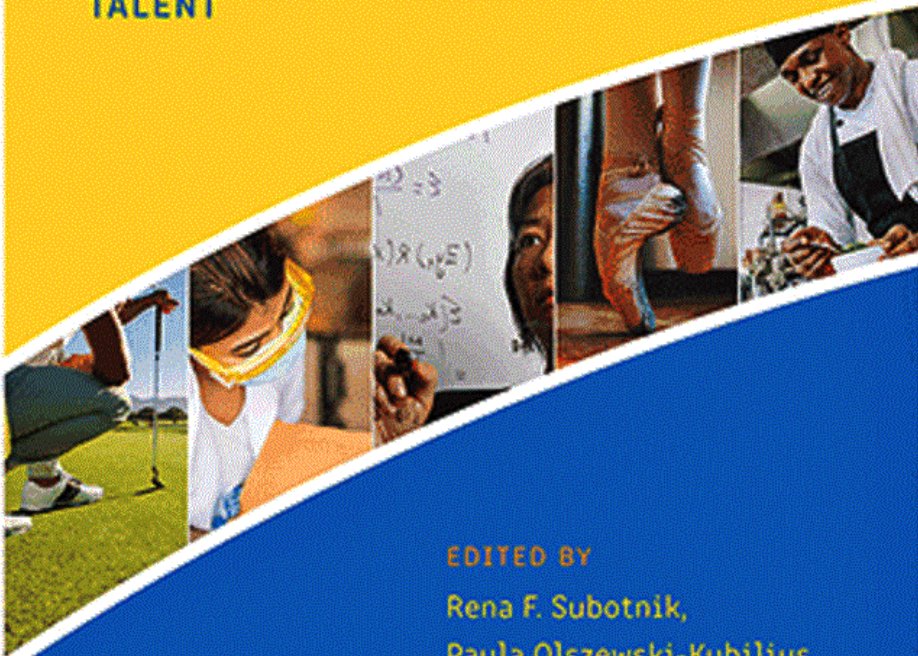# The Psychology of High Performance

DEVELOPING HUMAN POTENTIAL INTO DOMAIN-SPECIFIC TALENT

EDITED BY

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The Psychology of High Performance
Developing Human Potential Into Domain-Specific Talent

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In this volume, Rena F. Subotnik, Paula Olszewski-Kubilius, and Frank C. Worrell explore how an individual's early potential develops into high performance in five domains: sport (specifically golf and team sports), the professions (medicine, software engineering, professional teams), academics (mathematics, psychology), the performing arts (dance, acting), and the producing arts (culinary arts, drawing/painting).

The contributors address many questions: What does "raw" potential in a specific domain look like? How can those abilities be nurtured and grown, and what psychosocial skills are necessary for this development? They examine similarities and differences within and between domains and present personal interviews with "gatekeepers"—experts in a field whose professional judgment determines whether individuals' developed abilities are good investments for further instruction and coaching. With its mix of scholarship and personal interviews, this book brings new insights based on psychological science and best practices to inform educators, parents, coaches, and psychologists guiding young people on their path to becoming high performers.

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TALENT AND ABILITY IN DRAWING AND VISUAL ART

AARON KOZBELT AND ANDREA KANTROWITZ

Visual art is one of the most complex and multifaceted domains in which to study the manifestation of talent and high performance. Art is a cultural universal (Brown, 1991), practiced throughout humanity's tenure as a species (Pfeiffer, 1982). It is paradigmatic of creativity in general (Sawyer, 2006) and has high value in terms of cultural and financial capital (Bourdieu, 1979/1984; Galenson, 2009). Visual artistry has also been regarded as a fundamental domain of the mind (Feist, 2004) and a basic type of human intelligence (Gardner, 1983). Art is inherently creative. It is not bound by a prescribed set of rules, like games or sport are; it also differs from domains such as medical diagnosis in which the goal is a well-defined, correct answer. Artistic styles, the concept of art, and the role of the artist in society vary tremendously, both transhistorically and cross-culturally (Kozbelt, 2016; Shiner, 2001).

This chapter is mainly concerned with *drawing*. Drawing has been a major focus of research on the psychology of art. Individual differences in drawing skill are profound, ranging from the glories of Michelangelo's Sistine Chapel frescoes to the stick-figure doodles demarcating the limit of many adults' artistic achievements. Drawing ability is often (incorrectly, in our view) conflated with artistic ability. Throughout this chapter, we endeavor to keep the two distinct—though by the end, we hope to provide some integration, because drawing, besides being a distinct activity with its own value, can also facilitate imagination and understanding more generally beyond the domain of visual art. Drawing is a foundational activity within and beyond the domain of visual art: Artists, designers, and architects—as well as scientists, engineers, and others—draw to generate, explore, and test new and established ideas and perceptions (Root-Bernstein et al., 2008). The simplicity and accessibility of materials needed, and the way drawing can provide a direct externalization and exploration of thoughts and perceptions, make it a particularly good illustration of the human imagination at work. Skilled drawing also represents a provocative domain of expertise in its own right because the perceptual and cognitive correlates of acquiring skill in drawing may differ from those in other domains such as chess or sport (Kozbelt & Ostrofsky, 2018). Beyond theoretical considerations, learning to draw remains a distinct yet essential part of most areas of art and design education, albeit one that varies widely across curricula in its specifics.

The purpose of this chapter is to survey what is known about talent development in drawing and visual art, to characterize those abilities, and to explore links between basic drawing skill and higher, more creative aspects of artistic achievement. Both authors of this chapter have substantial experience as scholarly academics and as practicing artists, and we address both theoretical and practical aspects of talent development in art and drawing. We begin by laying out some issues that make the domain of art and conceptions of artistic achievement complex. We then detail lines of evidence on the nature of drawing talent, beginning with an illustrative account from art history. Next, we transition to psychological studies comprising the bulk of this chapter, including research on the typical developmental trajectory of drawing, what precocious drawers may tell us about the nature of talent in this domain, and the perceptual nature of drawing expertise as it relates to the ability to translate what is seen into lines and marks on a flat surface. Although the link between perceptual processes and realistic drawing is our primary focus, we conclude by discussing some nonperceptual aspects of artistic creativity, synthesizing the constructs of drawing ability and artistic achievement.

COMPLEXITIES IN CHARACTERIZING ART AND TALENT

The domain of visual art is complex for several reasons. First, it affords a huge number of styles, media, subjects, and social purposes. Even when constrained by historical or stylistic considerations—as in, say, the production of a visually recognizable (but still flattering!) commissioned oil portrait in 17th-century Europe—artists still have at their disposal an enormous set of stylistic options and choices about what to depict and how to depict it. This latter issue is related to a second reason for art's complexity—the fact that it exploits the tremendous flexibility of the human visual system. Viewers easily interpret demonstrably different modes of depiction as *realistic*. This flexibility has given rise to the panoply of styles constituting the evolutionary history of Western art, as artists acquired ever more sophisticated depictive means (Gombrich, 1960). Finally, the recent history of art reminds us that the boundaries of art are constantly under revision: In an artistic culture prioritizing originality, there is rarely consensus about aesthetic criteria and no fixed target by which to assess achievement (see Galenson, 2009).

Even if we dispense with conflicting notions of what constitutes quality in artistic expression and focus on depictive mimesis—that is, the imitation of nature, still a touchstone for assessing artistic talent—we encounter substantial complications in characterizing artistic ability. Is it more rooted in low-level visual perceptual factors or higher order knowledge-driven factors? To what extent do artists perceive the world differently from how nonartists do? How broad or narrow are artists' perceptual advantages, and are they the antecedents or the consequences of involvement in drawing? Moving beyond mimesis and returning to art's more imaginative aspects—what is the functional relationship between drawing skill and artistic creativity?

AN EXAMPLE FROM ART HISTORY

In seeking to understand talent, why not begin with artists whose greatness has never been questioned? Examples from art history can provide some useful guidance on how talent has been conceptualized in the past and how such ideas might still be relevant. One of the most famous descriptions of the identification of talent is an anecdote from artist and biographer Giorgio Vasari's (1550/1991) semilegendary account of the life and work of Giotto. Vasari's capsule biographies have long been regarded as a significant factor in raising the intellectual status of artists from anonymous medieval craftsmen to individual creative geniuses—still probably our primary mode of regarding artists. Giotto, who lived from ca. 1267 to 1337, was the first artist to break

decisively with the artificial, Byzantine style of depiction that had dominated Western art for centuries.[1] Recognized as a genius during his lifetime, his stature has endured, and he has been ranked the eighth-most eminent Western artist of all time (Murray, 2003). Vasari relates how the 10-year-old shepherd boy's talent was spotted by the great Florentine painter Cimabue:

> One day Cimabue was going about his business between Florence and Vespignano, and he came upon Giotto who, while his sheep were grazing, was sketching one of them in a lifelike way with a slightly pointed rock upon a smooth and polished stone without having learned how to draw it from anyone other than Nature. This caused Cimabue to stop in amazement, and he asked Giotto if he would like to come to work with him . . . in a brief time, helped by his natural talent and Cimabue's teaching, not only did the young boy equal the style of his master, but he became such an excellent imitator of Nature that he completely banished that crude Greek style and revived the modern and excellent art of painting, introducing good drawing from live natural models, something which had not been done for more than two hundred years. (p. 16)

Regardless of its veracity, Vasari's (1550/1991) tale is significant in several respects. It argues for the early manifestation and ready recognition of talent. It complements the natural talent of the artist with the need for rigorous training. It suggests rapid progress once a commitment to the domain has been made. It emphasizes learning from nature without intermediaries as its own activity but also as a catalyst for original creative achievements. All these themes loom large below.

PSYCHOLOGICAL STUDIES OF DRAWING DEVELOPMENT AND DRAWING SKILL

Many aspects of visual art have been the subjects of psychological inquiry. In this section, we focus on psychological accounts of the development of drawing skill as a frame for the identification of unusual talent. A working definition of drawing ability is the knowledge and skill to convey complex information with marks on a flat surface in a manner that supports inferences and reinterpretations by oneself and others. This definition covers instances of relatively straightforward mimetic depiction as well as

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[1]Contrast, for instance, two frescoes depicting the lamentation of Christ: one, among the finest of all Byzantine-style images, dating from the mid-12th century in the Church of Saint Panteleimon in Gorno Nerezi, Republic of Macedonia (http://1.bp.blogspot.com/-EsNL4mzwowc/Tgo25gmqBeI/AAAAAAAAADDw/HINWkoHTTKE/s1600/f08.JPG); the other, Giotto's revolutionary painting from the Scrovegni Chapel in Padua, created around 1305 (https://upload.wikimedia.org/wikipedia/commons/3/3a/Giotto_-_Scrovegni_-_-36-_-_Lamentation_%28The_Mourning_of_Christ%29_adj.jpg).

renderings in which the visual realism of a scene or object is transformed for some expressive purpose.

Typical Drawing Development

Virtually all children draw. Drawing follows a well-documented developmental sequence, which provides a baseline for identifying unusual ability. Over the course of childhood, drawings progress from the visible traces of motor activity toward more intentional, recognizable depictions. Numerous frameworks have been proposed to document this change. One of the first attempts at analyzing artistic development (Luquet, 1927/2001) described four stages of realism in children's drawings: fortuitous, failed, intellectual, and visual. According to Luquet, whose work influenced Piaget's understanding of cognitive development, fortuitous realism involves noticing an accidental resemblance between marks on the page and reality; failed realism, intentional but mistake-laden attempts at depiction; intellectual realism, generic symbolic depictions of characteristic features; and visual realism, an accurate viewpoint-specific depiction.

Luquet's (1927/2001) characterization of these stages assumed that children had the same representational goals as adults of his place and time. Subsequent studies have shown that children are interested in mastering culturally prevalent schema for depiction of figures, objects, and scenes, whatever they may be, rather than visual realism per se (Pariser, 1991). Also, the high value Luquet placed on visual realism is far from universal (see also Gombrich, 1960). For example, many avid young drawers today are much more interested in reproducing TV and video game characters than in naturalistic portraiture. Drawings by Japanese children, as compared with those of American children the same age, demonstrate greater sophistication in spatial treatment. This development is relatively recent, seemingly associated with their greater exposure to Manga (Japanese comics style), which emphasizes complex spatial settings (Toku, 2001). Many models of the sequence of typical drawing development used in education today account for a variety of factors, including sociocultural influences (e.g., Burton, 1981; Kerlavage, 1998; Lowenfeld, 1947/1982). Usefully, these models have also linked changes in children's drawings to broader developmental themes of efficacy and judgment and more richly characterize later, more sophisticated stages of drawing skill.

Current accounts of drawing development start very early in life. Many toddlers start scribbling before they have mastered walking. From about 1 to 3 years old, they delight in making marks with no concern for representation; adult attempts to label their creations are irrelevant to their joy in leaving traces of their hand movements in the sand, on paper, or (to the dismay of

their parents, perhaps) on the walls. Near the end of this "scribbling" stage, ideas may come to the child while engaged in the process of making. It is "a picture of an alligator in my pocket" (of course!) a toddler may exclaim to a pesky adult interlocutor (Burton, 2005).

Between ages 3 and 4, children enter a *preschematic* stage, where they begin to draw more intentional shapes and lines and designate these marks as people or objects. The "tadpole" figure, an enclosure with extended lines representing arms and legs, is a common production. This and other configurations emerge and coexist among earlier scribbles as drawing gradually becomes a vehicle for describing objects and people in the child's world.

By age 5 or 6, children are in the *schematic* stage. Increased fine motor ability affords them more control over the shapes they draw, and they have often assimilated culturally prevalent schemas for representation. For example, New York City kindergartners may designate "home" by drawing a squarish shape with a triangle on top, even if everyone they know lives in flat-roofed apartment buildings. At first, objects and people appear to float. Then gravity takes hold: A ground line appears, and at the top of the page, a blue line for the sky, with the obligatory sun (a circle with extended lines around the circumference). Visual realism is happily sacrificed to symbolic value—for example, children often draw "me" much larger than Mommy and Daddy, though the parents may appear to have proportionately longer legs.

By age 7 or 8, as children become more aware that others might think differently from how they do, they become more critical of their own work: A child may say for the first time, "I can't draw." By age 9 or so, without proper instruction and encouragement, many will stop drawing for pleasure altogether. Indeed, many adults remain stuck in the schematic stage, embarrassed by the stick figures alluded to above. But some children keep at it, moving on to what has been called *dawning realism* (Lowenfeld, 1947/1982), *representing expertise* (Burton, 1981), or *emerging expertise* (Kerlavage, 1998). They develop ever more complex and satisfying schemas by imitating more advanced peers, siblings, or other relatives, by assiduously copying cartoon characters or how-to-draw instructions, and by more carefully observing the appearance of people and objects.

By the onset of puberty, children become even more self-conscious regarding their artistic ability and demand more sophistication in their work, and they become frustrated and discouraged if they cannot achieve it. At this stage, the opportunity and resources to develop more mature means of visual expression are essential if an individual is to continue drawing (Burton, 1981; Kerlavage, 1998; Lowenfeld, 1947/1982). Techniques such as basic linear perspective and the use of light and shadow can be taught and learned and provide a sense of power, competence, and peer approval via the

mastery of simple tricks, including how to make the letters of their name look three-dimensional.

By adolescence, most youth who have not benefited from the social support to continue drawing, via instruction or encouragement, completely stop, believing for the rest of their lives that drawing and art making are things they cannot do and are not interested in. Others, however, move on to what Burton (1981) called *ideas in search of forms* and use a growing repertoire of techniques to describe their understanding of themselves and their world. These young people can use art making to navigate complex issues of identity formation in adolescence, within their sociocultural context (Burton, 1981; Gude, 2007). Many continue to enjoy art-related activities as a pleasurable use of leisure time, and some may go on to careers in art, design, or related fields.

Artistic Talent and Drawing Prodigies

The well-established backdrop of typical development provides a frame for identifying early manifestations of drawing talent among children whose work deviates from the usual pattern—either in specific characteristics of their drawings and/or in the time course of achievement. One method of understanding early manifestations of talent involves retrospective studies of the childhood work of famous artists such as Toulouse-Lautrec, Picasso, and Klee (Pariser, 1987); unfortunately, there are few extant drawings by such artists made before age 9 or so. However, biographical accounts of later notable artists often emphasize an early strong motivation to master drawing techniques accompanied by an unusual facility at imitating nature and other artists' work. This is evident in Vasari's (1550/1991) account of Giotto as well as in later anecdotes about Picasso and many others, including contemporary luminaries such as Kerry James Marshall (Molesworth, 2016; see also Schlewitt-Haynes, Earthman, & Burns, 2002).

An alternative method is to examine children whose parents or teachers have identified them as precocious in drawing. Although prodigies in drawing are rarer than in chess, music, or mathematics, enough reports have accumulated to assess their developmental progress. Though drawing prodigies do not necessarily become artists as adults, their depictions are typically advanced by at least several years beyond their childhood peers'.

Winner and Drake (2013) outlined several characteristics that distinguish precocious drawers from ordinary children. First, precocious drawers learn more rapidly in the domain. They may draw recognizable shapes and differentiate basic body parts by the age of 2, use fluid contour to outline complex shapes, draw objects in noncanonical orientations, add rich detail, and suggest depth by the full range of historically hard-won techniques

of Western artists: foreshortening, occlusion, size diminution, shading and modeling, and even linear perspective—most remarkably in the case of a prodigy named Eitan (see Golomb, 1992). Second, drawing prodigies evince a *rage to master*—a high level of intrinsic motivation to perform exceptionally well in the domain. They work compulsively, needing no encouragement. The co-occurrence of precocity and drive suggests that motivation is an ineluctable component of talent—which arguably contrasts with claims in the cognitive psychological literature on expertise that the main determinant of accomplishment level is the amount of deliberate practice in a domain a person engages in rather than some innate talent or ability (see Ericsson, Krampe, & Tesch-Römer, 1993). Third, drawing prodigies make discoveries through self-teaching and without much explicit scaffolding. Fourth, in many cases, precocious drawers can do things, such as employ a complex but accurate fluid contour line beginning at any part of an object or vividly recall something previously seen, that are *never* mastered by ordinary children, even those who draw a lot. Indeed, by age 5, some prodigies are drawing at a level considerably more sophisticated than the vast majority of adults.

The preceding portrait of the artist as a child reinforces several themes in Vasari's (1550/1991) account of the young Giotto: intrinsic motivation (evident in Giotto's case by his drawing with makeshift materials in the meadow), early involvement and rapid progress in the domain, confident use of line, easy recognition of talent by others, and making depictive discoveries on one's own by the observation of nature and absorption of established representational schemas within an artist's culture (Gombrich, 1960). This last point is underscored by cases of non-Western prodigies such as the Chinese girl Wang Yani, who worked in the traditional brush painting style of her native country (Zhensun & Low, 1991).

MOVING BEYOND PRODIGIES TO A BROADER CHARACTERIZATION OF TALENT IN DRAWING AND ART

Although Vasari's (1550/1991) art historical account dovetails nicely with some contemporary psychological findings, many questions remain unanswered. Perhaps chief among these is, What kinds of psychological characteristics undergird the ability to draw realistically—in special populations such as prodigies or savants, in art students, and in accomplished adult artists? Identifying and characterizing such characteristics is central to understanding the nature of talent in drawing and in art. Moreover, understanding the extent to which advantages in, for instance, perceptual processing are antecedents versus consequences of drawing experience also bears strongly on the identification and cultivation of talent. Additionally, nonperceptual

factors involving, say, how artists structure their creative behavior within their sociocultural context may be just as critical in ultimately determining high achievement. The remainder of the chapter deals with these themes.

Perceptual and Cognitive Differences Associated With Drawing Skill

Several potential biological markers for precocious drawing skill have been identified. These include a higher-than-average incidence of nonright-handedness (Mebert & Michel, 1980) and of linguistic deficits such as dyslexia (Gordon, 1983), poor stereopsis (depth perception produced by the brain receiving input from both eyes; Livingstone, Lafer-Sousa, & Conway, 2011), plus a constellation of visual strengths. Some have argued that these may include superior visual memory and mental rotation ability (Perdreau & Cavanagh, 2015; Winner & Casey, 1992), object recognition (Kozhevnikov, Blazhenkova, & Becker, 2010), as well as notable advantages in local aspects of visual processing (Drake, Redash, Coleman, Haimson, & Winner, 2010)—that is, being able to draw details without the distraction of a broader context. The same strengths have been observed in several drawing savants with autism, such as the famous case of Nadia, who at age 5 could draw horses from memory with great expression, fluidity, and foreshortening (Selfe, 1977), or, more recently, a boy with autism known as JG (Drake & Winner, 2011, 2012).

The abilities evinced by savants like Nadia or Stephen Wiltshire, who can draw phenomenally detailed and accurate cityscapes from memory after seeing them only once (Treffert, 2009), are astounding by any standard. However, their relevance to the study of drawing and art more generally is ambiguous. Despite the interest such cases arouse, the extraordinary eidetic ability of such individuals may not reflect profiles of perceptual or cognitive abilities that are more broadly characteristic of artists. Indeed, some eminent artists apparently showed no signs of precocity—Matisse, for instance, did not even begin painting until he was 20. Moreover, an undue research focus on prodigies and savants suggests that artistic ability is largely innate and offers little guidance on how to best educate art students and cultivate the talent they have.

What kinds of perceptual or cognitive individual differences are broadly associated with drawing skill, and how might one use this information to identify talent in drawing or visual art? Few data on these questions were available just a few decades ago. Fortunately, numerous recent studies have addressed such questions. Many have focused on the possible perceptual advantages enjoyed by skilled artists. For instance, Kozbelt (2001) gave artists and nonartists various drawing tasks (mostly copying line drawings, which were then judged on accuracy) and perception tasks requiring visual analysis but that did not involve drawing per se (e.g., locating simple target shapes

embedded in more complex displays or identifying the subject of fragmented images). Artists outperformed nonartists on both kinds of tasks, providing empirical support for the idea that they perceive the world differently—and in some respects objectively better—from how nonartists do. Performance on the two sets of tasks was positively correlated, and statistically controlling for one or the other kind of task revealed that artists' perceptual advantages are best viewed as a subset of their drawing skills. That is, artists' perceptual advantages seem to be developed largely to the extent that they are useful in drawing.

This last point suggests that experience and training in drawing are associated with and may indeed drive the development of artists' perceptual strengths. But what is the nature of those perceptual strengths, and how do they account for high levels of drawing performance?

Bottom-Up Versus Top-Down Accounts of Drawing

Characterizations of the nature of visual artists' expertise and ability have taken two major forms, which can be termed *bottom-up* and *top-down* (Fava, 2014; Kantrowitz, 2012, 2014; Ostrofsky, Kozbelt, & Seidel, 2012).

Bottom-Up

The bottom-up view is related to the venerable notion of the *innocent eye* advocated by art historians such as John Ruskin (1857/1971) and Roger Fry (1919/1960). In this view, everyday knowledge of objects has a deleterious effect on drawing performance; thus, to draw accurately, one should forget what one knows and try to depict what one actually sees. This approach has been famously promulgated by a technique in which to-be-drawn images are inverted to reduce conceptual interference (e.g., Edwards, 2012). This approach thus promotes a focus on local details, an aspect of perceptual processing characteristic of children with autism spectrum disorder (ASD), such as Nadia (Selfe, 1977) and JG (Drake & Winner, 2011, 2012). Similarly, studies of non-ASD samples (Tchalenko, 2009; Tchalenko, Nam, Ladanga, & Miall, 2014) have found systematic, detailed, and regularized segmentation of perceptual information, as well as shorter visual fixations while drawing (Cohen, 2005), to be key components of observational drawing skill.

In some psychological research, the bottom-up view has more generally been articulated as the *misperception hypothesis*, which emphasizes early perceptual misencoding as the main determinant of drawing inaccuracies (Cohen & Bennett, 1997). Incorrectly encoding a to-be-drawn stimulus is thought to produce a cascade of errors throughout the process of depiction, resulting in a poor final drawing. Several studies assessing how accurately

individuals perceive and draw identical stimuli (Mitchell, Ropar, Ackroyd, & Rajendran, 2005; Ostrofsky, Kozbelt, & Cohen, 2015) suggest that the degree to which one misperceives a feature of an object is associated with the degree to which one errs in drawing it. Thus, there is some empirical support for the misperception hypothesis. However, other studies have yielded more ambiguous results. For instance, Chamberlain and Wagemans (2015) found no artist-versus-nonartist differences in the experience of several optical illusions and null correlations between the degree to which participants experienced these illusions and measures of drawing accuracy.

Other research on the misperception hypothesis has examined perceptual constancies, which preserve a stable view of inherently transient aspects of the visual world, such as the apparent shape or size of an object. A classic instance of shape constancy involves the perception of circular objects that project to the retina as ovals; when asked to match an oval to one of a set of ovals of different eccentricities, responses are biased toward more circular shapes, as though influenced by the viewer's knowledge of the object's true shape. With the bottom-up view, drawers should *suppress* the knowledge of the circularity of the real-world shape to draw the oval accurately. Although some studies of perceptual constancies support the misperception hypothesis (Cohen & Jones, 2008; Hammad, Kennedy, Juricevic, & Rajani, 2008; Ostrofsky, Cohen, & Kozbelt, 2014; Taylor & Mitchell, 1997; Thouless, 1931, 1932), others do not (McManus, Loo, Chamberlain, Riley, & Brunswick, 2011; Ostrofsky et al., 2012; Perdreau & Cavanagh, 2011).

In sum, despite some empirical evidence supporting the utility of a focus on local details as an important aspect of drawing skill, the bottom-up view does not appear to be a tenable, full characterization of drawing ability or talent. Besides mixed empirical findings, the bottom-up view also lacks specificity about perceptual mechanisms that proactively facilitate good drawing (with concomitant pedagogical shortcomings) and includes some theoretical limitations having to do with the nature of perception itself. Many of these deficiencies are addressed by the alternative top-down view, to which we now turn.

Top-Down

In contrast to the bottom-up view, the top-down view argues that no eye is innocent; rather, the intrinsic role of knowledge in perception is something to be harnessed rather than avoided. This perspective is associated with art historian E. H. Gombrich (1960), who promoted the idea that realistic art has a history precisely because mimesis is an inherently difficult problem, requiring the acquisition of an extensive base of knowledge and experience for its solution. Psychological incarnations of Gombrich's top-down explanation

have emphasized domain-specific knowledge, active decision making, and endogenous (i.e., self-directed) shifts of attention as major factors inherent in drawing skill (Kozbelt & Seeley, 2007; Ostrofsky et al., 2012).

Several lines of empirical work support the top-down view. These include improved drawing accuracy when individuals are given explicit knowledge of the structure of objects such as faces (Ostrofsky, Kozbelt, Tumminia, & Cipriano, 2016), enhanced efficiency in the perceptual processing of objects (Perdreau & Cavanagh, 2014) that is attributed to robust representations of object structures in memory, more astute selection of important visual features in a limited line-tracing task (Kozbelt, Seidel, ElBassiouny, Mark, & Owen, 2010; Ostrofsky et al., 2012), and enhanced flexibility in shifting attention between the global and local aspects of a stimulus (Chamberlain & Wagemans, 2015; Perdreau & Cavanagh, 2013). Thus, although the top-down view has not been as extensively tested as the bottom-up view has, the available evidence is largely in line with its predictions.

Moreover, being less constrained by representing the world as it is seen, the top-down approach is more useful in cultivating imaginative possibilities than a bottom-up approach is. As in other accounts of expertise acquisition (see Ericsson, Hoffman, Kozbelt, & Williams, 2018), the top-down view emphasizes the necessity of artists acquiring, through intensive training, a large base of domain-specific knowledge in learning to draw well rather than merely trying to block the interfering effects of everyday knowledge. The top-down emphasis on visual attention underscores the idea that a key aspect of skilled drawing involves highlighting essential structural or configural aspects of an object or scene while suppressing irrelevant detail. Sutton and Rose (1998) found that progression toward visual realism in children's drawings was accompanied by a spontaneous increase in attention to the stimulus and that simple but explicit instructions to pay attention to the stimulus increased the visual realism of the drawings. Along these lines, explicitly teaching children to understand and manage relationships between parts and wholes helps them learn how to draw from observation (Smith, 1998).

In perceptual terms, a top-down approach to drawing pedagogy would emphasize acquiring declarative knowledge of specific common objects, such as the proportions of human faces and bodies (Kozbelt & Seeley, 2007; Ostrofsky et al., 2014); explicit representations of drawing systems for representation space, such as various forms of linear perspective (Willats, 1997); and standard techniques of depiction in various media, such as the use of contour line or cross-hatching to indicate volume (Hale, 1964; Nicolaides, 1941/1969). Beyond these, the top-down approach would also emphasize the importance of proceduralizing acquired knowledge through motor practice (Seeley & Kozbelt, 2008) as well as general visual analytic strategies for understanding and guiding attention to object features important

for depiction and recognition (Ostrofsky et al., 2012). In sum, the top-down perspective affirmatively proposes numerous specific means of cultivating drawing training and talent development in contrast with the more limited pedagogical applications of the bottom-up view.

INTEGRATING BOTTOM-UP AND TOP-DOWN ACCOUNTS

Although the bottom-up and top-down views may not be equally useful in theoretical or pedagogical terms, at the very least there is some evidence in support of both perspectives. In that case, how can the conflicting bottom-up and top-down accounts be integrated? First, they may simply apply to different depictive problems: Bottom-up methods may help resolve an object's two-dimensional proportions or clarify details, whereas top-down methods may facilitate appropriate visual selection in a complex scene. Clarifying the meaning of *knowledge* (and its interfering vs. facilitating effects) in the two accounts is also useful: The bottom-up view engages generic knowledge of object types useful for everyday perception, whereas the top-down view regards knowledge as highly specialized, artificial, domain- (or even medium-) specific, and useful for understanding object structure and achieving desired effects in a depiction.

It may also be advantageous to conceptualize bottom-up and top-down modes as attentional *strategies*, flexibly implemented to deal with perceptual ambiguities, rather than as mechanistic perceptual processes (Chamberlain & Wagemans, 2015; Fava, 2014; Kantrowitz, 2014; Kozbelt & Seeley, 2007; Seeley & Kozbelt, 2008). A bottom-up strategy might involve selecting the most characteristic lines, angles, or shapes upon which to construct forms and assessing overall spatial relationships. Novices may find bottom-up strategies particularly useful because they must slow down and look carefully rather than rely on simplistic and inaccurate preconceptions as they learn to avoid common cognitive errors about the appearance of things in the world. Top-down strategies may help resolve perceptual ambiguities based on the expectation of a feature at a particular location or inform a decision to emphasize a diagnostic feature, enhancing recognition of a depicted object (Kozbelt & Seeley, 2007). For example, an artist might render facial features obscured by a half shadow more distinctly than they would appear, say, in a photograph to clarify the structure or identity of a person's face; although these enhancements depart from the bottom-up perceptual signal, they promote recognition and fluent perceptual processing among viewers. As artists develop an expert knowledge base of declarative patterns and dynamic procedures for perception and depiction, top-down schemas (Gombrich, 1960) become increasingly important. These may facilitate astute selection of viewpoint-dependent

information that still accurately captures an object's structure (Kozbelt et al., 2010; Perdreau & Cavanagh, 2011, 2014). Experienced artists may have substantial strategic flexibility, reverting from top-down to bottom-up strategies when drawing unfamiliar objects, correcting depictive errors, or generating novel visual ideas.

Finally, the two accounts arguably address fundamentally different issues. The bottom-up view, via the misperception hypothesis, focuses on *why nonartists draw poorly*. The top-down view, articulated as knowledge-based schemas driving shifts of attention, focuses on *why artists draw well*. Knowing the answer to one of these questions does not necessarily tell you the answer to the other. Two sets of explanations, rooted in processes and mechanisms that are differentially characteristic of skilled versus unskilled drawers, may be required, with concomitant pedagogical emphases, depending on the skill level in question.

SUMMARY CHARACTERIZATION: ARTISTS AS EXPERTS IN VISUAL COGNITION

Most of our preceding treatment has focused on the *perceptual* factors associated with skill and talent in drawing. By way of some final remarks about artists' perception, we note that a rich psychological characterization of the activity and skill of drawing can be grounded in an insight that has only been alluded to thus far: In creating realistic depictions of a three-dimensional world on a two-dimensional surface, *skilled artists must solve precisely the same problems as the human visual system does more generally*. The flexibility of the visual system in processing all manner of visual information (even novel objects) suggests, potentially, a similar flexibility in the nature of artists' expertise (Kozbelt & Ostrofsky, 2018). Expertise in drawing or visual art may thus differ from other domains in which skilled performance relies on a repertoire of highly domain-specific patterns. As a paradigmatic instance, chess grandmasters can accurately reproduce the positions of some 20 pieces from a midgame chessboard seen only briefly; this is not the case if the pieces are randomly arranged (Chase & Simon, 1973). This dissociation underscores the fragility of experts' apparent perceptual advantages in chess and many other domains.

Artists may be different. Kozbelt (2001) characterized artists as experts in visual cognition. Rather than relying on set, familiar patterns, artists have potentially greater flexibility in processing visual information. This advantage is clearest in their understanding of the structure of objects (Perdreau & Cavanagh, 2014) and other high-level aspects of visual analysis (e.g., Kozbelt, 2001); it need not extend to very early stages or very low levels of

visual processing (Ostrofsky, Kozbelt, & Kurylo, 2013; Perdreau & Cavanagh, 2011), as with visual illusions (Chamberlain & Wagemans, 2015; Cohen & Bennett, 1997). In any case, the weight of the evidence to date strongly suggests that many aspects of visual perception are highly relevant to the activity of drawing and plausibly play a significant role in talent development in that domain.

ARTISTS, PERCEPTION, AND TALENT DEVELOPMENT: UNRESOLVED ISSUES

From the standpoint of talent development, the aspect of artists' perceptual advantages that is probably of greatest interest is the extent to which they are antecedents versus consequences of experience in drawing. On the one hand, perceptual strengths may predispose individuals to pursue art and drawing in the first place, facilitating development and bolstering motivation, because these individuals may naturally be better able to perform than individuals who lack such perceptual advantages. Evidence from drawing prodigies (e.g., Winner & Drake, 2013) suggests the plausibility of some initial advantages in perceptual processing, though as noted above, the extent to which these apply to nonprecocious (but still talented) young artists remains unknown.

Alternatively, extended engagement with the process of observational drawing may drive changes in perceptual ability, along the lines of Kozbelt's (2001) finding that artists' perceptual advantages appear to be developed mainly to the extent that they are useful in drawing. An important role for experience in inducing changes in perceptual abilities also suggests some malleability in the nature of any accrued advantages based on the kind of training or experience an artist has—a point relevant to cross-cultural (Kozbelt, 2016; Nisbett, 2003) and transhistorical (Kozbelt & Ostrofsky, 2013) comparisons—as well as differences resulting from varied training regimens that emphasize, say, drawing for the purpose of spatial visualization versus expressive mark making (Enstice & Peters, 1990).

Despite several decades of research on artists and perception, we still have few answers to basic questions about the relation between artistic training and perceptual abilities. These questions include the direction of the causal arrow linking the two, the developmental time course of changes in perceptual versus depictive skill as artists undergo drawing training, and the extent to which different emphases in drawing curricula differentially impact various perceptual abilities. Such questions are likely to remain unanswered in the absence of controlled longitudinal training studies. But in pursuing this line of inquiry, some guidance may be had from more general surveys

of perceptual differences associated with expertise (Landy, 2018) as well as research on other perception-intensive domains. For instance, in a noteworthy series of studies, Bevalier and colleagues (e.g., Li, Polat, Makous, & Bavelier, 2009) found systematic changes in low-level visual processing resulting from videogame playing—even when conditions were randomly assigned—implying that videogaming causally impacted some perceptual abilities. Moving forward, such research may serve as a model for resolving many questions about drawing and perception—both among young persons who demonstrate early ability in drawing and among more advanced artists-in-training.

BEYOND PERCEPTION: OTHER ASPECTS OF ARTISTIC TALENT

Throughout this chapter, we have argued that perceptual strengths play an inherent and substantial role in drawing ability, and we have summarized theoretical perspectives and the available empirical evidence on this point. However, although much psychological research on artists has focused on perceptual issues, these are not the only important characteristic of ability in drawing or art. Many other factors may play roles, particularly in moving beyond mimesis and considering creative aspects of depiction and real-world artistic achievement more generally.

Another set of factors may be broadly characterized as *process* factors. These involve how individuals structure their behavior and cognition while involved in creative work and may take several forms at different levels of analysis. One theme, still engaging perceptual processes and operating at a microlevel of analysis, concerns how individuals engage the process of drawing. Suwa and Tversky (2003) coined the term *constructive perception* to describe the "deliberate adoption of perceptual strategies in the service of cognition" (p. 1140). The purposeful employment of top-down and bottom-up strategies in alternation allows experts to *see into* their sketches, revising and reconfiguring their own lines and marks, to come up with unanticipated interpretations.

Over a more extended timeframe, the ability to prolong ambiguities and not impose a premature sense of closure on a developing drawing is another important way in which skilled artists often structure their creative behavior. Doing so promotes discovery, allowing the final sense of the whole to emerge slowly rather than be imposed prematurely. Novices, on the other hand, have been found to rush toward resolution (Kavakli, Suwa, Gero, & Purcell, 1999; Verstijnen, van Leeuwen, Goldschmidt, Hamel, & Hennessey, 1998). Taking more time to notice what is happening on the page that might be unplanned

or unexpected and seeing and responding to those small discoveries result in a kind of nonverbal dialogue between artist and artwork (Fish & Scrivener, 1990; Kantrowitz, 2012). This dialogic process is also essential to sketching to solve problems by designers and architects (Goldschmidt, 1991; Schon & Wiggins, 1992; Suwa, Gero, & Purcell, 1998; Suwa, Tversky, Gero, & Purcell, 2001). Fine artists who draw improvisationally (i.e., without a clear target in mind) employ a similar dialogic process to generate new ideas for their work (Kantrowitz, 2014).

This contrast echoes a venerable finding in the creativity literature by Getzels and Csikszentmihalyi (1976) in their study of the creative processes of college art students as they created drawings based on an open-ended still-life arrangement task. Getzels and Csikszentmihalyi coined the term *problem finding* to characterize the highly exploratory behavior characteristic of the artists in their sample who produced the most creative drawings. By examining many possibilities both before and while drawing, more creative study participants were able to discover an idea or problem that was not predetermined by the situation and to address that problem in the drawing. Interestingly, this exploratory behavior prior to and during drawing predicted success in the art world many years later (Csikszentmihalyi & Getzels, 1989). Other researchers have replicated and extended aspects of problem finding (Dudek & Côté, 1994; Kozbelt, 2008), reinforcing the importance of avoiding premature closure and engaging in opportunistic problem-solving strategies as key aspects of creative behavior in art.

More refined analyses of the concurrent verbal protocols of visual artists and nonartists as they created original drawings have also revealed substantial differences (e.g., Fayena-Tawil, Kozbelt, & Sitaras, 2011). In that study, verbal statements by each artist or nonartist were categorized into several types of cognitive processes (e.g., descriptions, goals, plans) and corresponding metacognitive processes, as well as positive or negative evaluations and indications of uncertainty. When drawing, artists made more goal statements, more positive evaluations, and fewer negative evaluations than did nonartists. Artists also engaged in more metacognition having to do with monitoring the emerging progress of the drawing. Similarly, when Fava (2014) analyzed the verbal protocols of experienced artists as they drew, she found there was a deliberate and rhythmic alternation between attentional and metacognitive processes. Together, these studies suggest that certain higher-order cognitive processes may contribute to creative thinking in visual art and that these might be deliberately cultivated in the service of talent development.

As Suwa and Tversky's (2003) work on constructive perception implies, such cognitive processes related to creativity and imagination are built on a foundation of drawing skill, whereby external depictive representations are put down in the service of idea development and evaluation. This iterative

dynamic between evolving internal and external representation echoes Gombrich's (1960) dictum "making comes before matching." Gombrich's original formulation concerned the way artists devise, apply, and evolve schemas for increasingly mimetic depictions. However, the same principle applies to creative and imaginative aspects of drawing in which the external representation is used as a springboard for further development—both at the level of developing a single drawing and during the more extended timeframe of a solid technical foundation of drawing ability facilitating visual thinking and expression toward imaginative ends.

Tools for creative visualization are integrated into many drawing pedagogies. But within educational settings, the use of drawing as a way of having a conversation with oneself, to generate and explore ideas and perceptions, is more likely to take place in students' private sketchbooks, or doodles in the margins of academic notebooks, than in art class. What Burton (2005) called the *integrity of personal experience* is often put to the side as students are encouraged to gain technical skills and familiarity with sanctioned exemplars of visual culture. Sustainable creative work may need to be built on a solid foundation of manual and cognitive skills, as it is in other forms of artistry (see also Kozbelt, 2004). If a goal is the development of creativity as well as technique, however, learning to pay attention and respond to the unexpected and unforeseen in one's artwork is essential (Kantrowitz, 2014).

CONCLUSION

> You may say this is a visionary world, but it has its own Way, and is, while you look at it, just the same as the real world.
>
> —Gong Xian, 17th century

The connections between drawing and art, perception and cognition, and development and training, which we have discussed throughout this chapter, suggest a rich emerging conceptual constellation that is becoming increasingly tractable to empirical study and whose links are mutually reinforcing. The acquisition of drawing skill facilitates a capacity for greater creative expression; perceptual strengths and cognitive strategies undergird those capacities, and these factors' natural courses of development are guided and impacted by training and experience. Better understanding the nature of these relations in the service of talent development is its own reward, in both scientific and humanistic or experiential terms.

Indeed, the maturation of artistic talent echoes children's world of pretend play (Gopnik, 2009; Taylor, 1999). When children and imaginative artists construct imaginary worlds, they learn to make up their own rules

and play out their consequences. Children's pretend play is in the service of acquiring understanding of, and agency in, the real world; adult artists bring a repertoire of skills, knowledge, and understandings acquired over decades to their intentional reimagination of virtual objects and worlds. Visual art provides an arena for adults to engage in a kind of childlike play in which rules are invented and played out and logically consistent alternative realities can be constructed and explored. Artists can create a kind of parallel universe, a place of escape and solace, or high adventure and fantasy, where things can happen that would be catastrophic in real life. Art can make visible invisible or overlooked aspects of experience. By harnessing the complexity of the ways in which seeing and understanding are linked in human beings, at its best, art reaches across differences between individuals, cultures, and historical periods, joining viewer and artist in recognition of a common humanity.

REFERENCES

Bourdieu, P. (1984). *Distinction: A social critique of the judgement of taste*. Cambridge, MA: Harvard University Press. (Originally published in 1979 by Les Éditions de Minuit, Paris, as *La Distinction: Critique sociale du jugement*)

Brown, D. (1991). *Human universals*. New York, NY: McGraw-Hill.

Burton, J. (1981). Developing minds: Representing experiences: Ideas in search of forms. *School Arts*, *80*, 58–64.

Burton, J. (2005). The integrity of personal experience, or, the presence of life in art. *International Journal of Arts in Education*, *3*, 9–23.

Chamberlain, R., & Wagemans, J. (2015). Visual arts training is linked to flexible attention to local and global levels of visual stimuli. *Acta Psychologica*, *161*, 185–197. http://dx.doi.org/10.1016/j.actpsy.2015.08.012

Chase, W. G., & Simon, H. A. (1973). Perception in chess. *Cognitive Psychology*, *4*, 55–81. http://dx.doi.org/10.1016/0010-0285(73)90004-2

Cohen, D. J. (2005). Look little, look often: The influence of gaze frequency on drawing accuracy. *Perception & Psychophysics*, *67*, 997–1009. http://dx.doi.org/10.3758/BF03193626

Cohen, D. J., & Bennett, S. (1997). Why can't most people draw what they see? *Journal of Experimental Psychology: Human Perception and Performance*, *23*, 609–621. http://dx.doi.org/10.1037/0096-1523.23.3.609

Cohen, D. J., & Jones, H. E. (2008). How shape constancy relates to drawing accuracy. *Psychology of Aesthetics, Creativity, and the Arts*, *2*, 8–19. http://dx.doi.org/10.1037/1931-3896.2.1.8

Csikszentmihalyi, M., & Getzels, J. W. (1989). Creativity and problem finding. In F. H. Farley & R. W. Neperud (Eds.), *The foundations of aesthetics* (pp. 91–116). New York, NY: Praeger.

Drake, J. E., Redash, A., Coleman, K., Haimson, J., & Winner, E. (2010). "Autistic" local processing bias also found in children gifted in realistic drawing. *Journal of Autism and Developmental Disorders*, *40*, 762–773. http://dx.doi.org/10.1007/s10803-009-0923-0

Drake, J. E., & Winner, E. (2011). Realistic drawing talent in typical adults is associated with the same kind of local processing bias found in individuals with ASD. *Journal of Autism and Developmental Disorders*, *41*, 1192–1201. http://dx.doi.org/10.1007/s10803-010-1143-3

Drake, J. E., & Winner, E. (2012). Predicting artistic brilliance. *Scientific American Mind*, *23*, 42–49. http://dx.doi.org/10.1038/scientificamericanmind1112-42

Dudek, S. Z., & Côté, R. (1994). Problem finding revisited. In M. A. Runco (Ed.), *Problem finding, problem solving, and creativity* (pp. 130–150). Norwood, NJ: Ablex.

Edwards, B. (2012). *Drawing on the right side of the brain: The definitive* (4th ed.). New York, NY: Penguin.

Enstice, W., & Peters, M. (1990). *Drawing: Space, form, and expression*. New York, NY: Prentice Hall.

Ericsson, K. A., Hoffman, R. H., Kozbelt, A., & Williams, A. M. (Eds.). (2018). *The Cambridge handbook of expertise and expert performance* (2nd ed.). New York, NY: Cambridge University Press.

Ericsson, K. A., Krampe, R. Th., & Tesch-Römer, C. (1993). The role of deliberate practice in the acquisition of expert performance. *Psychological Review*, *100*, 363–406. http://dx.doi.org/10.1037/0033-295X.100.3.363

Fava, M. (2014). *Understanding drawing: A cognitive account of observational process* (Unpublished doctoral dissertation). Loughborough University, Loughborough, England.

Fayena-Tawil, F., Kozbelt, A., & Sitaras, L. (2011). Think global, act local: A protocol analysis comparison of artists' and non-artists' cognitions, metacognitions, and evaluations while drawing. *Psychology of Aesthetics, Creativity, and the Arts*, *5*, 135–145. http://dx.doi.org/10.1037/a0021019

Feist, G. J. (2004). The evolved fluid specificity of human creative talent. In R. J. Sternberg, E. L. Grigorenko, & J. L. Singer (Eds.), *Creativity: From potential to realization* (pp. 57–82). Washington, DC: American Psychological Association. http://dx.doi.org/10.1037/10692-005

Fish, J., & Scrivener, S. (1990). Amplifying the mind's eye: Sketching and visual cognition. *Leonardo*, *23*, 117–126. http://dx.doi.org/10.2307/1578475

Fry, R. (1960). *Vision and design*. New York, NY: Meridian Books. (Original work published 1919)

Galenson, D. W. (2009). *Conceptual revolutions in 20th century art*. New York, NY: Cambridge University Press. http://dx.doi.org/10.3386/w15073

Gardner, H. (1983). *Frames of mind*. New York, NY: Basic Books.

Getzels, J. W., & Csikszentmihalyi, M. (1976). *The creative vision: A longitudinal study of problem finding in art*. New York, NY: Wiley.

Goldschmidt, G. (1991). The dialectics of sketching. *Creativity Research Journal*, *4*, 123–143. http://dx.doi.org/10.1080/10400419109534381

Golomb, C. (1992). *The creation of a pictorial world*. Berkeley: University of California Press.

Gombrich, E. H. (1960). *Art and illusion*. Princeton, NJ: Princeton University Press.

Gopnik, A. (2009). *The philosophical baby: What children's minds tell us about truth, love, and the meaning of life*. New York, NY: Random House.

Gordon, H. (1983, April). The learning disabled are cognitively right. *Topics in Learning and Learning Disabilities*, 29–39.

Gude, O. (2007). Principles of possibility: Considerations for a 21st-century art and culture curriculum. *Art Education*, *60*, 6–17. http://dx.doi.org/10.1080/00043125.2007.11651621

Hale, R. B. (1964). *Drawing lessons from the great masters*. New York, NY: Watson-Guptill.

Hammad, S., Kennedy, J. M., Juricevic, I., & Rajani, S. (2008). Ellipses on the surface of a picture. *Perception*, *37*, 504–510. http://dx.doi.org/10.1068/p5840

Kantrowitz, A. (2012, May). Drawn to discover: A cognitive perspective. *Tracey*. Retrieved from http://www.lboro.ac.uk/microsites/sota/tracey/journal/edu/2012/kantrowitz.html

Kantrowitz, A. (2014). *A cognitive-ethnographic study of eight contemporary artists' drawing practices* (Unpublished doctoral dissertation). Teachers College, Columbia University, New York, NY.

Kavakli, M., Suwa, M., Gero, J. S., & Purcell, T. (1999). Sketching interpretation in expert and novice designers. In J. S. Gero & B. Tversky (Eds.), *Visual reasoning in design* (pp. 209–219). Sydney, Australia: Key Centre of Design Computing and Cognition, University of Sydney.

Kerlavage, M. S. (1998). Understanding the learner. In J. W. Simpson, J. M. Delaney, K. L. Carroll, C. M. Hamilton, S. I. Kay, M. S. Kerlavage, & J. L. Olson (Eds.), *Creating meaning through art: Teacher as choice maker* (pp. 23–72). Upper Saddle River, NJ: Pearson.

Kozbelt, A. (2001). Artists as experts in visual cognition. *Visual Cognition*, *8*, 705–723. http://dx.doi.org/10.1080/13506280042000090

Kozbelt, A. (2004). Originality and technical skill as components of artistic quality. *Empirical Studies of the Arts*, *22*, 157–170. http://dx.doi.org/10.2190/NDR5-G09N-X7RE-34H7

Kozbelt, A. (2008). Hierarchical linear modeling of creative artists' problem solving behaviors. *The Journal of Creative Behavior*, *42*, 181–200. http://dx.doi.org/10.1002/j.2162-6057.2008.tb01294.x

Kozbelt, A. (2016). Creativity and culture in visual art. In V. Glăveanu (Ed.), *The Palgrave handbook of creativity and culture* (pp. 573–594). Hampshire, England: Palgrave. http://dx.doi.org/10.1057/978-1-137-46344-9_28

Kozbelt, A., & Ostrofsky, J. (2013). Extending the psycho-historical framework to understand artistic production. *Behavioral and Brain Sciences*, *36*, 148–149. http://dx.doi.org/10.1017/S0140525X12001689

Kozbelt, A., & Ostrofsky, J. (2018). Expertise in drawing. In K. A. Ericsson, R. H. Hoffman, A. Kozbelt, & A. M. Williams (Eds.), *The Cambridge handbook of expertise and expert performance* (2nd ed., pp. 576–596). New York, NY: Cambridge University Press. http://dx.doi.org/10.1017/9781316480748.030

Kozbelt, A., & Seeley, W. P. (2007). Integrating art historical, psychological, and neuroscientific explanations of artists' advantages in drawing and perception. *Psychology of Aesthetics, Creativity, and the Arts*, *1*, 80–90. http://dx.doi.org/10.1037/1931-3896.1.2.80

Kozbelt, A., Seidel, A., ElBassiouny, A., Mark, Y., & Owen, D. R. (2010). Visual selection contributes to artists' advantages in realistic drawing. *Psychology of Aesthetics, Creativity, and the Arts*, *4*, 93–102. http://dx.doi.org/10.1037/a0017657

Kozhevnikov, M., Blazhenkova, O., & Becker, M. (2010). Trade-off in object versus spatial visualization abilities: Restriction in the development of visual-processing resources. *Psychonomic Bulletin & Review*, *17*, 29–35. http://dx.doi.org/10.3758/PBR.17.1.29

Landy, D. (2018). Perception in expertise. In K. A. Ericsson, R. H. Hoffman, A. Kozbelt, & A. M. Williams (Eds.), *The Cambridge handbook of expertise and expert performance* (2nd ed., pp. 151–164). New York, NY: Cambridge University Press. http://dx.doi.org/10.1017/9781316480748.010

Li, R., Polat, U., Makous, W., & Bavelier, D. (2009). Enhancing the contrast sensitivity function through action video game training. *Nature Neuroscience*, *12*, 549–551. http://dx.doi.org/10.1038/nn.2296

Livingstone, M. S., Lafer-Sousa, R., & Conway, B. R. (2011). Stereopsis and artistic talent: Poor stereopsis among art students and established artists. *Psychological Science*, *22*, 336–338. http://dx.doi.org/10.1177/0956797610397958

Lowenfeld, V. (1982). *Creative and mental growth*. New York, NY: Macmillan. (Original work published 1947)

Luquet, G.-H. (2001). *Le Dessin enfantin* [Children's drawings]. (A. Costall, Trans.). Paris, France: Alcan. (Reprinted from *Le Dessin enfantin* [Children's drawings], by G.-H. Luquet, 1927, London, England: Free Association Books)

McManus, C., Loo, P., Chamberlain, R., Riley, H., & Brunswick, N. (2011). Does shape constancy relate to drawing ability? Two failures to replicate. *Empirical Studies of the Arts*, *29*, 191–208. http://dx.doi.org/10.2190/EM.29.2.d

Mebert, C., & Michel, G. (1980). Handedness in artists. In J. Herron (Ed.), *Neuropsychology of left-handedness* (pp. 273–278). New York, NY: Academic Press.

Mitchell, P., Ropar, D., Ackroyd, K., & Rajendran, G. (2005). How perception impacts on drawings. *Journal of Experimental Psychology: Human Perception and Performance*, *31*, 996–1003. http://dx.doi.org/10.1037/0096-1523.31.5.996

Molesworth, H. (Ed.). (2016). *Kerry James Marshall: Mastry*. New York, NY: Skira Rizzoli.

Murray, C. (2003). *Human accomplishment*. New York, NY: Basic Books.

Nicolaides, K. (1969). *The natural way to draw: A working plan for art study*. Boston, MA: Houghton Mifflin. (Original work published 1941)

Nisbett, R. (2003). *The geography of thought: How Asians and Westerners think differently . . . and why*. New York, NY: Free Press.

Ostrofsky, J., Cohen, D. J., & Kozbelt, A. (2014). Objective versus subjective measures of face-drawing accuracy and their relations with perceptual constancies. *Psychology of Aesthetics, Creativity, and the Arts*, 8, 486–497. http://dx.doi.org/10.1037/a0037558

Ostrofsky, J., Kozbelt, A., & Cohen, D. J. (2015). Observational drawing biases are predicted by biases in perception: Empirical support of the misperception hypothesis of drawing accuracy with respect to two angle illusions. *Quarterly Journal of Experimental Psychology*, 68, 1007–1025. http://dx.doi.org/10.1080/17470218.2014.973889

Ostrofsky, J., Kozbelt, A., & Kurylo, D. (2013). Perceptual grouping in artists and non-artists: A psychophysical comparison. *Empirical Studies of the Arts*, *31*, 131–143. http://dx.doi.org/10.2190/EM.31.2.b

Ostrofsky, J., Kozbelt, A., & Seidel, A. (2012). Perceptual constancies and visual selection as predictors of realistic drawing skill. *Psychology of Aesthetics, Creativity, and the Arts*, 6, 124–136. http://dx.doi.org/10.1037/a0026384

Ostrofsky, J., Kozbelt, A., Tumminia, M., & Cipriano, M. (2016). Why do non-artists draw the eyes too far up the head? How vertical eye-drawing errors relate to schematic knowledge, pseudoneglect, and context-based perceptual biases. *Psychology of Aesthetics, Creativity, and the Arts*, 10, 332–343. http://dx.doi.org/10.1037/a0040368

Pariser, D. (1987). The juvenile drawings of Klee, Toulouse-Lautrec and Picasso. *Visual Arts Research*, *13*, 53–67.

Pariser, D. (1991). Normal and unusual aspects of juvenile artistic development in Klee, Lautrec, and Picasso. *Creativity Research Journal*, *4*, 51–65. http://dx.doi.org/10.1080/10400419109534373

Perdreau, F., & Cavanagh, P. (2011). Do artists see their retinas? *Frontiers in Human Neuroscience*, *5*, 171. http://dx.doi.org/10.3389/fnhum.2011.00171

Perdreau, F., & Cavanagh, P. (2013). The artist's advantage: Better integration of object information across eye movements. *Iperception*, *4*, 380–395. http://dx.doi.org/10.1068/i0574

Perdreau, F., & Cavanagh, P. (2014). Drawing skill is related to the efficiency of encoding object structure. *Iperception*, *5*, 101–119. http://dx.doi.org/10.1068/i0635

Perdreau, F., & Cavanagh, P. (2015). Drawing experts have better visual memory while drawing. *Journal of Vision*, *15*, 5. http://dx.doi.org/10.1167/15.5.5

Pfeiffer, J. E. (1982). *The creative explosion*. New York, NY: Harper & Row.

Root-Bernstein, R., Allen, L., Beach, L., Bhadula, R., Fast, J., Hosey, C., . . . Podufaly, A. (2008). Arts foster scientific success: Avocations of Nobel, National Academy, Royal Society, and Sigma Xi members. *Journal of Psychology of Science and Technology*, *1*, 51–63.

Ruskin, J. (1971). *The elements of drawing*. Mineola, NY: Dover. (Original work published 1857)

Sawyer, R. K. (2006). *Explaining creativity: The science of human innovation*. New York, NY: Oxford University Press.

Schlewitt-Haynes, L. D., Earthman, M. S., & Burns, B. (2002). Seeing the world differently: An analysis of descriptions of visual experiences provided by visual artists and nonartists. *Creativity Research Journal*, *14*, 361–372. http://dx.doi.org/10.1207/S15326934CRJ1434_7

Schon, D. A., & Wiggins, G. (1992). Kinds of seeing and their function in designing. *Design Studies*, *13*, 135–156. http://dx.doi.org/10.1016/0142-694X(92)90268-F

Seeley, W. P., & Kozbelt, A. (2008). Art, artists, and perception: A model for pre-motor contributions to perceptual analysis and form recognition. *Philosophical Psychology*, *21*, 149–171. http://dx.doi.org/10.1080/09515080801976573

Selfe, L. (1977). *Nadia: A case of extraordinary drawing ability in an autistic child*. London, England: Academic Press.

Shiner, L. (2001). *The invention of art: A cultural history*. Chicago, IL: University of Chicago Press. http://dx.doi.org/10.7208/chicago/9780226753416.001.0001

Smith, N. R. (1998). *Observation drawing with children: A framework for teachers*. New York, NY: Teachers College Press.

Sutton, P. J., & Rose, D. H. (1998). The role of strategic visual attention in children's drawing development. *Journal of Experimental Child Psychology*, 68, 87–107. http://dx.doi.org/10.1006/jecp.1997.2419

Suwa, M., Gero, J. S., & Purcell, T. A. (1998). The roles of sketches in early conceptual design processes. In *Proceedings of the 20th Annual Meeting of the Cognitive Science Society* (pp. 1043–1048). Hillsdale, NJ: Erlbaum.

Suwa, M., & Tversky, B. (2003). Constructive perception: A skill for coordinating perception and conception. In R. Alterman & D. Kirsh (Eds.), *Proceedings of the Cognitive Science Society Meetings* (pp. 1140–1145). Mahwah, NJ: Erlbaum.

Suwa, M., Tversky, B., Gero, J., & Purcell, T. (2001). Seeing into sketches: Regrouping parts encourages new interpretations. In J. S. Gero, B. Tversky, & T. Purcell (Eds.), *Visual and spatial reasoning in design* (pp. 207–219). Sydney, Australia: Key Centre of Design Computing and Cognition.

Taylor, L. M., & Mitchell, P. (1997). Judgments of apparent shape contaminated by knowledge of reality: Viewing circles obliquely. *British Journal of Psychology*, 88, 653–670. http://dx.doi.org/10.1111/j.2044-8295.1997.tb02663.x

Taylor, M. (1999). *Imaginary companions and the children who create them*. New York, NY: Oxford University Press.

Tchalenko, J. (2009). Segmentation and accuracy in copying and drawing: Experts and beginners. *Vision Research*, *49*, 791–800. http://dx.doi.org/10.1016/j.visres.2009.02.012

Tchalenko, J., Nam, S.-H., Ladanga, M., & Miall, R. C. (2014). The gaze-shift strategy in drawing. *Psychology of Aesthetics, Creativity, and the Arts*, 8, 330–339. http://dx.doi.org/10.1037/a0036132

Thouless, R. H. (1931). Phenomenal regression to the real object. *British Journal of Psychology*, *21*, 339–359.

Thouless, R. H. (1932). Individual differences in phenomenal regression. *British Journal of Psychology*, *22*, 216–241.

Toku, M. (2001). Cross-cultural analysis of artistic development: Drawing by Japanese and US children. *Visual Arts Research*, *27*, 46–59.

Treffert, D. A. (2009). The savant syndrome: An extraordinary condition. A synopsis: Past, present, future. *Philosophical Transactions of the Royal Society of London: Series B. Biological Sciences*, *364*, 1351–1357. http://dx.doi.org/10.1098/rstb.2008.0326

Vasari, G. (1991). *The lives of the artists* (J. C. Bondanella & P. Bondanella, Trans.). New York, NY: Oxford University Press. (Original work published 1550)

Verstijnen, I. M., van Leeuwen, C., Goldschmidt, G., Hamel, R., & Hennessey, J. M. (1998). Creative discovery in imagery and perception: Combining is relatively easy, restructuring takes a sketch. *Acta Psychologica*, 99, 177–200. http://dx.doi.org/10.1016/S0001-6918(98)00010-9

Willats, J. (1997). *Art and representation: New principles in the analysis of pictures*. Princeton, NJ: Princeton University Press.

Winner, E., & Casey, M. B. (1992). Cognitive profiles of artists. In G. Cupchik & J. László (Eds.), *Emerging visions of the aesthetic process* (pp. 154–170). New York, NY: Cambridge University Press.

Winner, E., & Drake, J. E. (2013). The rage to master: The decisive role of talent in the visual arts. In S. B. Kaufman (Ed.), *The complexity of greatness: Beyond talent or practice* (pp. 333–365). New York, NY: Oxford University Press. http://dx.doi.org/10.1093/acprof:oso/9780199794003.003.0016

Zhensun, A., & Low, A. (1991). *A young painter: The life and paintings of Wang Yani—China's extraordinary young artist*. New York, NY: Scholastic.

GATEKEEPER INTERVIEW: TALENT AND ABILITY IN DRAWING: AN ACCOUNT FROM THE FIELD

LINDA JARVIN

This section summarizes the main points discussed in an interview with the recently retired provost of a major art institution on the East Coast of the United States.[1] The college enrolls nearly 3,500 undergraduate, graduate, and continuing studies students, and its programs are ranked in the top 10 by U.S. News and World Report. This interview took place on November 5, 2017.

Linda Jarvin: Looking back over your career at major art schools in the United States, how would you say that the role of drawing in the art curriculum has changed over time?

Interviewee: Drawing used to be perceived as the fundamental backbone of visual expression and the doorway to any visual arts career, but more and more there is a perception that drawing isn't necessary for all students. Students can present application portfolios without including drawing; they can submit portfolios that are all photography, animation, or digital work.

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[1] The interviewee opted to remain anonymous but reviewed and approved this transcription of the interview.

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Many art programs start with a shared foundation year before students specialize in a major; however, there is less and less common agreement as to what a foundation program is.

Linda Jarvin: So what do you think the freshman curriculum should be? Does the foundation program still have its place?

Interviewee: At [the institution I used to direct] none of the faculty members at the freshman level came out of art school with a drawing education and likely do not understand what drawing is. Over the course of the years, there has been an explicit devaluation of drawing, which is being replaced with greater focus on things like community and social engagement, and emphasis on a playful exploration of new technologies. This represents a total reorganization and reprivileging of the value of an art education. The melting of the boundaries between art and other disciplines started years ago. The change is profound and has resulted in a reexamination of what we think of as traditional skills and the importance of acquiring those skills as a foundation.

Linda Jarvin: What evolution do you predict in the years to come? Is the importance of drawing gone for good?

Interviewee: Trends in education tend to be cyclical, and there will certainly be some backlash against the current move away from skills, but it is troubling that right now we have faculty in freshman year who did not have a classical foundation themselves, and that we have students coming in with portfolios made up of everything from computers to cameras, and who have never held a pencil. You can argue that the computer is just another drawing tool: Whether with a pencil or a mouse or a stylus, you are still creating eye–hand coordination and interpreting perceived experience. But there's all this haptic stuff that comes into play—you can choose to make the stylus feel like a pencil or a crayon—it's like sex over the Internet—but then you miss out on the physicality of drawing: real graphite on the grain of a particular paper.

We're becoming more comfortable with simulation rather than the real thing. Throughout the centuries, we've looked to the physicality of art to place us in time and ground us in the physicality of our world. This no longer seems to be important. We're increasingly

privileging the value of virtual experience over physical presence—even in preparatory pedagogy. This is not just my observation; I've heard a number of artists say that it's time for objects, physicality, and hopefully, permanence to come back.

Linda Jarvin: Today, what would you say is the purpose of an art education? Should we still encourage aspiring artists to go to art school?

Interviewee: Nobody can make you a good artist, and no one can claim that going to art school is absolutely going to make you a better artist than had you not gone. However, you could defend the idea that going to art school—that is, placing oneself in an environment wholly dedicated to developing as an artist—will help you evolve in your practice more efficiently and therefore more quickly.

One important dimension of an art education—perhaps the most important—is the imparting from one generation to another that which has been—and might still be—considered the most valued qualities in those experiences we consider to be art. In modern jargon, this might be called a rubric, a set of criteria against which the production of an artwork might be measured. This may even trump skill in its importance, because it forms the foundation on which—or against which—a student builds a personal practice. This is easier said than done, because we live in an age of pluralism when the "rubric" that a student receives in one class may differ greatly from that which she receives in another. Consequently, she is left to sort out that which is most applicable and therefore most valuable for herself. But hopefully, accept or reject, the student will come away with an understanding of why a work by say a Michelangelo is valued as an ardent expression of values that both capture and transcend the time and place in which it was made.

Linda Jarvin: And what should we teach?

Interviewee: You have to ask yourself, what makes a drawing good? Not just what makes it realistic, but what, as a drawing standing on its own, makes it good? Students need to have an understanding of drawing as something that transcends a faithful copy of the observed, and need to understand what the experience of perceiving something and translating that onto the two-dimensional surface offers in terms of understanding one's own internal

dialogical process. As I suggested above, there is a language of drawing, which can be described as a set of values. The challenge of teaching drawing today is parallel to the challenge of teaching writing in contemporary education. There has been a real devaluation in the importance of grammar. Just as many students don't learn to write within the context of the rules of grammar, similarly in the teaching of drawing, there is not an understanding that you are always working within a language or method of drawing.

You can enjoy drawing, find it relaxing or cathartic, but if you want to share that with somebody else, if you want to share something that maybe could not be expressed in any other way but visually—like words, writing, or music, for example—you are asking people to see it through some syntactical history. Just as the clear communication of a written thought assumes a clear understanding of sentence structure, the compelling communication of a visual thought depends upon an understanding of principles of visual structure. I believe we need to be straightforward about teaching these principles as something students work out of, and hopefully, reinvent and advance. The measure of drawing is not simply superficial representation but the syntactical context in which it is expressed. We must provide students with this cultural heritage, not as rigid dogma but as a toolbox out of which they can make choices based on what they want to say.

Linda Jarvin: So we should insist on teaching skills?

Interviewee: I believe that the greatest challenge in teaching drawing— and art in general—is keeping a parallel relationship between the development of skills and the understanding of concepts. Skills untethered to the expression of concept is merely craftsmanship, while the most sophisticated concept will fail to engage if it is poorly or inappropriately articulated. Understanding the relationship between these two interdependent dimensions of artistic creation and their relationship to history provides students with a sound basis for making and evaluating choices as well as furthering their independent development.

A third important idea in teaching drawing—and again art in general—is helping students understand what I've characterized as the "poetic transferability," that is, the notion that one of the most important but often least conscious values of what you learn in one medium is the

transferability of that experience to working in another. Therein lies the fundamental belief in the importance of drawing as a gateway to everything else. When you learn to make a drawing, you construct a process and an expressive language based on a sympathetic understanding of the qualities and limitations of a particular medium, an experience easily understood as applicable to any and all artistic pursuits.

Linda Jarvin: So what is "good" drawing? How do we evaluate it in an educational setting?

Interviewee: How do you know it's good? You only know if you've been very clear about what the framework is in which you're making this artwork. One of the very poor inheritances from abstract expressionism was the idea of "you'll know it when you see it." It's true, you do know it when you see it, and one of the challenges of being a good teacher is to (a) be able to see the ways in which something could be improved, which requires an understanding of the explicit or implicit context in which the student is making a work, and (b) be able to translate those perceptions into words that you share with students. Then, by the same token, the student takes those words and translates them back into drawing, which implies that the student's language abilities will play a role in the visual production. It used to be that an instructor would work on a student's drawing: they would just go in and draw on it. Today it is generally understood that an instructor does not do this, because a student will not like that. The problem with that is that the student is already elevating the little drawing of hers to some precious masterpiece status that no one else can touch. But it is the way to bypass the student's language abilities, and it could be the best way for that student to acquire knowledge. After all, they are in art school, not in a writing seminar.

Linda Jarvin: What are the implications for the admissions process? How should we evaluate students' drawings (if they submit any)?

Interviewee: There should be a context, a set of shared values that one is looking for in a portfolio, and a way of rating those values relative to one another. It should be done with enough consistency to overcome any personal biases of the admissions officers. One model for doing this is an experience I had working for the Educational Testing Service as an evaluator for the examination of portfolios

for Advanced Placement (AP) in Studio Art. In this process, a number of "readers" were each given a pile of student portfolios with various subject areas to be covered (drawing, design, etc.). Every component was rated on a scale of 1 to 4, with 4 being the highest rating. Once you made your grade, it was covered over, and a second reader got the portfolio, and then the two were amalgamated.

The statistical accuracy with which we marked these portfolios was so high that statisticians started coming to look at what we were doing. What had happened is that the AP leadership took a gymnasium and laid out row after row of examples of student art. We readers then walked the rows and discussed grading each and every work and, more important, why one work would receive one grade versus another. By the time we got through this, we had reached a consensus as to what constituted a 4 and why, versus a 2 and why. It created the kind of confidence and consistency in evaluation that we often lack in teaching. The result of this lack of confidence is that teachers are worried about being perceived as too tough and inconsistent by their colleagues and often err on the side of grade inflation. Also, they don't want trouble. But were the AP process undertaken in studio art, it would make faculty feel more comfortable with their decisions, and it would help them understand what they are doing in a larger context.

Another way of creating that consistency is what happened at a previous, much smaller institution I worked at, where freshman end-of-semester reviews consisted of students putting up work from all of their classes. There would be a team of three faculty (one from liberal studies, one from a studio course who was the advisor, and one studio teacher whom the student did not know); the faculty would talk with students individually about their respective strengths and challenges. Indirectly though, the benefit was that it gave faculty a chance to look at the whole curriculum, and it showed where pedagogical weaknesses were apparent. If weak work consistently came out of one course, then it was probably linked more to the course than to the students. It was a very good way of cocreating a shared understanding of what was important and developing a shared vocabulary. It really worked—it was a very tight foundation program.

Linda Jarvin: How sensitive—if at all—should art schools be to changing demands and trends in the art market?

Interviewee: There is a tension between the values expressed in traditional art education and the demands of the market place, but that's not new either. That's been the case in fine arts for years: abstract expressionism, postmodernism, and other currents that were favored by collectors flew in the face of the values propagated in traditional art education.

It should also be recognized that the marketplace can undermine the values of art education in another very important way. Most art education today inculcates experimentation and risk, that is, trying new things, as important elements in advancing one's artistic development. My mentor once said that "innocence is the awareness of possibility" and encouraged us to freely explore new approaches. The marketplace, however, can often deliberately stunt or freeze this continued exploration of possibility by demanding that an artist continue to work in a style that has proven commercially successful. This is especially dangerous for artists who are promoted too early in their careers and may therefore be directly or indirectly discouraged from changing their artistic perspectives.

This potential problem has changed with the increasing shift in the market toward conceptual art, that is, art in which the work of a particular artist can vary greatly in form and medium based on the expression of an extra-aesthetic concept such as social politics and issues of identity. But that then flies in the face of an art education that still primarily focuses on traditional aesthetic concerns and contributes strongly to a perception that "anything goes."

Linda Jarvin: Any closing thoughts to share?

Interviewee: With my repeated emphasis on values and principles, I want to be sure that this is not interpreted as evaluation based on intellectual analysis. Another one of my teachers used to say, "A drawing is the process of making marks that stand for a sensuous experience." Any examination of drawing and learning to draw is helping people make contact with the sensuality of their experience and the celebration of that sensuality. The mark becomes a metaphor for touch, which becomes a metaphor for sight, so that you are visually stroking something, or you are creating a tactile equivalent for something that is only accessible visually, like light. That's what makes drawing such a unique part of the human expressive experience.