Chapter 4

Cognitive outcomes of visual arts education

This chapter discusses the habits of mind that are potentially trained in strong visual arts classes, and then reviews the research on the effects of visual arts learning on cognitive outcomes: general academic achievement, reading, geometric/spatial reasoning, and observational skills. The one area where transfer has been shown – and only from one study – relates to visual observation skills, and this is one of the habits of mind that visual arts teachers often emphasise. The other area which we believe is promising is the relationship between visual arts education and geometry – since spatial reasoning is used in both visual arts and geometry. Thus far, though, only correlational links have been found, even if one ongoing study is now examining the effects of visual arts on geometry with a quasi-experimental design.

Visual arts are a key component of arts education taught in school, and visual skills developed by visual arts classes can plausibly be used in non-arts settings. Some level of visual appreciation and drawing skills is part of everyday life, as we process text, advertisement, or choose products. Visual skills are an important dimension of professions such as design, marketing, advertising, photo journalism etc. Similarly, some professions such as surgery, geology, radiology, mathematics (particularly geometry), chemistry, and architecture require sharp visual skills that might be trained through visual arts classes.

Is there any evidence that skills developed in visual arts education can have a positive impact on other areas such as reading, writing, geometry or science? Before undertaking any impact assessment, transfer research would benefit from an analysis of the kinds of cognitive skills trained in a particular art form prior to developing hypotheses about what skills might transfer. Such an analysis was carried out by Hetland, Winner, Veenema and Sheridan (2013) on visual arts learning. This study identified six potentially generalizable, broad habits of mind that teachers of visual arts at the high school level stressed (in addition to technique and to learning about the art world). The schools studied were not typical, but were ones in which students majored in an art form, and the classes were taught by practicing artists who were excellent teachers. Thus the kind of teaching observed was most likely the very best kind of visual arts training, a kind not available for most students. The habits of mind stressed in the excellent visual arts classes observed are however ones that all teachers can model. These habits are described in Box 4.1.

Three of these habits can make us reasonably hypothesise an impact of visual arts education on science and writing at least. Visual arts classes try to develop the ability to mentally envision forms and to observe closely, two skills that could transfer to the study of science and possibly geometry. Expressing one's vision is another important dimension of visual arts training, and one could expect this skill to transfer to writing and, possibly, in text understanding. While these hypotheses rely on near transfer theories, one could also imagine that the visual perception skills developed in visual arts education (for example pattern recognition, attention to detail) can be deployed in other areas such as reading, science or mathematics if the brain processes involved in visual spatial skills in these subjects are related to those involved in visual arts. A final possible reason is motivational: the topic of motivation will be addressed in Chapter 8.

This chapter reviews the available evidence that visual arts education enhances academic achievement, general academic achievement, reading, geometric/spatial reasoning, and observational skills.

Visual arts education and general academic achievement

Does visual arts education develop certain skills that are useful in other subjects and translate into better general academic achievement, whatever the reason? We located relatively few studies investigating this question.

REAP analyses of visual arts education and general academic achievement

Vaughn and Winner (2000) compared the SAT scores of students who did and did not take visual arts classes in high school as part of the Reviewing Education and the Arts Project (REAP). (The SAT is the exam taken for admission to US colleges and universities.) Students taking visual arts classes (studio art, design, but also art history) have average higher verbal and maths SAT scores than those taking no arts

Box 4.1. **Studio habits of mind stressed by visual arts teachers**

If you ask someone what students learn in visual arts classes, you are likely to hear that they learn how to paint, or draw, or throw a pot. Of course students learn arts techniques in arts classes. But what else do they learn? Are there any kinds of general thinking dispositions that are instilled as students study arts techniques?

Before any non-trivial study of transfer from arts learning to other areas of cognition can be undertaken, researchers must take a serious look at the kinds of thinking skills being taught in the "parent domain" of the art form in question. Only then does it make sense to ask whether one or more of these skills might transfer to learning in another domain of cognition outside of the arts.

In order to determine the habits of mind that emerge from serious visual art study, Hetland, Winner, Veenema and Sheridan (2013) undertook a qualitative, ethnographic study of "serious" visual arts classrooms. They observed and videotaped 38 visual arts classes from the Walnut Hill School for the Arts and the Boston Arts Academy, and interviewed the teachers after each class to find out what they intended to teach and why. They selected these schools because they wanted to start with the best kinds of arts teaching. These are schools for students with interest and talent in an art form, where students spend at least 3 hours a day working in their chosen art form, and where teachers are practicing artists.

After coding videos of teaching (two independent coders achieved high inter-rater reliability), the researchers found four potentially generalizable habits of mind and two potentially generalizable working styles being taught at the same time as students were learning the craft of painting and drawing.

Four kinds of potentially generalizable cognitive skills

Envision (Mental imagery)

Students are constantly asked to *envision what they cannot observe directly* with their eyes. Sometimes students were asked to generate a work of art from imagination rather than from observation. Sometimes they were asked to imagine possibilities in their works. Sometimes they were asked to imagine forms in their drawings that could not be seen because they were partially occluded. And sometimes they were asked to detect the underlying structure of a form they were drawing and then envision how that structure could be shown in their work.

A reasonable transfer hypothesis: if art students in fact become better at envisioning in art class, they may transfer this skill to the study of science.

Express (Personal voice)

Students are taught to go beyond craft to *convey a personal vision* in their work. As one of our drawing teachers said, "…art is beyond technique…I think a drawing that is done honestly and directly always expresses feeling." Students who learn to convey a personal vision in their art may possibly have become better writers.

A reasonable transfer hypothesis: art students who become better at conveying a personal vision (going beyond technique) may bring this skill to writing.

Observe (Noticing)

"Looking is the real stuff about drawing," one of our teachers told us. The skill of careful observation is taught all the time in visual arts classes and is not restricted to drawing classes where students draw from the model. Students are taught to *look more closely than they ordinarily do* and to see with new eyes.

(continues…)

Box 4.1. Studio habits of mind stressed by visual arts teachers (continued)

A reasonable transfer hypothesis: art students who learn to look more closely at the world and at works of art may bring these improved observational skills to science class.

Reflect (Meta-cognition/critical judgment)

Students are asked to become reflective about their art making and this reflection took two forms.

Question and Explain. Teachers often ask students to step back and focus on an aspect of their work or working process. Teachers' open-ended questions prompt students to reflect and explain, whether aloud or even silently to themselves. Students are thus stimulated to *develop meta-cognitive awareness* about their work and working process.

Evaluate. Students in art classes get continual training in evaluating their own and others' work. Teachers frequently evaluate student work informally as they move around the room while students are working, as well as more formally in critique sessions. Students are also asked to make evaluations themselves – they are asked to talk about what works and what does not work in their own pieces and in ones by their peers. Thus students are trained to *make critical judgments and to justify these judgments*.

A reasonable transfer hypothesis: art students who become meta-cognitive about their working process/products in art may show more meta-cognitive awareness of their working process/products in other areas of the curriculum.

Two kinds of potentially broadly generalizable working styles

Engage and persist (A kind of motivational skill)

Teachers in visual arts classes present their students with projects that engage them, and they teach their students to stick to a task for a sustained period of time. Thus they are teaching their students to *focus and develop inner-directedness*. As one of the teachers said, she teaches them to learn "how to work through frustration."

A reasonable transfer hypothesis: art students who learn to stick to art projects in a disciplined manner over long periods of time may become more focused and persistent in other areas of the school curriculum.

Stretch and explore (Another way of talking about creativity)

Students are asked to try new things and thereby to extend beyond what they have done before – to explore and take risks. As one painting teacher said, "You ask kids to play, and then in one-on-one conversation you name what they've stumbled on."

A reasonable transfer hypothesis: art students who become comfortable with making mistakes and being playful may be willing to take creative risks in other areas of the curriculum.

Transfer cannot be assumed. These skills must first be clearly taught and learned in the visual arts. These skills may or may not be used by students outside of the context in which they were learned. If skills do transfer, they may only do so when teachers explicitly teach for transfer. The study of transfer of learning from one domain to another has a long and vexed history, and one should never assume that a skill that "sounds" general is in fact generalised. Only careful research can tease apart those skills which generalise from those which do not, and the circumstances under which transfer occurs.

(and about the same as those taking classes in other arts forms). The differences range from 25 to 40 SAT points depending on the type of class and the type of outcome: there is more difference in verbal than mathematic skills, and for studio art than for art history. T-tests comparing mean verbal SAT scores over ten years for students with and without visual arts classes proved highly significant.

While there is a positive link between visual arts education and higher general academic achievement, no causal conclusions about the effects of visual arts classes on SAT scores can be drawn since these analyses are based on correlational data. High performers in school may just study more visual arts education than lower performers. In addition, as with all of the SAT data from the College Board, however, students' socio-economic status (SES) was not able to be controlled.

Post-REAP quasi-experimental studies of visual arts education and general academic achievement

We located three quasi-experimental studies that have sometimes been cited as demonstrating a positive effect of visual arts education on composite verbal/maths test scores, summarised in Table 4.1. These studies were all evaluations of Housen's (2002) visual arts curriculum called Visual Thinking Strategies (VTS). In this curriculum, students are asked to make observations about works of art and to support their observations with evidence. They are asked to think about three questions as they look at art works: What's going on here? What do you see that makes you say that? What more can you find?

In a first study, Housen (2002) compared children in classes receiving VTS compared to control classes not receiving this curriculum. The children were 2nd and 4th graders as the study began, and they were followed for five years. There was no finding that standardised achievement scores rose for children receiving VTS. However, when the researchers examined whether children used visual thinking strategies when observing both art and non-art objects, they did find that for 8th graders receiving VTS, these scores improved. Thus, this study demonstrates that a programme teaching visual thinking strategies can lead children to use such strategies in new contexts. However, despite what is implied in a commentary by the researchers (Burchenal, Housen, Rawlinson and Yenawine, 2008), this study tells us nothing about whether VTS leads to improvement in standardised achievement tests.

In a second study examining the effects of VTS, Curva, Milton, Wood, Palmer, Nahmias, Radcliffe, Ogartie and Youngblood (2005) compared elementary school children who did and did not receive VTS instruction. The executive summary concludes with the following statement: "this evaluation study shows that integrating art in the curriculum… clearly contributes to students' critical thinking and measurable academic achievement as well. In fact, it would not be surprising to find that such curricular 'enhancements' may be the best test preparation the schools can provide." This is however not demonstrated in the report. To show that art contributes to academic achievement, one must compare the test scores of the arts group to those of the control group to see whether the art group's scores rose more. But the test scores are not reported in the study; and neither was such an analysis. Moreover, even if the art group's scores rose more, one could only claim that art is the best test preparation after comparing art to other (perhaps more direct) types of test preparation. There was a significant correlation reported in this study for the VTS group between test scores and the skills taught (visual literacy and critical thinking), but it does not follow that visual literacy caused the test scores to rise.

In a third study, researchers examine the effects of VTS on student reasoning about art in the classroom, in the museum, and on standardised tests (Adams, Foutz, Luke and Stein, 2007). Adams et al. (2007) saw growth in strategies for visual thinking in the first two contexts (classroom and museum) but could find no link with higher standardised test scores: "when standardised test scores from the 2004-5 MCAS [Massachusetts Comprehensive Assessment System] and the 2005-6 SAT-9 were analysed, there were no differences between treatment and control students" (p. iii).

Table 4.1. **Three quasi-experimental studies assessing effects of visual thinking strategies curriculum on general academic skills**

Study	Positive effect	Negative or inconsistent effects
Housen (2002)		X
Curva, Milton, Wood, Palmer, Nahmias, Radcliffe, Ogartie and Youngblood (2005)		X
Adams, Foutz, Luke and Stein (2007)		X

Thus, although the authors conclude differently, none of the three studies of the Visual Thinking Strategies curriculum show that this programme causes rises in scores on the kind of tests that children now take in school. The conclusions that have been drawn from these studies are not warranted given the evidence.

In conclusion, like for music or multi-arts, students taking visual arts classes have higher general academic achievement than those taking none. But this is a correlational result that does not allow us to infer the direction of causality. There is as yet no evidence that visual arts education improves general academic skills.

Visual arts education and reading

Can studying the visual arts help remedial readers improve their reading? This is the assumption guiding several programmes developed in New York City, such as the Guggenheim Museum's Learning to Read through the Arts, Reading Improvement Through the Arts, and Children's Art Carnival. In these programmes, children with reading difficulties are given experience in the visual arts integrated with reading and writing. These programmes generally report that remedial readers improve their reading scores quite considerably and go on to conclude that this improvement is due to the arts experience students received. Unfortunately, these programmes have failed to compare the effects of an arts-reading integrated programme with the effects of an arts-alone programme. Therefore we cannot know whether the reading improvement that undoubtedly did occur was a function of art experience, art experience integrated with reading, or simply from the extra reading experience and instruction. In what follows, we review studies that test more clearly whether visual arts education improves reading.

REAP meta-analyses of visual arts education and reading

Burger and Winner (2000) examined two groups of studies: those that compared an arts-only instruction to a control group receiving no special arts instruction (nine studies); and those that compared an art-reading integration treatment to a control group receiving reading only (four studies). The first group allowed us to see whether instruction in visual art by itself teaches skills that transfer to reading skills; the second group allowed us to test whether reading integrated with art is more effective than reading instruction alone.

Table 4.2. **Seven quasi-experimental and two experimental studies included assessing effects of stand-alone visual art instruction on reading**

Study	Positive relationship	Mixed, null, or negative relationship
Dewberry (1977)		X
Diamond (1969)		X
Johnson (1976)*		X
Mills (1972)*	X	
Schulte (1983)		X
Schulte (1983)		X
Schulte (1983)		X
Spangler (1974)	X	
Wootton (1968)	X	
Weighted mean		X

Note: The full results are presented in Table 4.A1.1. The two asterisked studies are true experimental studies.

Source: Burger and Winner (2000).

Quasi-experimental and experimental studies

A meta-analysis of a body of both quasi-experimental and experimental studies testing the effects on reading of art instruction alone (studies listed in Table 4.2) yielded a small weighted mean effect size ($r = 0.12$, equivalent to $d = .24$) which could not be generalised to new studies on this topic, as shown by a nonsignificant t- test of the mean $Zr = .53$.

A second meta-analysis examined the four studies (both quasi- and true experimental studies were combined) shown in Table 4.3 testing the effects of art-reading integrated instruction. This analysis yielded a weighted mean effect size of $r = .22$ (equivalent to a d of between .4 and .5), and again this result could not be generalised to new studies (the *t*- test of the mean *Zr* was not significant). Moreover, this effect was entirely due to reading readiness outcomes, and these are visual outcomes. There was no effect for reading achievement outcomes.

Table 4.3. **Three quasi-experimental and one experimental studies assessing effects of reading instruction integrated with visual arts**

Study	Positive relationship	Mixed, null, or negative relationship
Catchings (1981)		X
Lesgold, et al (1975)*		X
Shaw (1974)	X	
Wootton (1968)	X	
Weighted mean		X

Note: The full results are presented in Table 4.A1.2. The asterisked study is a true experimental study.

Source: Burger and Winner (2000).

Burger and Winner's (2000) meta-analysis found no support for the claim that the visual arts enhance reading skills or even that reading integrated with visual arts works better than reading instruction alone. Programmes that help remedial readers improve their reading through a reading-arts integrated programme are likely to work well because of the extra intensive reading training that the children receive, independently of the fact that this training is fused with drawing.

Post-REAP studies of visual arts education and reading

We identified only one study post-REAP examining the relationship between visual arts and reading (Table 4.4). New York City's Guggenheim museum developed a programme called Teaching Literacy Through the Arts in which the visual arts were integrated into the curriculum of public elementary school classrooms. While students in this programme improved significantly more than a comparison group in the sophistication and complexity of language that they used to discuss works of art, they did not improve more on a verbal standardised test requiring reading (Korn, 2007).

Thus far there is no evidence to support the hypothesis that the visual arts can be used to improve verbal literacy. Moreover, there is no theoretical reason to support such a hypothesis since linguistic and visual-spatial skills are not correlated with one another (e.g. Gardner, 1983).

Table 4.4. **One quasi-experimental study since reap examining effect of visual arts education on reading**

Study	Positive association	No association
Korn (2007)		X

Visual arts education and geometric/spatial reasoning

Both visual arts and geometric reasoning require spatial visualisation, and the skill of spatial visualisation is stressed in visual arts classes. As shown in Box 4.1, students in the classes analysed by Hetland, Winner, Veenema and Sheridan (2013), students were often asked to envision what they could observe directly with their eyes. They were asked to generate a work of art from imagination rather than from observation. They were asked to imagine how their work might look if they made certain kinds of verbally described changes (e.g. how would this look if you moved this shape over to the left?). And they were asked to imagine the invisible underlying structure of a form they were drawing and then envision how that structure could be shown in their work. Given this kind of spatial reasoning training in visual arts classes, it is reasonable to hypothesise that if students do gain spatial reasoning skills in visual arts classes, these skills might spill over into geometry classes, where spatial reasoning is also important.

Is there any evidence that visual art students excel in spatial reasoning and geometric thinking, and if so is there any evidence that their superiority is a function of their art training rather than an inborn trait that drew them to study the visual arts?

Adult artists

There is evidence from correlational studies that adult artists and art students excel in a wide range of visual-spatial abilities (e.g. Chan, 2008; Chan et al., 2009; Morrison and Wallace, 2001; Pérez-Fabello and Campos, 2007; Winner and Casey, 1993). What about with children?

Correlational studies

We found two correlational studies investigating whether visual arts learning is associated with improved geometric and/or spatial reasoning in children and adolescents (Table 4.5).

Walker, Winner, Hetland, Simmons and Goldsmith (2010) reported that college students majoring in studio arts significantly outperform students majoring in the more academic discipline of psychology (see Box 4.2).

Spelke (2008) showed that visual arts majors in high school perform better than theatre as well as writing majors on a spatial measure of geometric reasoning (Box 4.3).

Table 4.5. **Two correlational studies examining relationship between visual arts learning and visual spatial skills**

Study	Positive association	Negative/inconsistent/ no association
Spelke (2008)	X	
Walker, Winner, Hetland, Simmons and Goldsmith (2010)	X	

Box 4.2. Visual arts majors outperform psychology majors on a test of geometric reasoning

The ability to visualise what cannot be seen directly plays an important role in mathematics and science. Virtually every STEM (Science, Technology, Engineering, and Mathematics) discipline calls upon visual or spatial thinking: chemists envision molecular structures and their interactions; geologists use field observations to envision structures that cannot be seen; engineers use visual feedback from computer models as they develop and test designs; topologists and geometers investigate mathematical relationships under various transformations. Educational organisations in mathematics and science also emphasise the importance of visual representation and reasoning capacities and stress the essential role of being able to represent and interpret mathematical ideas and problems in visual forms, including graphs, sketches, and diagrams.

Visualisation seems to be a fundamental habit of the artistic mind. Artists do not just magically "see" in their mind's eye, but deliberately and systematically analyse shape and space into familiar simple forms, construction lines, angles, and size ratios (Kozbelt, 1991). This process is essential for depicting three-dimensional objects on a two-dimensional surface. Visualisation is also of value when creating three-dimensional objects, which often must be "pictured" as a whole before they are built. Hetland, Winner, Veenema and Sheridan's (2013) ethnographic study of intensive high school arts programmes (featured in Box 4.1) found that "envisioning" (visualisation) is one of eight habits of mind that are taught in visual arts studio classes. Visualisation (envisioning) involves the formation of images (often mental) which can then guide actions and problem solving and can even lead to problem finding. The art teachers they studied provided their students with continual practice in imagining space, line, color, and shape, regularly asking their students such questions as, "What would this look like if you extended this line?", "What is the underlying structure of this composition?", "Where would the shadow fall if the light were coming from that window?" Such questions prompt students to envision what is not there. Visual art students also study skeletal and muscular anatomy to help them envision the underlying structure of the human figure and the forces at work within various poses.

Given that both art and geometry entail visualisation and mental manipulation of images, and that one of the habits of mind stressed by visual art teachers is the habit of envisioning what one cannot see (Hetland et al., 2013), Walker, Winner, Hetland, Simmons and Goldsmith (2010) investigated whether individuals with training in the visual arts show superior performance on geometric reasoning tasks. Two groups of undergraduates, one majoring in studio art, the other majoring in psychology, were given a set of geometric reasoning items designed to assess the ability to mentally manipulate geometric shapes in two- and three-dimensional space.

(continues...)

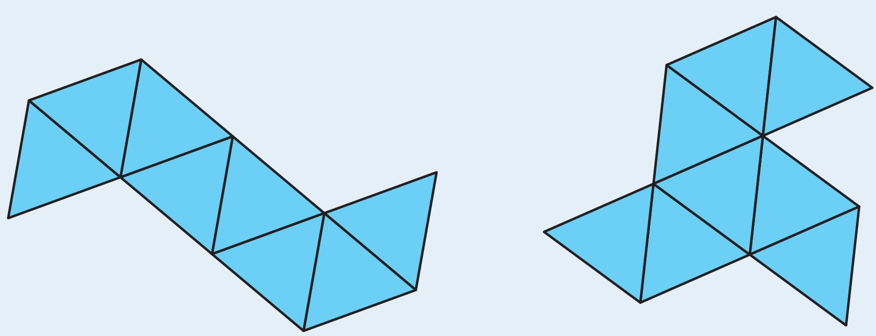
Box 4.2. **Visual arts majors outperform psychology majors on a test of geometric reasoning** (continued)

With the help of a group of geometers and mathematics educators, a set of items originally developed by Callahan (1999) was adapted to create a 27-item geometric visualisation/reasoning inventory which was not dependent upon knowledge of formal geometry knowledge such as equations or definitions, but instead focused on geometric thinking. These items required participants to rely upon visual working memory and the ability to engage in various spatial transformations. Participants were not allowed to make drawings to help them solve the problems, because the objective was to assess their capacity to solve the problems using mental visualisation, rather than the manipulation of external representations. Here are three of the items used:

Sample Item 1. Below are pictures of "nets." You can fold them on the solid lines to make 3-dimensional forms. Circle the one(s) that can be folded into a closed form (that is, one that has no holes or openings).

Sample Item 2. Imagine holding a small square card by the diagonal corners and spinning it around the diagonal. What shape would be carved out in the air? Figure out the answer in your head without drawing. Describe your answer in words as best you can.

Sample Item 3. Imagine a triangle that has 3 equal sides. In your mind, mark the sides of this triangle into thirds, and cut off each of the triangle's corners at the marks. Describe the shape you get. Figure out the answer in your head without drawing. Describe your answer in words as best you can.

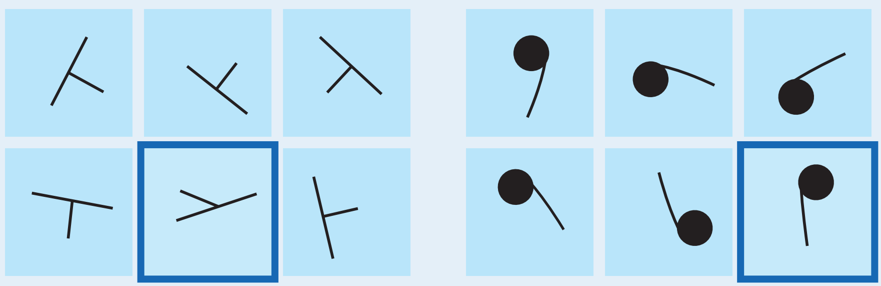


Participants were also given a verbal intelligence test. Both training in the arts and verbal intelligence were strong predictors of geometric reasoning, but training in the arts was a significant predictor even when the effects of verbal intelligence were removed. These correlational findings lend support to the hypothesis that training in the visual arts may improve geometric reasoning via the learned cognitive skill of visualisation.

Box 4.3. **High school visual arts majors outperform theatre and writing majors in test of geometric reasoning**

Spelke (2008) used visual arts students in her control group when she investigated whether music training fostered geometric reasoning skills (as described in Box 3.4) The kinds of measures on which the visual arts students excelled included recognition of geometric invariance. She used a task developed by Dehaene, Izard, Pica and Spelke (2006) in which children were shown six geometric figures that differed in size and orientation.

Five of the figures shared one geometric invariant property not possessed by the sixth figure, and their task was to find the figure that was different. Two sample items are shown below with the correct answer outlined. In the images on the left, the item that does not fit in does not have a right angle; in the images on the right, the item that does not fit in has the stem on the left of the ball. The music students outperformed theatre and writing majors in geometric thinking, and dance and visual arts majors did so as well.



Quasi-experimental and experimental studies

Correlational studies cannot tell us whether spatially strong students seek out the visual arts or whether training in visual arts strengthens visual spatial skills. Is the superiority of art student on spatial and geometric tests due to training, or is this superiority a preexisting condition? We located one meta-analysis of quasi-experimental studies and one ongoing quasi-experimental study investigating the relationship between visual arts education and visual spatial skills (Table 4.6).

A meta-analysis by Haanstra (1996) of 30 primarily quasi-experimental studies testing the claim that training in the visual arts improves visual spatial ability found no effects of arts training on visual-spatial ability except for children between the ages of 4-6. This result is surprising given the apparently close connection between the kind of thinking required in the visual arts and the kind of thinking assessed by spatial and geometric reasoning tests, and further research on this question is therefore warranted.

Winner, Goldsmith, Hetland, Hoyle and Brooks (2013) conducted a longitudinal study to examine changes in geometric reasoning and in performance on standardised spatial reasoning measures after one and two years of visual arts training. While the visual arts group improved more than a control theatre group, the results were difficult to interpret because improvements in drawing did not correlate with improvements in geometric reasoning.

Table 4.6. **One meta-analysis of 30 studies and one further quasi-experimental study examining effect of visual arts education on visual spatial skills**

Study	Positive association	Negative/inconsistent/ no association
Haanstra (1996) (meta-analysis of 30 studies)		X
Winner, Goldsmith, Hetland, Hoyle and Brooks (2013)	X	

In summary, there is correlational evidence for a relationship between visual arts ability and geometry reasoning. What is not yet known is whether this relationship is due to visual arts training, or to pre-existing spatial ability. Experimental studies are needed to determine if children without selection for or interest in the visual arts can be trained to improve their geometric reasoning skills via training in the visual arts. If this can be shown, it will be important to determine what kind of visual arts training has this effect (e.g. observational drawing training? compositional exercises? etc.).

We note that we conclude from merely correlational studies that there may indeed be a relationship between visual arts and geometry. In other cases in this report we have come to less optimistic conclusions based on correlational findings. This is because it is important to have a theoretical reason to expect transfer. In the case of visual arts and geometry, we know that both involve spatial reasoning. But for example when we read of a correlation between taking arts courses and SAT performance, it is not clear to us what the underlying similarity might be between arts learning and multiple choice verbal and mathematical questions. This makes us skeptical that transfer will ultimately be demonstrated.

Visual arts education and observational skills

As shown by Hetland et al. (2013), visual arts education puts a strong emphasis in the development of observational skills. Students in the classes they analysed were taught to look closely at the model, at their own drawings, and at the drawings of others. At the end of every class, for example, there was a class critique where all of the drawings were tacked up on the bulletin board and students look at each one and talked about what they saw. Students also spent time looking through a view-finder (a rectangular cardboard frame) and noticing how things looked when partially cut-off by the frame. Looking through a viewfinder is a way of getting students to see things as patterns and shapes rather than as objects on which they can impose their schemas. Thus when one looks at part of a chair through a viewfinder one is more likely to see (and thus draw) it accurately than when one looks at the whole chair directly. One can reasonably hypothesise that as students gain observational skills in visual arts classes, these skills may spill over into other areas such as biology, where observational skills are central.

Adult studies

Ainsworth, Prain and Tytler (2011) argue drawing should be used as a tool to help children understand scientific concepts, and they refer to this as "drawing to learn." Of course this is not drawing as art, and it is not art education.

We found one experimental study with adults testing the hypothesis that observational skills learned through the activity of looking at paintings leads to greater medical observational skill (Table 4.7). Dolev, Friedlaender and Braverman (2001) randomly assigned one group of medical students to training in careful observation of paintings and another to a control group. Those trained to look closely at art later outperformed those in the control group when given photos of people with medical disorders and asked to describe what they observed. Thus, training in looking at paintings can improve the kind of observational skills considered valuable in medicine. We see this as a case of near transfer where the same kinds of skills learned in an art form are used in another area.

Table 4.7. **One experimental studies examining effect of training in looking at paintings on medical observational skill**

Study	Positive association	Negative, inconsistent or no association
Dolev, Friedlaender and Braverman (2001)	X	

We found one quasi-experimental study with children testing the same kind of hypothesis (Table 4.8).

This was a study showing positive gains in observational skill after arts training, but that arts training focussed entirely on training in looking at pictures. When children were trained to look closely at works of art and reason about what they see, they gained skill in an observational science activity. Tishman, MacGillivray and Palmer (1999) studied 162 9- and 10-year-olds exposed to a Visual Thinking Curriculum in which they were taught to look closely at works of art and talk about what they saw. After seven to eight 40 minute sessions over the course of a year, children were shown a picture of a fossil record of two intersecting sets of animal footprints and were asked the same questions they had learned to answer about works of art: What's going on in this picture? What do you see that makes you say that? Children who received the Visual Thinking Curriculum achieved higher scores on the footprints task than did those who did not. They used less circular reasoning and were more aware of the fact that their interpretations were subjective. Thus children in the art group had acquired looking and reasoning skills from looking at works of art and were able to deploy these when given a scientific image to analyse.

Table 4.8. **One quasi-experimental study examining the effect of visual arts learning on observational skills**

Study	Positive association	Negative, inconsistent or no association
Tishman, MacGillivray and Palmer (1999)	X	

This is again a case of near transfer: the skills involved in the art domain are very close to the skills tested in the science domain: in both cases, the critical skill is that of looking closely and reasoning about what is seen. Close visual observation is probably a skill that could be learned in non-arts domains (e.g. biology, chemistry) but this study does demonstrates that observational acuity can be trained by looking at art images, and that this skill then transfers to biological images.

We can conclude that experimental studies have shown that training to look closely at works of visual art improves observational skills when studying scientific and medical images. However, this finding is based on only two studies.

Summary and conclusion

In this chapter we have reviewed the research on transfer of learning from the visual arts. We began by summarising the kinds of broad habits of mind taught in strong visual arts classes. Most of the studies we reviewed did not examine skills related to these habits of mind – yet this is where one is most likely to find transfer, and this argument holds for transfer from any art form. The one area where transfer has been shown relates to visual observation skills, and this is one of the habits of mind trained directly by the visual arts. The other area which we believe is promising is the relationship between visual arts education and geometry – since spatial reasoning is used in both visual arts and geometry. Thus far, only correlational links have been found, though one quasi-experimental study reported that visual arts students improved more than non-visual arts students in geometry – results difficult to interpret since the hypothesised mechanism of growth in drawing predicting growth in geometry was not supported.

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Annex 4.A1

Supplementary tables

Table 4.A1.1. Nine quasi-experimental and experimental studies assessing effects of stand-alone visual art instruction on reading

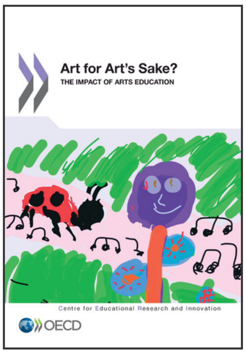
Study	N	R	Z(p)
Dewberry (1977)	22	-.22	-1.02 (p = .85)
Diamond (1969)	88	.10	.91 (p = .18)
Johnson (1976)*	42	.00	0.00 (p = .50)
Mills (1972)*	52	.54	3.92 (p = <.0001)
Schulte (1983)	34	-.30	-1.73 (p = .96)
Schulte (1983)	40	-.29	-1.84 (p = .97)
Schulte (1983)	39	.18	1.09 (p = .14)
Spangler (1974)	85	.21	1.91 (p = .03)
Wootton (1968)	93	.21	2.00 (p = .02)

Note: N: number of observations; R: effect size; Z(p): statistical significance. See Box 1.2. Only the two asterisked studies were true experimental studies

Source: Burger and Winner (2000).

Table 4.A1.2. Three quasi-experimental studies and one experimental study assessing effects of reading instruction integrated with visual arts

Study	N	R	Z(p)
Catchings (1981)	111	.15	1.60 (p = .06)
Lesgold et al. (1975)*	30	.00	0.00 (p = .50)
Shaw (1974)	43	.51	3.34 (p = .0004)
Wootton (1968)	93	.23	2.24 (p = .01)



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