

The Perceptual Foundations of Drawing Ability

Rebecca Chamberlain, University College London

Howard Riley, Swansea Metropolitan University

Chris McManus, University College London

Qona Rankin, Royal College of Art

Nicola Brunswick, Middlesex University

Abstract

Observational drawing is fundamental to artistic practice, by enhancing perceptual processing (Kozbelt, 2001; Seeley & Kozbelt, 2008) and creativity (Chan & Zhao, 2010; Pratt, 1985) regardless of an artist's specialist medium. However the perceptual and memorial processes underlying drawing ability remain poorly characterised. The aim of this exploratory study was to measure the contribution of visual long-term memory, visual perception and attitudes and abilities in education to drawing. Long term memory was found to be correlated with drawing ability confirming previous findings (McManus et al., 2010). Specific visual perceptual faculties such as the identification and reproduction of geometric characteristics also accounted for a proportion of the variability in drawing ability. However, learning disabilities such as dyslexia were not predictive of inaccurate drawing. In light of these findings, pedagogical methods are proposed using an *Eight Step Strategy* which focuses upon elements of the visual scene such as figure/ground and spatial relationships.

Introduction

This article is an extended version of a presentation made to the *Thinking Through Drawing* conference held at the Teachers College, Columbia University, New York City in October 2011. The authors would like to thank the organisers, Andrea Kantrowitz, Angela Brew and Michelle Fava for the opportunity to share their research, which has been driven by the authors' common interest in the

various processes employed by art and design students. This common interest developed in the first instance from an initial aim to study a potential relationship between dyslexia and drawing ability, and to this end, studies were conducted between 2008 and 2011 in collaboration with students on the Foundation Diploma course (a diagnostic, pre-degree year) at Swansea Metropolitan University, Wales, and with Masters level students at the Royal College of Art, London.

There is much evidence to suggest that individual differences in visual perceptual processing underpin differences in drawing ability. One of the earliest studies of perceptual advantages in artists in general was conducted by Theron Cain (1943) who found that individuals who were able to copy simple geometric shapes were also more likely to gain higher grades at art school. Cohen and Bennett (1997) followed this line of inquiry in their seminal study on the effect of motor coordination, representational decisions and misperception on drawing accuracy. They concluded that misperception of the to-be-drawn object was likely to be the greatest source of drawing errors, but did not posit precisely which perceptual errors were most likely to yield inaccurate depictions. In a more recent study (Kozbelt, 2001) artists' perceptual expertise was investigated using visuo-spatial tasks including Gestalt completion, embedded figures, mental rotation and line drawing. Artists outperformed novices on perceptual and line drawing tasks, and a large proportion of the variance in perceptual and drawing scores was shared, suggesting the influence of visual processing on drawing performance.

Furthermore, a recent study by Cohen and Jones (2008) suggests that artists that are more impervious to phenomenal regression produce more accurate drawings. In line with these earlier findings, our initial studies aimed to assess the relationships between drawing ability and: dyslexia; visual memory ability; perception of geometric figures; and phenomenal regression.

Method

Participants

The sample consisted of 105 art students (84 female, mean age = 21.7 (± 0.4) years) attending the Art and Design Foundation course at Swansea Metropolitan University (SMU).

Apparatus and Stimuli

Questionnaire and drawing/perceptual tasks were completed in one A4 size paper booklet. Participants were provided with HB pencils, erasers and sharpeners to complete the tasks. All visual stimuli were presented via a Microsoft Office PowerPoint presentation, presented on a 4x3 m projector screen.

Questionnaire

1. *Self-perceived artistic and design ability* – Rated artistic performance on a range of skills in relation to others studying art and design. Responses were indicated on a 5-point Likert-type scale ranging from '*much above average*' to '*much below average*'.
2. *Drawing and painting experience* – Amount of time spent drawing and painting currently and over the past two years on an 11-point scale ranging from '*most days for 4+ hours*' to '*never*'.
3. *Communication and numerical difficulties*- Family history or a personal diagnosis of dyslexia, dyspraxia, dyscalculia, stuttering or stammering.
4. *Spelling test* – Correct spelling of a word from 4 alternative spellings for 20 commonly misspelled words (Brunswick, McManus, Chamberlain, Riley, & Rankin, 2011)
5. *Mathematical ability* – Response to a range of statements on attitudes to mathematics on a 4-point scale ranging from '*strongly agree*' to '*strongly disagree*'.

6. *Educational background* – GCSE, AS and A-Levels (subject-specific academic examinations generally taken in the UK at ages 15, 16 and 18) attained for all subjects including art and design
7. *Demographics* – Gender, date of birth, nationality, and parental practice and sympathy toward the arts.

Drawing and Perceptual Exercises

1. *The Rey Osterrieth Complex Figure* (Rey & Osterrieth, 1993; Meyers & Meyers, 1995) – Copy of the Rey Osterrieth Complex Figure (4 mins)
2. *Hand Photograph* – Copy a photograph of a hand holding a pencil (5 mins)
3. *Cain House Task* – Copy of five hexagonal shapes (Cain, 1943) described as representing the cross-sections of different types of houses (5 mins)
4. *Block Construction* – Copy of a construction made from children's building blocks (5 mins)
5. *Rey Osterrieth Delayed Recall* – Reproduction of the Rey Osterrieth Complex Figure from memory (3 mins).
6. *Doors Task* – An adaptation of stimuli used in a previous study (Cohen & Jones, 2008; McManus, Loo, Chamberlain, Riley, & Brunswick, 2011). Matching of five consecutive computer rendered images of doors at different angles with one of a set of 23 door outlines (20s per image).
7. *Shapes Task* – Methodology as in previous task however visual stimuli were door outlines without computer rendered 3-D information (20s per image).

Drawing Rating Procedure for Hand and Block Drawings

Participants' drawings were rated by a convenience sample of ten non-expert judges consisting of postgraduate and undergraduate students at University College London (UCL). Each judge was required to rate the drawings from best to worst by sorting them into seven categories (figure 1). Judges were informed that quality of drawing was to be determined solely on the basis of accuracy, and

not on aesthetic appeal. Exemplars of the quality of drawing accuracy in each category were given to the judges in order to aid the rating process.

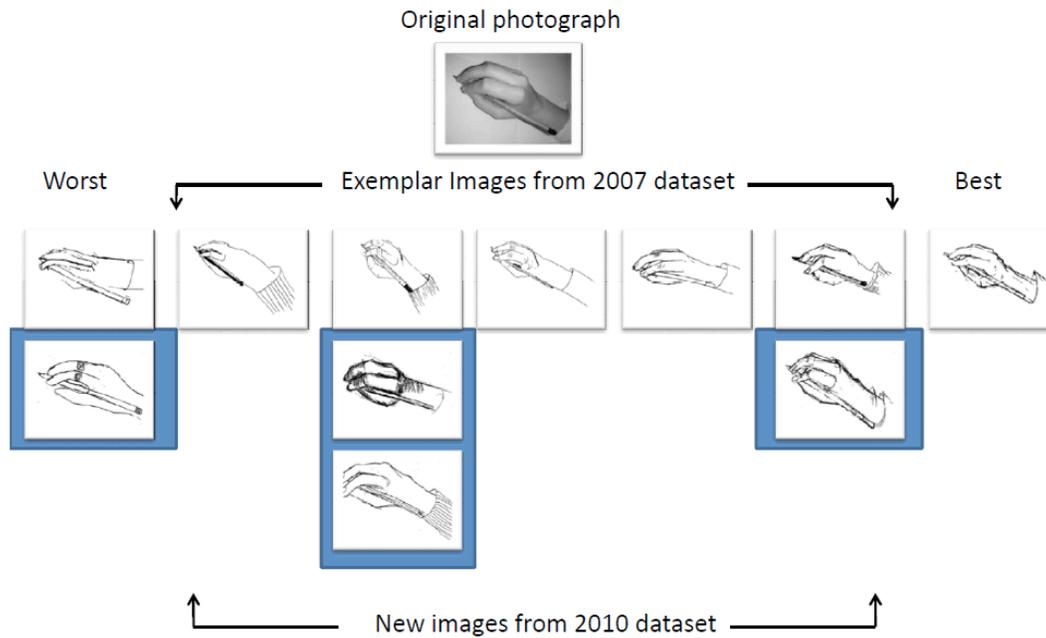


Figure 1 – Diagram of drawing rating methodology

Results

Learning Disabilities and Mathematical Ability

No relationship between learning disabilities such as dyslexia, dyspraxia or dyscalculia and drawing ability was found (all $p > .1$). However, mathematical ability and an interest in mathematics were significant predictors of drawing ability as well as academic attainment at age 16 but not age 18 (table 1).

Table 1 – Correlations between GCSE scores, maths ability and attitudes toward maths and observational drawing ability (n range 47-102)

	GCSE Mean Grade	A-Level Mean Grade	GCSE maths grade	Maths more enjoyable at school
Externally rated drawing ability	.353, $p < .01$.169, $p = .256$.240, $p < .05$.231, $p < .05$

Artistic Practice

Painting and drawing time total values were calculated by adding scalar points pertaining to amount of drawing and painting practice from 2008-09 to 2009-10. Multiple regression showed that amount of drawing practice ($t_{76}=3.55$, $p<.01$, $\beta=.54$) and painting practice ($t_{76}=-2.52$, $p<.05$, $\beta=-.39$) both significantly predicted drawing rating. This model accounted for 14.5% of the variance in drawing rating scores.

Perception of Geometry and Phenomenal Regression

Phenomenal regression did not predict observational drawing ability but accuracy in the copying of angles and linear proportions were found to be predictors of high level observational drawing ability (Table 2).

Table 2 – Correlations between drawing rating and angular and proportional errors on the Cain house task (n=102)

	Angular Error	Proportional Error
Externally rated drawing ability	-.296, $p<.01$	-.233, $p<.01$

Visual Memory

A significant correlation was found between drawing ability and performance on both the Rey Osterrieth copy and delayed recall (table 3; figure 2).

Table 3– Relationship between Rey Osterrieth Performance, Performance on the Cain House Task, and Observational Drawing Ability (n range 98-104)

Externally rated drawing ability	Cain House Task Angle Error	Cain House Task Proportion Error
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Rey Osterrieth Copy	.299, $p < .01$.085, $p = .393$.014, $p = .890$
Rey Osterrieth Delayed Recall	.266, $p < .01$.015, $p = .880$	-.023, $p = .820$

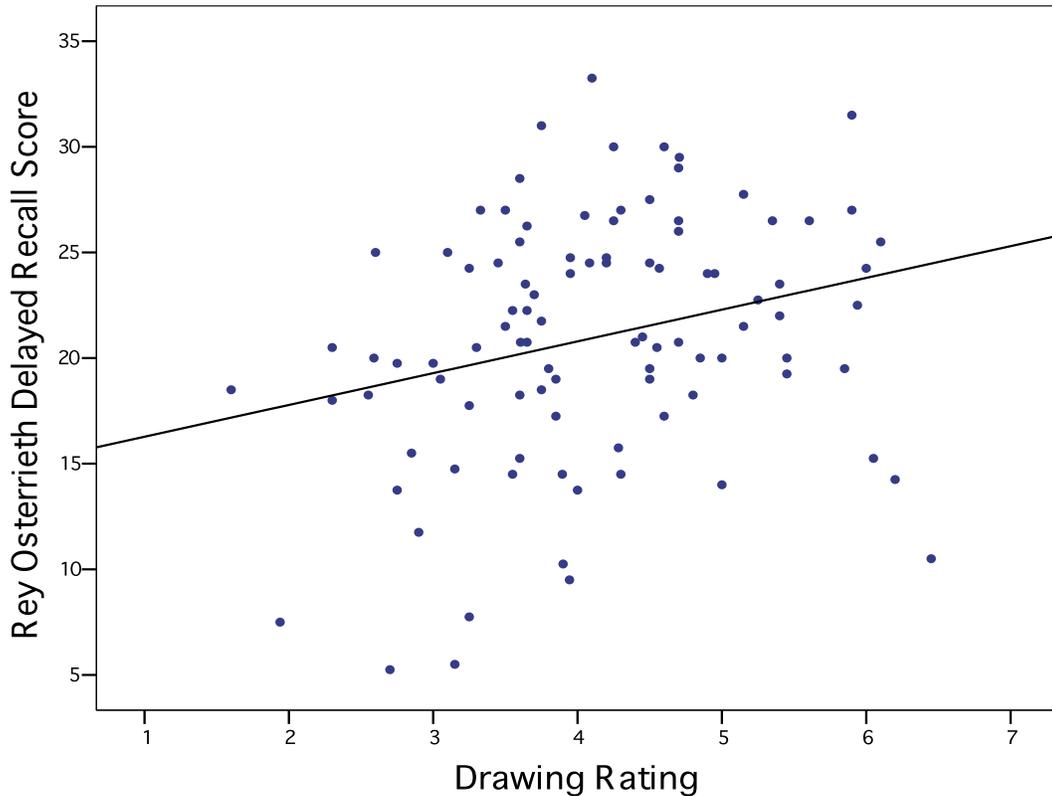


Figure 2 – Relationship between Rey Osterrieth delayed recall score and drawing rating

Discussion

Drawing practice significantly predicted self-perceived and externally rated drawing ability, and accounted for a moderate amount of the variance in drawing scores. This suggests that expertise in drawing is developed over time, in much the same way as other areas of expertise (Ericsson, Charness, Feltovich, & Hoffman, 2006). Chan & Zhao (2010) found that involvement in the arts correlated with drawing ability most greatly in young adults, suggesting that

dedication to arts in general may be a good predictor of drawing ability. Similarly, academic achievement also seemed to underpin drawing ability at GCSE level, however this correlation disappeared by the time students reached A-Level. The foundation of the relationship between academic achievement and drawing ability could be due to intellectual functioning. Alternatively, the relationship could be sub-served by motivational factors. The manner in which academic achievement in general, and practice in the specific area of expertise, contribute to drawing ability has yet to be investigated.

Observational drawing ability appears to relate to the ability to process simple geometrical relationships between components of the subject-matter under observation. This suggests that subtle nuances in direction of line, which when violated give rise to the feeling of poor drawing, are reflected in the angular properties of the visual stimulus. Artists appear to break down more complex images into simple lines (Tchalenko, 2009) therefore identification and replication of subtle angular deviations within complex lines could be the basis of accurate observational drawing. Whether perceptual heightening as demonstrated in these drawing tasks transcends the rendering scenario is a matter of debate in the literature (Glazek, 2011; Glazek & Weisberg, 2010; Phillips, Inall, & Lauder, 1985; Seeley & Kozbelt, 2008).

Positive correlations were found between performance on the Rey Osterrieth Complex Figure task and drawing ability, suggesting that visual memory is implicated in the drawing process. This link is independent of any relationship between perception and drawing as scores on the Rey Osterrieth memory condition did not correlate with errors in the Cain house task. It is necessary to develop memory tasks that do not call upon drawing as previous research has found differences in visual recognition memory attributed to artistic competence only when graphic depiction is involved (O'Connor & Hermelin, 1987). Stimuli such as those used in the Cain house task in Study 1 would be ideal for this kind of analysis. They have similar geometric properties as the Rey Osterrieth complex figure and can be subtly manipulated to produce many

variations on one original image for use in a delayed match to sample task as used in previous investigations (Bays, Gorgoraptis, Wee, Marshall, & Husain, 2011; Glazek & Weisberg, 2010; Sullivan & Winner, 1989)

Directions of Future Research

The current research suggests that accurate perception of the geometry of the stimulus gives rise to more accurate drawing. If accurate perception does in fact lead to accurate production, then strategies can be incorporated into drawing teaching that exploit these faculties.

A primary objective is to develop *inclusive* strategies for the teaching of drawing which empower all students. An exploration of the *Eight-Step Strategy* first introduced by Sherrie Nist and Donna Mealy (Mortimore, 2011, p.113) is being conducted as a means of teaching dyslexic students, but is here adapted and developed from current findings:

1. *Focus attention upon a) the model and their surroundings (figure/field relationship), and b) the relationship between scale of drawing and size and format of paper:*



Figure 3

An example of a lack of awareness of the semiotic potential implied in the relationship between the model and her surroundings is illustrated in Figure 3.

The scale of the drawn figure bears an uncomfortable relationship with the scale of the sheet of paper, and its positioning within the sheet allows no relationship with the key axes (central vertical, central horizontal and the two diagonals) to be perceived by the viewer. Moreover, the figure appears unrelated to its surroundings; not a single mark is deployed to explore the tonal contrasts between the figure and the surroundings, or the possibilities of geometric harmonies between the linear proportions and the angles within the figure-shape and those of the environmental context.



Figure 4

Once attention is focussed upon the figure/field relationships, we see in Figure 4 the possibilities for expressing the rhyming and the rhythms that exist between the two, the figure is seen to be integrated with its environment, and also with the format of the drawing sheet.

2. *Explain a general overview of the task: in terms of drawing from observation, this is the equivalent of mapping the spatial relationships between salient points on the subject-matter under observation, whilst at the same time keeping an awareness of the proportions between the figure and the drawing sheet (Wholist mixed with Analyst cognitive styles)*

The 'N-Grid', a network made up of those salient points on the figure; Nose, Nipples, Navel, kNees, kNuckles, is a useful concept to introduce the method of triangulation, a way of maintaining accuracy between the location of those salient points, and the proportions and angles which relate those points.

Figure 5 illustrates a lack of awareness of the N-Grid, with the result that proportional relationships within the figure are not under control, neither are the relationships between figure and surroundings.

Figure 5





Figure 6

Here in Figure 6, on the other hand, we see evidence of control of proportions, both within the figure itself and between the figure and surroundings.

3. *Introduce new terms, such as 'contrast boundary' and 'negative space':*

The term *contrast boundary* refers to the juxtapositioning of light and dark tones at each edge formed when one material surface is occluded by another. The term is preferred to the more common one, *outline*.

Negative space is a term familiar to most teachers of drawing. It refers to those spaces observed between objects, the spaces for which we have no word to describe. Thus, a way of looking without language acting as some kind of visual filter is encouraged. It appears that those spaces are drawn with more accuracy than those shapes/objects to which we have allocated words. Evidence of the student's awareness of both these useful concepts is illustrated in Figure 7:

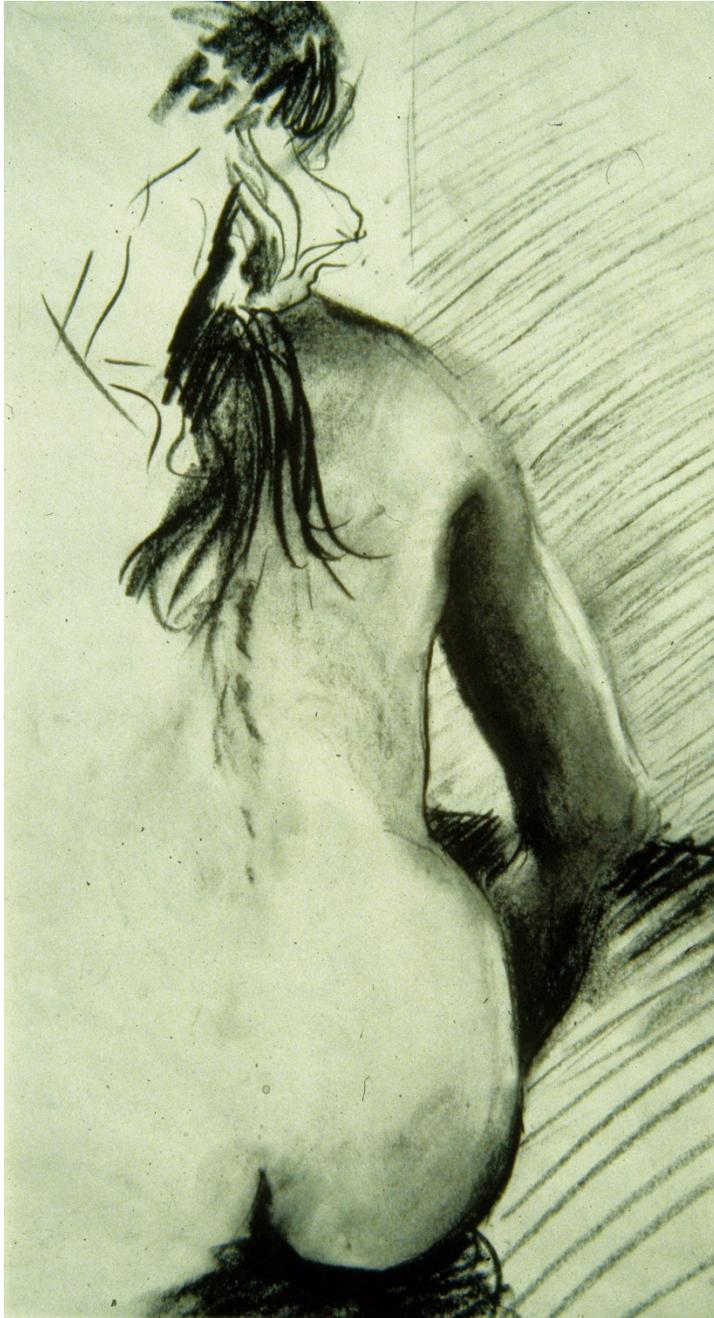


Figure 7

Steps 4 to 8 are laid out below, and mainly refer to the strategies of repetition and discussion with tutors:

4. *Repeat first three steps at the beginning of every session.*
5. *Discuss with tutor the process underway on the drawing board.*
6. *Repeat the tutor's strategy with support from the tutor.*
7. *Draw independently at unsupervised sessions.*
8. *Re-demonstrate strategies at each session as reinforcement.*

Summary

Associations have been found between drawing ability and academic achievement, visual long-term memory and perception of angular relationships. It seems the *Eight Step Method* is adaptable and useful in the context of these findings: Students, both dyslexic and non-dyslexic, report improvements in their observational drawing.

The impact on perceptual functioning as a result of the *Eight Step Method*: Novices who have not had extensive training in drawing can be tested for visual memory and perceptual ability before and after drawing tuition in order to assess whether the act of drawing serves to improve perceptual functioning. This will extend current findings from correlation to causation, and will test the hypothesis that drawing leads to domain-general perceptual enhancement, further characterising the mechanisms by which perceptual and memorial functioning come to be associated with drawing ability.

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