal. There was speculation on whether scanning strategies in like groups of individuals would demonstrate some degree of homogeneity or whether more commonly held notions of artistic independence, individuality, and originality would be supported. Essentially, we found each notion to contain some truth. Within a group--novices in Session 1 compared with other novices in Session 1--there were marked behavioral variations. But as a group--novices in Session 1 compared to experts-behavioral differences were significant. (To follow a more detailed presentation of the data, go to http://nscaddrawinglaboratory.psychology.dal.ca/)

As cross-disciplinary, collaborative researchers working in the NSCAD University Drawing Laboratory, we have gained knowledge about where artists look when drawing from observation and have accrued a better understanding of the way our differing approaches to research may be reconciled to mutually beneficial ends. Predictably, at times we struggled to reconcile our technical vocabularies. One example was the interpretation of *significance*. For the artist during the drawing process, recognition and recording of subtle differences can be the marker between excellence and mediocrity. So to look at data that shows a difference and be reminded that, from a statistical point of view, that difference is not *significant* requires an adjustment in thinking. For the scientist, objective measurement and quantitative analysis is a prerequisite for presenting results and drawing inferences from them. From such a perspective, the artists’ ability to find significant meaning in statistically nonsignificant differences was unexpected.

Scientists may favor an approach that is convergent, having a clear hypothesis and controlled processes that are devoid of ambiguities and that work towards a measurable end. By contrast, artists most often find virtue in divergence, embracing the serendipitous, the subjective, and the original. The often-quoted, although perhaps outdated, observation by the artist Georges Braque would seem to capture this dichotomy: “The function of Art is to disturb. Science reassures” (Braque as cited in *Oxford Dictionary of Quotations*, 1999, p. 147). As interdisciplinary researchers, we are learning that traditional paradigms, prejudices, and practices do not have to function in opposition. “Art and science,” as poet and politician Edward Bulwer-Lytton opined, “have their meeting point in method” (Bulwer-Lytton, 1864, p. 122). For all those involved in this study: researchers, experts, and students, and those who have attended presentations about the NSCAD Drawing Laboratory, opinions, interests, and suggestions for further studies are indicators that artists and scientists are more than willing to find points of contact. Perhaps the time is now right to undermine perceptions that are mired in romantic versus scientific, inspiration versus measurement.

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* The first picture is the expert's drawing.

Received 9 October 2009
Accepted 6 November 2009