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TECHNOLOGICAL EFFECTS ON AESTHETIC EVALUATION: VERMEER AND THE CAMERA OBSCURA

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The question of whether an artist's use of technology to create art results in a detectable aesthetic difference was investigated in the case of Dutch realist painter Johannes Vermeer and his use of the camera obscura. In Experiment 1, participants evaluated 20 Vermeer paintings on 6 aesthetic dimensions and preferred paintings created with the aid of the camera obscura. In Experiment 2, participants evaluated 4 Vermeer paintings on 6 aesthetic dimensions after they either read about camera obscura technology or read in general about methods of creating art in the Dutch realist school of painting. Knowledge of technology use did not affect aesthetic evaluation. In Vermeer's case, technology was used to enhance rather than substitute for artistic talent and did not decrease but rather enhanced the viewer's aesthetic experience.

The painter stood
Before her work
She looked around everywhere
She saw the pictures and she painted them
She picked the colors from the air
"Painter," Neil Young (2005)

Aesthetics, an appreciation of the beautiful and the sublime, is used to evaluate technology (Norman, 2004) and behavioral interventions (Hineline, 2005), but technology's role in creating beauty is less explored. With the ready availability of technology that can be used in aesthetic creation, such as a digital camera to take photographs, a computer program to create graphic art, or a synthesizer to compose music, the role of technology as a contextual factor in the evaluation of art deserves further scrutiny. Art criticism has moved away from considering only the technical and aesthetic qualities of a work to explicit assessments of its social and contextual implications, including the means used to create art (Dickie, 1997; Shusterman, 1997). However, aesthetic assessment from the perspective of the art viewer may be less concerned with contextual criticism and more concerned with an

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experience of beauty. Aesthetics is rarely investigated in psychology (Averill, Stanat, & More, 1998), and most psychological studies that have considered aesthetics have focused on the underlying cognitive and perceptual processes involved in art appreciation (e.g., Russell, 2003).

The way in which technology use affects people psychologically has been of interest to social scientists for more than a century (Stern, Alderfer, & Cienkowski, 1998). Technology can be defined as "all means by which people increase their own or others' capabilities" (Kipnis, 1991, p. 62) or *any* human modification of the natural world (Tenner, 2003). Advocates of technology assert that it provides people with an ability to do things that they could not have done before (Stern, Mullennix, Dyson, & Wilson, 1999) and that some forms of technology have improved many aspects of people's lives. However, technology might not always lead to positive outcomes. For example, employing behavioral technology in the treatment of psychopathology has been shown to influence patients' behavior in unwanted and unpredicted ways (Kipnis, 1987) and to alter their acceptance of treatment (Hineline, 2005). Jobs are often technologized for the sake of efficiency; however, this use of technology can result in deskilling. Degradation of craftsmanship occurs when knowledge of the work process lies only within management, leaving the employees to function only as a tool (Braverman, 1974). Indeed, employees using automated technology often report a sense of dissatisfaction and alienation in the workplace (Hackman & Oldham, 1980; Shaiken, 1985). Using technology that requires little skill is related to diminished self-confidence and loss of enjoyment in everyday activities (Stern & Kipnis, 1993). Further, use of technology also affects other people's perceptions of technology users. For example, workers operating automated technology are not given much praise for success, nor are they given much responsibility for failures by supervisors (Stern, 1999). Whereas Braverman views technology as the ruin of craftsmanship and job satisfaction, Stern et al. (1998) suggest that too little technology might not be desirable either. Instead, there may be an optimal level of technology that enhances a job while still requiring and allowing a certain level of skill. The extent to which the effects of technology are generalizable may indicate how findings from research on job satisfaction and psychotherapy also apply to aesthetic evaluation, or whether use of technology by an artist influences people's evaluation of the art.

Art historians have long suspected that the Dutch artist Johannes Vermeer (1632–1675) used the camera obscura when painting. The camera obscura, forerunner of the modern camera, is a device made from convex lenses that projects an image onto a screen, allowing an artist to trace the outline of an object or scene, rather than draw it "from scratch." Using the camera obscura while creating a painting would result in an almost photographic image, although the end result would be a painting on canvas. Although some art historians argue vehemently against the claim that Vermeer used the camera obscura (e.g., Gussow, 2001), other scholars such as Hockney (2001) and Steadman (2002) make a compelling case that many of Vermeer's works were created with the aid of this technological device. The debate intensified with the publication of several newspaper articles (e.g., Boxer, 2001, 2004; Rothstein, 2001), books (e.g., Hockney, 2001; Steadman, 2002), and Web sites (e.g., http://www.vermeerscamera.co.uk). The debate became so heated that in 2001, museum curators, artists, and

scholars gathered at a symposium at New York University titled "Art and Optics" to discuss the issue.

If Vermeer did use the camera obscura to create his paintings, what impact, if any, would this have on the aesthetic evaluation of his work? Opinion on this issue is by no means consensual. Some argue that if Vermeer used a technological aid, it would seriously diminish people's respect for him as an artist and detract from the aesthetic value of his paintings. Indeed, some experts claim that most artists would probably find it "shameful" to be caught using a photograph to create their paintings (Boxer, 2001, para. 21). Art historian Martin Kemp (1990) has gone as far as labeling the use of the camera obscura as cheating. Others (e.g., Hockney, 2001; Steadman, 2002) argue that the use of a technological device like the camera obscura is nothing for an artist to be ashamed of and see the device as an artistic tool, rather than a substitute for artistic talent. Still others assert that the controversy over whether or not artists such as Vermeer used technology as an aid is irrelevant, claiming that knowledge of how an artist created his or her work adds little to aesthetic appreciation (Gussow, 2001).

A question in this controversy that has not been explored is whether or not lay art viewers can detect the use of the camera obscura or any other technological aid when viewing art, or the degree to which such a device makes a qualitative difference in the work of art that can be detected by the lay art viewer. The goal of the present research is to investigate the aesthetic ramifications of Vermeer's use of the camera obscura in creating his work. Are paintings created with the help of technology judged to be aesthetically superior to paintings created without it? If so, on what aesthetic dimensions are they deemed superior? We sought to answer these questions through an investigation of people's judgments of the aesthetic value of 20 paintings by Johannes Vermeer. This first experiment focused on whether technology improves Vermeer's work on a variety of aesthetic dimensions. Specific predictions regarding participants' judgments of the aesthetic value of the paintings were not made, as the experiment was purely exploratory in nature.

Experiment 1

Method

Participants. Twenty-nine undergraduate students (2 men and 27 women; age range from 17 to 37 years old, mean age = 19 years) volunteered for an "Art Appreciation" study for course credit. Overall, participants were very interested in the arts and most were involved in some form of visual or performing art as a hobby, with a mean number of art activities engaged in by participants of 2.36. All participants were debriefed and interviewed at the end of the experiment.

Materials and Setting. Twenty high-quality, 8 × 10-in., laminated color reproductions of paintings by Vermeer (listed in Table 1), representing the majority of his oeuvre, were used. Paintings were classified as camera obscura aided versus non–camera obscura aided based on Steadman's (2002) evidence of Vermeer's use of the camera obscura. The experiment took place in a small, well-lit classroom with overhead fluorescent lighting and no windows.

Table 1
Title, Year, and Camera Obscura Use for Paintings Viewed by Participants in Experiment 1

Painting title	Year	Camera obscura use
The Procuress	c. 1656	No
Girl Asleep at a Table	c. 1657	No
Girl Reading a Letter at an Open Window	c. 1657	No
Officer and Laughing Girl	c. 1658	Yes
The Milkmaid	c. 1658-60	Yes
The Glass of Wine	c. 1658-61	Yes
A Lady and Two Gentlemen	c. 1659-60	No
Girl Interrupted at Her Music	c. 1660-1	Yes
The Music Lesson	c. 1662-4	Yes
A Woman Holding a Balance	c. 1664	Yes
Woman with a Lute near a Window	c. 1664	Yes
The Concert	c. 1665-6	Yes
Mistress and Maid	c. 1666-7	No
Allegory of Painting	c. 1666-7	Yes
The Love Letter	c. 1669-70	Yes
Lady Writing a Letter with Her Maid	c. 1670	Yes
The Guitar Player	c. 1670	No
Allegory of Faith	c. 1671-4	Yes
Lady Standing at the Virginals	c. 1672-3	Yes
Lady Seated at the Virginals	c. 1675	Yes

Note. Painting title, year, and camera obscura usage according to Steadman (2002).

Procedure. Participants were asked to look at 20 paintings randomly spread out on a large table and fill out rating questionnaires (one for each painting) across six aesthetic dimensions: *pleasingness, liking, preferability, beauty, interestingness,* and *wish to see again*. Russell and George (1990) show that these dimensions are highly related to one another and may be used as valid measures of aesthetic value. Rating questionnaires contained the following instructions: "Please read the instructions carefully and try to answer each question to the best of your ability. Look at each painting in turn and rate it according to how *[aesthetic dimension]* you find it to be by circling the appropriate point on the *[aesthetic dimension]* scale, ranging from *1 = low [aesthetic dimension]* to *5 = high [aesthetic dimension]*. Try to compare the paintings with one another, not with other paintings you know."

A rating method was used because it is better suited for paintings that are very similar and allows two pieces of art to have the same rating (Russell & Gray,

1994).[1] Participants were assured that there were no right or wrong answers and that the experimenters were purely interested in their aesthetic judgments of the paintings. Participants were also encouraged to take their time and look at each painting for as long as they felt necessary to perform the task.

Results

Participants' ratings for all paintings across six dimensions were significantly correlated (all ps < .05), so mean ratings for all 20 paintings on each of the six aesthetic dimensions were obtained by averaging across participants in the rating task, and a composite measure of aesthetic preference was computed. Means and standard deviations of composite aesthetic evaluation ratings for each painting are displayed in Table 2. Aesthetic evaluation of paintings created using the camera obscura versus those paintings created without it was examined by comparing mean ratings for the two types of paintings using a t test. Camera obscura-aided paintings received significantly higher ratings ($M = 3.00$, $SD = .51$) on aesthetic evaluation than non–camera obscura paintings ($M = 2.75$, $SD = .57$), $t(28) = 2.84$, $p = .008$, with a medium-size effect, $d = .52$.

Discussion

Participants preferred paintings created with the aid of the camera obscura; these paintings had significantly greater aesthetic value than paintings created without the camera obscura. In this case, technology improved Vermeer's paintings on a variety of aesthetic dimensions. Returning to the definition of technology as "all means by which people increase their own or others' capabilities" (Kipnis, 1991, p. 62), this result is not surprising. If Vermeer was increasing his capabilities as an artist by using the camera obscura, then paintings created with the aid of this device should be more aesthetically pleasing than paintings created without it. Further, if the camera obscura is viewed as an artist's tool rather than as a substitute for artistic talent (e.g., Hockney, 2001; Steadman, 2002), then deft and discerning use of the camera obscura may reflect further expertise in terms of the artist's command of the tools of his art, rather than a technical failing.

The participants in this study were neither art majors nor art experts. However, participation in the study was voluntary, making it likely that self-selection biases led people inherently interested in art to sign up for a study of "Art Appreciation." Indeed, the sample was very familiar with art; every participant included in the study had some involvement in the arts, whether it be creating art as a hobby or going to museums regularly. Additionally, more than half reported having received formal training in some visual or

1 Preliminary research compared a ranking method to a rating method. Data from a ranking task of these 20 Vermeer paintings showed little sensitivity and indicated that participants had no clear aesthetic preference or lack of preference for paintings created using the camera obscura versus paintings created without the use of the camera obscura. Because the same artist painted the artwork during a limited time period, and in the same style, the paintings were very similar and therefore less suitable for a ranking method (Russell & Gray, 1994). When stimuli are highly similar, a ranking task may force participants to artificially differentiate between paintings they view as equivalent. Conversely, a rating method allows participants to convey that two paintings are aesthetically equivalent by assigning the same rating and thus was a more valid procedure for this task.

musical art form. Thus, although participants were not art "experts," it is likely that they had more of an interest in and knowledge of art than the average student.

Table 2
Means and Standard Deviations (SD) of Composite Aesthetic Evaluations for Camera Obscura and Non–Camera Obscura Paintings in Experiment 1

Painting title	Camera obscura use	Mean	SD
The Procuress	No	3.03	.99
Girl Asleep at a Table	No	2.91	.96
Girl Reading a Letter at an Open Window	No	3.70	.78
Officer and Laughing Girl	Yes	2.62	.95
The Milkmaid	Yes	3.30	.72
The Glass of Wine	Yes	2.80	.84
A Lady and Two Gentlemen	No	2.66	1.03
Girl Interrupted at Her Music	Yes	2.75	.85
The Music Lesson	Yes	2.99	1.10
A Woman Holding a Balance	Yes	3.07	.98
Woman with a Lute near a Window	Yes	2.06	.96
The Concert	Yes	2.85	.93
Mistress and Maid	No	2.56	.94
Allegory of Painting	Yes	3.21	.86
The Love Letter	Yes	3.08	.87
Lady Writing a Letter with Her Maid	Yes	2.84	.90
The Guitar Player	No	2.47	1.00
Allegory of Faith	Yes	3.70	.98
Lady Standing at the Virginals	Yes	2.68	.89
Lady Seated at the Virginals	Yes	3.06	1.00

It is important to note that participants were not aware of the artistic process involved in creating these paintings. Participants were not given any information about the paintings beyond the visual examination, and only two participants were able to define the term *camera obscura* in a postexperimental interview. Whether or not knowledge of the fact that Vermeer used the camera obscura in creating some of his works would change participants' aesthetic evaluation of his work is a question of great interest, as strong arguments exist on each side of the issue (Boxer, 2001, 2004; Hockney, 2001; Rothstein, 2001; Steadman, 2002). Given the romanticized view of painting and art one finds in the culture at large (and as exemplified by Neil Young's "Painter"), it is likely that knowledge of Vermeer's camera obscura use would lead viewers to devalue the aesthetic qualities of those paintings in which it was used.

Experiment 2

Effort after meaning theory (Russell, 2003) suggests that enjoyment from looking at a painting is derived from successfully interpreting the painting's meaning. Therefore, the more information the participant is

given about a painting, the more meaningful a painting becomes, and the greater the likelihood is that the participant will be able to extrapolate meaning. This premise brings art appreciation from the realm of aesthetics into a more interpretive context. While aesthetic dimensions measure one aspect of an experience, the ability to successfully extract meaning from a painting personalizes and contextualizes the experience for a different type of aesthetic evaluation. Some research on technology effects (Hackman & Oldham, 1980; Kipnis, 1987; Shaiken, 1985; Stern & Kipnis, 1993; Stern et al., 1998) indicates that information about technology use in creating art may lead to its aesthetic devaluation. Others such as Gussow (2001) argue that information about the process used to create the art is superfluous; therefore, use of the camera obscura is irrelevant to the aesthetic value of the art created with it. Furthermore, some might view the use of technology in the creation of art as part of the process, rather than a detached facet of the creation. Steadman's (2002) comprehensive treatment of Vermeer's use of the camera obscura raises these points and agrees most strongly with the latter position, but Steadman's analysis does not take the viewer's aesthetic experience into consideration. The current research investigates these differing views of the use of a particular technological innovation (the camera obscura) in the creation of art and its resulting aesthetic values. The second experiment focused on how the perception of art is affected by the knowledge that a potentially skill-reducing technology was involved in the art's creation. Specifically, we hypothesized that aesthetic ratings would diminish as a function of participants being informed of the camera obscura's use as an aid.

Method

Participants. Ninety undergraduate students (25 men and 65 women; age range from 17 to 43 years, mean age = 20 years) volunteered for an "Art Appreciation" study for course credit. None of the participants had been involved in Experiment 1. Again, participants were very interested in the arts and were involved in some form of visual or performing art as a hobby; 44 participants indicated that they had had previous art training, and two participants were able to define *camera obscura.*

Materials and Setting. Four reproductions of paintings by Vermeer that showed the least amount of variance in aesthetic quality in Experiment 1 were used and are listed in Table 3. All four paintings were created with the camera obscura, according to Steadman (2002). The paintings were viewed by participants through a PowerPoint presentation on an overhead projector in a university classroom. During the presentation, the lights were dimmed and the windows were covered.

Table 3
Title and Year of Paintings Viewed by Participants in Experiment 2

Painting title	Year
Girl Interrupted at Her Music	c. 1660-1
The Concert	c. 1665-6
Lady Writing a Letter with Her Maid	c. 1670
Lady Seated at the Virginals	c. 1675

Note. Painting title and year according to Steadman (2002).

Procedure. Participants were randomly assigned to two groups; one group was given information about the camera obscura and one was not. This information was provided through a background information page before the paintings were viewed. In the non–camera obscura (non-co) condition, 46 participants read general information about the creation of art in the Dutch realist school of painting. In the camera obscura (co) condition, 44 participants read about the use of the camera obscura in the creation of art in the Dutch realist school of painting.

After reading the background information, participants were asked to view and rate the four paintings across six aesthetic dimensions: *pleasingness, liking, preferability, beauty, interestingness,* and *wish to see again*. The rating questionnaires contained questions structured in the following way: "Please look carefully at the painting and rate it according to how *[aesthetic dimension]* you find it by circling the appropriate point on the *[aesthetic dimension]* scale, ranging from *1 = low [aesthetic dimension]* to *5 = high [aesthetic dimension].*" The order in which participants rated the various dimensions of the paintings was randomized. Throughout evaluation of the paintings, participants were reminded that there were no correct or incorrect answers and that the research was only interested in the judgment of this art. Participants also were instructed to take as much time as necessary to complete the task.

Results

Ratings for all paintings across six dimensions were significantly correlated (all ps < .05). Computing the mean ratings from each aesthetic dimension and averaging the means across participants yielded a composite measure of aesthetic preference. Means and standard deviations of the composite aesthetic score for each painting are listed in Table 4. Aesthetic evaluation of paintings in the co condition versus that of paintings in the non-co condition was assessed through comparison of the two conditions using a t test. While overall ratings in the co condition (M = 3.20, SD = .61) were numerically higher than ratings in the non-co condition (M = 3.13, SD = .54), this difference was not statistically significant, t (88) = .60, p = .55, r = .06.

Table 4
Means and Standard Deviations (SD) of Combined Aesthetic Evaluations for Camera Obscura and Non–Camera Obscura Conditions in Experiment 2

Painting title	Condition	Mean	SD
Girl Interrupted at Her Music	Camera Obscura	3.13	1.05
	Non–Camera Obscura	3.24	.87
The Concert	Camera Obscura	3.28	.91
	Non–Camera Obscura	3.30	.91
Lady Writing a Letter with Her Maid	Camera Obscura	3.34	.79
	Non–Camera Obscura	3.03	.84
Lady Seated at the Virginals	Camera Obscura	3.09	.83
	Non–Camera Obscura	2.95	.92

Discussion

This experiment investigated the effect of knowledge of technological aid in the artistic process on aesthetic judgment. While ratings were numerically higher for the non-co condition, the differences were not statistically significant. The small effect size rules out the possibility that sample size is the culprit for the null results. Aesthetic evaluation showed no difference in preference for the non-co condition and the co condition, suggesting that technological aid has no effect on aesthetic judgment for this sample. Thus, technology does not always negatively affect perceptions of art.

It is important to note that, while a description of the camera obscura was provided in the co condition, the participants may not have viewed this technology as controversial or even deskilling due to its relatively antiquated nature. In order to access the construct, it might be necessary to choose a topic more relevant to the sample. For example, 25% of the participants listed photography as a hobby, suggesting that the camera obscura might not be an unusual aid in creating art. More simply, the camera obscura might not seem like technology to an individual who is used to taking pictures with a digital camera. In addition, Stern (1999) showed that technological effects on evaluation are more pronounced when the outcome is a failure. The paintings used in this study are considered to be masterpieces, not failures; indeed, in Vermeer's rather sparse oeuvre of less than two dozen paintings, none are seen as particularly bad works of art (Steadman, 2002).

General Discussion

Some 400 years after their creation, Vermeer's paintings continue to attract attention and analysis from art historians and critics, as well as from scientists interested in subjects ranging from perception (Deregowski & Parker, 1988; West & Van Veen, 2007) to psychoanalysis (Baudry, 2007; Kramer, 1970; Rizq, 2005). However, this appears to be the first study to examine empirically the influence of the camera obscura on aesthetic evaluation of Vermeer's work. In an aesthetic analysis of Vermeer's paintings, the participants in Experiment 1 found some paintings created with the use of the camera obscura (according to Steadman, 2002) to be more pleasing than those created without the camera obscura. To art critics the camera obscura may degrade the paintings' aesthetic quality, but to young adults interested in art, the camera obscura appeared to make the art better. In a more contextualized analysis of the camera obscura's impact in Experiment 2, a second group of young adults interested in art did not find that information about the technology and its use in painting detracted from their aesthetic evaluation.

Perhaps the participants did not understand the implications of the camera obscura as an innovative technology for 16th-century art, but again, the participants were art appreciators, not art critics. It is also possible that this sample had a higher level of technology acceptance than the general population. The sample consisted of young college students who were comfortable with technological innovation; college students are immersed in an environment that is technology driven. Technology may not be a factor in their aesthetic judgment of art because technology is neither good nor bad but simply a norm in their world. However, the issue of technology and aesthetics is not limited to visual arts. For example, use of "beta blockers" (drugs that inhibit the sympathetic nervous system, which produces the fear

response) has become common in professional classical musicians (Tindall, 2004). Before performing a concert, some musicians take beta blockers to relieve performance anxiety. This poses the same question in a modern context: Does this specific technological innovation affect our aesthetic judgment of classical music? Is music created by performers who have taken beta blockers less aesthetically pleasing? The same question can be extended to other forms of aesthetic experience ranging from theater performances to wine tasting. When does technology enhance or detract from an experience of beauty? Does technology use in the creation of art lessen its intrinsic value, as Cavanagh (2008) suggests? Stern et al. (1998) suggest there is an optimal level of technology for determining mood or attitude. At the extremes of no technology and maximum technology, there is minimal enjoyment and poorer mood; however, there is a sweet spot in the middle in which people derive enjoyment and happiness from a moderate amount of technology.

Future research should investigate this optimal level of technology as it relates to aesthetic evaluation and expand the stimuli beyond visual art to other artistic and aesthetic experiences. Additional research in art and technology also should expand the participant pool to include art experts. Using such a sample may eliminate some of the variation of art appreciation found in a student sample and also may provide more strongly pronounced contextual effects.

In conclusion, these results suggest that individuals view Vermeer paintings created with the aid of the camera obscura, a technological device, as more aesthetically pleasing than paintings created without the aid of technology, and that knowing that such a technological device was used to create art does not lower observers' perceptions of its aesthetic qualities. The two experiments suggest that technology can improve work (in this case, art) and does not have to negatively affect perceptions of the work. A deft use of technology can, indeed, be used to enhance rather than simply substitute for artistic talent.

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