Observational Drawing Research Methods

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Abstract and Keywords

tion in the United States’ elementary and high school education systems. Thus, drawing is a universal and important human behavior.

Although there are many different types of drawings that each have their own depictive and creative goals (e.g., schematic drawings, expressive drawings, memory- or imagination-based drawings, abstract drawings), this chapter exclusively focuses on the activity of *observational* drawing. Observational drawing is the behavior of creating a recognizable depiction of a specific model object or scene that is directly perceived by the individnority of drawing research that has been recently conducted, it will not be the focus of this chapter.

Rather, this chapter mainly focuses on research that has adopted the product-oriented approach, which represents the majority of the research that has been conducted on this topic over the past 20 years and is largely concerned with assessing the quality and content of the final drawing. A major focus is assessing the visual accuracy of the final drawing, which is commonly measured in such studies. Cohen and Bennett (1997) defined a visually accurate drawing as “one that can be recognized as a particular object at a particular time and in a particular space, rendered with little addition of visual detail that cannot be seen in the object represented or with little deletion of visual detail [seen in the object represented]” (p. 609). Studies that have adopted this approach have aimed to understand how drawing accuracy/skill is (a) affected by manipulating various cognitive and perceptual factors (e.g., Cohen & Earls, 2010; Ostrofsky, Kozbelt, Tumminia & Cipriano, 2016), and/or (b) associated with performance in nondrawing tasks that measure some aspect of cognitive ability (e.g., Ostrofsky, Kozbelt & Seidel, 2012).

In this chapter, I will provide an overview of the various methods used in laboratory-based observational drawing research that adopts a product-oriented approach. First, I will describe the general questions and methodological designs used in such research. Next, I will summarize the various types of drawing tasks administered in studies focusing on this topic. Afterwards, I will summarize the various methods used to measure drawing skill/accuracy. Finally, I will end the chapter with a discussion of the challenges research in this area currently faces and suggestions as to the future directions research on this topic would benefit from by adopting.

General Questions and Methodological Strategies in Drawing Research

Multiple lines of general questions have been addressed in drawing research over the past 20 years. Below, I will identify each type of general question that has been studied and describe the methodological strategies that have been adopted to address them.

Relationship between drawing skill and performance in nondrawing tasks: Correlational studies

Since drawing is a complex behavior that is supported by p amples of cognitive and perceptual processes that have been studied along these lines include:

- perceptual constancies pertaining to shape and size (Cohen & Jones, 2008; McManus, Loo, Chamberlain, Riley, & Brunswick, 2011; Ostrofsky et al., 2012; Ostrofsky, Cohen, & Kozbelt, 2014),
- various visual illusions (Chamberlain & Wagemans, 2015; Mitchell, Ropar, Ackroyd, & Rajendran, 2005; Ostrofsky, Kozbelt, & Cohen, 2015),
- local (in contrast to global) perceptual processing biases (Chamberlain, McManus, Riley, Rankin, & Brunswick, 2013; Drake, 2013; Drake & Winner, 2011),
- flexibility of visual attention (Chamberlain & Wagemans, 2015),
- efficiency of perceptually encoding the shape of an object (Perdreau & Cavanagh, 2014),
- integration of object-based visual information across eye movements (Perdreau & Cavanagh, 2013), and
- absolute and relative spatial positioning ability (Huang & Chen, 2017).

Correlational studies have been used to investigate such associations. In these studies, participants are required to create a drawing and complete at least one nondrawing task that has been designed to assess the perceptual or cognitive processing ability of interest. Statistically significant correlations between performance in the drawing and nondrawing tasks are the primary evidence used to support claims that drawing skill is associated with a particular perceptual or cognitive process.

Although much has been learned from such studies, this methodological strategy has important limitations one should be sensitive to when interpreting the correlational evidence. First, the observation of such statistically significant correlations is not solid evidence that drawing skill is directly related, in a causal manner, to the perceptual or cognitive process of interest. There is always the possibility that some unaccounted for variable exists that directly affects ability in drawing and perceptual/cognitive processing ,3procese699 T playing (Green & Bavelier, 2003), musical notation reading (Wong & Gauthier, 2012), and navigation (Maguire et al., 2000) have been observed to differ with respect to a variety of perceptual, cognitive, and neural processes. Such studies are conducted for one of two general purposes. Some studies make such comparisons to provide clues pertaining to the perceptual, cognitive, or neural processes that support skilled performance. Other expert-versus-novice studies are performed to probe the plasticity of perceptual, cognitive, and neural systems that are associated with extensive experience in a specific domain.

Similar research has been conducted for the domain of drawing by comparing expert artists and novice nonartists (Kozbelt & Ostrofsky, 2018; Kozbelt & Seeley, 2007). Examples of processing abilities that have been compared between artists and nonartists include:

- the experience of perceptual constancies (Cohen & Jones, 2008; Ostrofsky et al., 2012; Perdreau & Cavanagh, 2011; McManus et al., 2011),
- susceptibility to various visual illusions (Chamberlain et al., 2019),
- perceptual grouping (Ostrofsky, Kozbelt, & Kurylo, 2013),
- perception of the size of angles (Carson & Allard, 2013),
- the flexibility of visual attention (Chamberlain & Wagemans, 2015),
- the ability to recognize objects found in degraded images (e.g., out-of-focus images, images of objects with segments deleted from the images) (Chamberlain et al., 2019; Kozbelt, 2001),
- visual memory ability (Perdreau & Cavanagh, 2014),
- the volume and activity of various brain regions (Chamberlain, McManus, Brunswick-et al., 2014; Schlegel et al., 2015), and
- face recognition (Devue & Barsics, 2016; Tree, Horry, Riley, & Wilmer, 2017; Zhou, Cheng, Zhang, & Wong, 2012).

Such studies adopt a quasi-experimental approach where expertise (artist versus nonartist) is the independent variable and performance on a nondrawing task assessing perceptual, cognitive, or neural processing is the dependent variable. Although many interesting expertise-based differences (and nondifferences) have been observed in [(sl ;4gh567x201(2

Physically present three-dimensional objects are also used at times, most often in the form of a “still-life” collection of objects. In some studies, the researchers standardize the distance and angle from the objects the participants are seated at (Chamberlain et al., 2013) and other studies allow participants to freely inspect the collection of objects by moving their head and sitting at different positions (Carson, Millard, Quehl, & Danckert, 2014).

Studies employing photographs and physically present objects as models represent the most complex free-hand drawing tasks. In order to skillfully draw such models, participants must accurately depict a wide variety of visual information that includ 4RVNMadoto,ei more time to produce it or did not know from the outset that they had to complete the drawing within a specific time frame.

Tracing tasks

It is widely accepted that observational drawing is a complex behavior that is guided by multiple perceptual and cognitive processes. Cohen and Bennett (1997) identified four main processes that guide the production of a drawing: (a) perceptual encoding of the model; (b) representational decision-making as to what features from the model to emphasize, de-emphasize, or neglect in the drawing; (c) eye–hand motor coordination; and (d) evaluation of the quality of the emerging drawing and making necessary corrections when deviations between the model and drawing are perceived. Tracing tasks have generally been used by researchers in order to study, in an isolated fashion, the decision-making, and/or eye–hand motor coordination processes involved in drawing. Cohen and Bennett (1997, Experiment 1) asked participants to trace photographs. This task eliminated the need for participants to perceptually encode many aspects of the photograph that would have needed to be accurately encoded in a free-hand drawing task (e.g., one does not need to accurately encode size-proportions, relative spatial positioning of different features, angles, etc.). This task also substantially reduced the difficulty of the evaluation process, as the only evaluation participants needed to make was whether they missed any lines or if their drawn line deviated from the path of the printed line found in the photograph. Thus, the researchers isolated decision-making (i.e., deciding which lines to emphasize/de-emphasize and how thick to draw a specific line) and eye–hand coordination as the pertinent skills needed to produce a high-quality depiction. In their second experiment, the researchers asked participants to trace a tracing produced by another individual, which further isolated eye–hand motor coordination as the only pertinent skill needed to produce a high-quality tracing. Here, decision-making processes are eliminated, or at least are substantially reduced.

A variant tracing task that has been argued to more sensitively assess representational decision-making processes is the “limited-line tracing task” (Chamberlain et al., 2019; Kozbelt et al., 2010; Ostrofsky et al., 2012). A potential limitation of the traditional tracing method is that individuals are free to use an unlimited number of lines to trace the model. For studies that aim to compare representational decision-making differences between groups (e.g., artists versus nonartists), this freedom may mask any differences between individuals who make stronger versus weaker depictive decisions. The limited line tracing task controls the lines participants are allowed to use to trace the model, so that the number, thickness, and length of lines used for the tracing are standardized and equated across participants. Critically, the number of lines participants are allowed to use is fewer than what is required to trace the entire the image. This method forces participants to be more economical in their decision-making, forcing them to prioritize and decide which segments of the model are more or less important to depict. This method has been useful in establishing differences in decision-making quality between those who are more versus less skilled in drawing, as the quality of such limited line tracings have been

the relative spatial positioning of multiple objects, (b) form and shape, (c) shadows, and (d) overall realism. Presumably, one goal of providing such rubrics is to increase inter-rater reliability, as one may expect higher reliability if all of the judges are basing their ratings on the same criteria as opposed to each judge utilizing their own idiosyncratic criteria of drawing accuracy in the absence of such a rubric. However, the effect of providing a rubric on such reliability has not been explored, as no study has compared rubric- vs. non-rubric-based ratings for a single set of drawings. Furthermore, high reliability levels observed in studies employing non-rubric-based rating methods suggest that rubrics are not necessary to establish strong inter-rater reliability.

One criticism of measuring drawing performance using single ratings to represent overall perceived accuracy is that this type of measure does not capture the complex, multifaceted nature of drawing accuracy. A single drawing can be relatively accurate with respect to reproducing some aspects of a model but relatively inaccurate with respect to reproducing others. For instance, a drawing may be highly accurate with respect to reproducing the relative spatial positioning of features, but may be highly inaccurate with respect to reproducing shading gradients that are needed to convey depth or in drawing the detailed appearance of individual features. This complexity of drawing accuracy is masked when drawing performance is reduced to a single-value accuracy rating. This potentially creates problems of interpretation for the types of correlational and experimental studies described earlier. When significant correlations or experimental effects are observed, it is unclear which aspects of drawing accuracy are related to nondrawing task performance or which are affected by experimental manipulations when drawing accuracy is assessed via single-value accuracy ratings. The correlations or experimental effects could pertain to all or only some aspects of perceived drawing accuracy, and the use of single-value accuracy ratings makes it impossible to determine which is the case.

In order to assess perceived drawing accuracy in a more specific way, some studies have instructed judges to provide multiple ratings that each focus on a different aspect of drawing accuracy. For instance, two face-drawing studies reported by Cohen and colleagues asked judges to provide three ratings per drawing: (a) overall accuracy, (b) accuracy in drawing individual facial features, and (c) accuracy in drawing the relative spatial positioning of the features (Cohen & Earls, 2010; Cohen & Jones, 2008). As another example, Hayes and Milne (2011) instructed judges to rate the accuracy of face drawings according to 10 aspects, including face shape, eye spacing, eye size, nose length, nose width, dist 0 0.66ut232.49 Tm[(wido$Vcml2ing, eyo5DF\TfeeF\MXGJZcS56.6P1LQJl BD 10 Vcml2ing, e tures. But, when assessing specific spatial relationships in a later study, Ostrofsky, Kozbelt, Cohen et al. (2016) found that not all spatial relationships within a face are impaired by face inversion; inversion impaired drawing accuracy for one spatial relationship (the vertical distance between the eyes and mouth), but not others (e.g., the horizontal distance between the two eyes; the vertical distance between the nose and mouth). Thus, although subjective accuracy ratings are useful for broad-level assessments of perceived drawing accuracy (i.e., allowing one to empirically establish whether one drawing is, overall, more or less accurate than another), they may mask some nuanced, and potentially important, aspects of how well a drawing reproduced specific aspects of the visual appearance of a model.

Objective measurement methods

Although subjective accuracy ratings are useful for assessing how accurate a drawing is perceived to be by observers, they do not allow one to specifically assess how a drawing deviated in appearance from the model. Subjective accuracy ratings often fall short in specifying the aspects of a drawing that are more or less accurate, and they do not allow one to precisely quantify the magnitude of drawing error. Thus, some studies have assessed drawing performance using objective measurements of drawing error that precisely quantify specific deviations between a drawing and the model. Generally speaking, there are three categories of objective measurement methods that have been used in drawing research: (a) anthropometric measures, (b) landmark-based morphometric measures, and (c) feature counting measures.

Anthropometric measures refer to those that quantify spatial aspects of a drawing (e.g., size of a feature, distance between multiple features) using proportional variables. Although anthropometry was developed specifically for measures of the human body in non-drawing contexts, the basic method has been used to measure the accuracy of drawings based on a variety of model object categories, including faces (Costa & Corazza, 2006; Harrison, Jones, & Davies, 2017; Hayes & Milne, 2011; Ostrofsky et al., 2014), the human body (Tchalenko, 2009), cylinders (Matthews & Adams, 2008), parallelograms (Mitchell et al., 2005), and houses (Harrison et al., 2017). As one simple example, the width of an eye has been quantified as the eye width divided by the face width (Ostrofsky et al., 2014). As another example, the height of a house's second story window has been quantified as the height of the window divided by the overall height of the house (Harrison et al., 2017). Such proportioned measures control for differences in the absolute size between a model and drawing (and between different drawings) in order to facilitate comparisons, which is useful as it is generally accepted that the quality in drawing spatial aspects of an image is normally assessed based on accuracy in reproducing relative proportions rather than absolute sizes. Once the drawings and the model have been measured using this method, drawing errors can be computed using a variety of quantitative variables (e.g., computing the difference between the drawing and model measures, computing ratios of the drawing and model measures, computing the difference between the drawing and model measures and dividing this difference by the model measure to express error as a proportion or percentage of deviation from the model measure).

Anthropometric methods are useful in that they allow researchers to define specific spapositioning (or coordinates) of all the landmarks between the drawing and model. After these transformations are applied, the deviation in the position of each landmark between the drawing and the model is computed as the Euclidean distance between them. Once

Directions for Future Research

In concluding this chapter, this section will highlight some suggested directions for future research, focusing on issues pertaining to the measurement of drawing performance and methodological approaches useful in assessing the causal relationships between drawing skill and perceptual/cognitive processing ability.

Measures of drawing performance

As explained in the prior section, subjective and objective measures of drawing accuracy differ in that subjective measures assess perceived accuracy whereas objective measures assess how drawings actually deviated in appearance from the model. Usually, studies utilize either subjective or objective measures. This results in a study either assessing how accurate a drawing is perceived to be by others without understanding how a drawing actually deviated in appearance from the model, or the study assessing how a drawing deviated in appearance from a model without understanding whether such deviations impacted perceived accuracy. Future drawing research would benefit by using subjective and objective measures in conjunction, as doing so would provide a more complete understanding of drawing performance within a study and may provide clues as to what types of objective drawing errors are more or less associated with how accurate a drawing is perceived to be by others. Just because a drawing objectively deviated from a model in some aspect does not necessarily mean that the specific drawing error is related to how accurate the drawing was perceived to be by others. For instance, the few studies that have assessed the relationship between subjective and objective accuracy measures for a single set of drawings b]TJETBdQJLVSHUFHLYHG01.hHUl is for fu60i610.64/hapter8sithin a ssg was

unaware of any study that has adopted this approach, and thus, this void presents a great opportunity for novel and theoretically significant research on this topic. Alternatively, if researchers are interested in understanding how cognitive/perceptual processing ability changes as a result of the acquisition of drawing skill, researchers can conduct an experiment where participants are trained over a long period of time to improve their drawing skill, and then determine how cognitive/perceptual ability changes as a consequence of drawing training (relative to a baseline measure). There have only been a few studies that have adopted this approach (Kozbelt et al., 2016; Schlegel et al., 2015; Tree et al., 2017), and thus, there is a clear need for more research along these lines as changes in only a small number of cognitive/perceptual abilities have been assessed.

Conclusion

Observational drawing is a topic of scientific interest to psychologists. As reviewed in the chapter, there are various methods that have been used to understand individual variability in drawing ability and in order to measure drawing performance in laboratory-based studies. Although much can be learned from each method, this chapter highlighted significant limitations each method has pertaining to interpretations one can validly draw from the results of a study or pertaining to the aspects of drawing performance a particular measurement method is capable of assessing. However, such limitations do not indicate that drawing is a topic that cannot be subjected to scientific inquiry. Rather, such limitations simply highlight the need of researchers to critically evaluate the methods used by a particular study in order to draw valid scientific conclusions and to avoid overgeneralizing results in such a way that they are not supported by the methodological features used by a particular study. This is by no means unique to the study of observational drawing, as the study of all topics in scientific research is based on methods that have their own unique limitations. Since the scientific study of adult observational drawing performance is a relatively young field, one can expect refinements in the methods used to study this topic to be developed in the future. The preceding section of this chapter provided suggestions on how some of these limitations can be improved upon in future research, and thus, one can be optimistic that research on observational drawing will continue to develop and to provide more insights that can explain the tremendous range of individual variability in drawing performance that is found in the population.

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