

The effect of left-right reversal on film: Watching Kurosawa reversed

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Abstract. The mirror reversal of an image is subtly different from the original. Often such change goes unnoticed in pictures, although it can affect preference. For the first time we studied the effect of mirror reversal of feature films. People watched *Yojimbo* or *Sanjuro* in a cinema, both classic films by Akira Kurosawa. They knew that this was a study and filled out a questionnaire. On one day *Yojimbo* was shown in its original orientation, and on another day the film was mirror reversed. *Sanjuro* was shown reversed on one day and non-reversed on another day. Viewers did not notice the reversal, even when they had seen the film before and considered themselves fans of Kurosawa. We compared this with estimates from a survey. In addition, the question about the use of space (scenography) revealed that although people who had seen the film before gave higher ratings compared with those who had not, this was only true when the film was not reversed.

Keywords: aesthetics, visual art, composition, film, laterality.

1 Introduction

In the opening scene of *Yojimbo* (1961), a samurai arrives at a fork in the road and throws a stick in the air. The stick points to the right, and the samurai follows the road to a village. Here the story begins. We will never know where he would have arrived if the stick had sent him to the left. But what we can test is how different the film would have been if keeping everything else the same, the stick had pointed to the left and the samurai had walked to the left to a similar but mirror-reversed village. In other words, an entire film can be shown with a left-right reversal of the images. This is what we did in our study, and afterwards asked viewers a series of questions on their experience. By doing this we tested (i) how often people reported that the film was reversed and also (ii) whether the judgments on the quality of the film, acting, and scenography were different for the participants that saw the original or the reversed versions.

2 Composition and scenography

In the study of the visual arts, composition and balance are important themes (recent studies of balance include McManus et al 2011 and Gershoni and Hochstein 2011). For instance, Oppé (1944) claimed that Raphael's cartoons changed in meaning as the drawings were turned into tapestries (and mirror reversed in the process). One possibility is that people have a specific way of scanning a picture, and as a consequence, they prefer images in which movement proceeds from left to right (Gaffron 1950). Empirical research on aesthetic judgments of pictures has identified some asymmetrical biases: there is a preference for having more salient content on the right side (Levy 1976; Beaumont 1985), for directional

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cues pointing from left to right (Mead and McLaughlin 1992), for light coming from the left (Mamassian 2008), for portraits (especially of females) to show the left cheek rather than the right cheek (McManus and Humphrey 1973; Schirillo 2000), and for more space present in front (anterior) as opposed to behind when objects have a facing direction (Palmer et al 2008; Bertamini et al 2011). All but the last of these aspects of an image are affected by a left-right reversal.

The aesthetic criteria for a film may differ from those used to assess a painting (Cutting 2002; Cutting et al 2011). In Arnheim's words: "Film almost never deals with non-moving pictures as do painting and photography, and thus we cannot speak here strictly of the composition of a static image" (1997, page 86). However, Arnheim goes on to argue that composition is part of a broader set of spatial aspects of a film. For dynamic images, composition in this broad sense is likely to be even more important than in paintings, and we will use the term scenography to refer to spatial composition as well as the set, costume, and lighting. Although usage of this term differs amongst authors, our use is in line with the following definitions of scenography: "the manipulation and orchestration of the performance environment. The means by which this is pursued are typically through architectonic structures, light, projected images, sound, costume and performance objects or props" (McKinney and Butterworth 2009, page 4) and "the creation of the stage space" (Howard 2002, page xix).

The left-right reversal manipulation changes some aspects of spatial layout while leaving others intact. Persons and objects relocate to the opposite side of the image, and any horizontal motion is in the opposite direction. The way that clothes are folded and swords are carried also changes. A kimono, for example, is always worn with the left side overlapping the right side (the reverse is used to dress a corpse for burial). Light that used to come from one side is now coming from the other. Any right-handed actor becomes left-handed and vice versa. Finally, many emotions are expressed by actors during a film, and facial expressions are also known to be asymmetrical (Sackheim and Gur 1978), and more so for deliberate facial actions (Ekman et al 1981). Any of these factors could be noticed by an observer, but even when they are not noticed, they could also contribute to a change in the evaluation of a film overall, or more specifically in relation to an evaluation of scenography (defined in our question as the use of space, set, costume, and lighting).

3 The films

Akira Kurosawa (1910–98) is frequently cited as one of the greatest directors of all time. He is also widely acknowledged as an influence on other directors, from Sergio Leone to George Lucas (both of whom used themes from Kurosawa's films in their own productions [Galbraith 2002; Richie 1999]). A perfectionist, he worked passionately on every aspect of the filmmaking process. He used multiple cameras and was particularly admired for his skills as an editor (Richie 1999). Images from Kurosawa's films are powerful and memorable.

Yojimbo (1961) is set in 1860's Japan. The main character is a *ronin* (a masterless samurai) played by the actor Toshirō Mifune. Some themes, such as the taciturn samurai, inspired later western films (eg, the nameless hero). *Sanjuro* (1962) is a sequel to *Yojimbo* in which we meet again the same protagonist, although the film is lighter in tone (see Figure 1). Both were filmed in black and white and have never been dubbed into English. In our study they were screened in the original Japanese with English subtitles. A few seconds (less than a minute) at the beginning of each film and at the end were omitted to avoid any words using the Roman alphabet (but titles and credits in Japanese were preserved). The running times for *Yojimbo* and *Sanjuro* are 110 minutes and 96 minutes, respectively.

We chose Kurosawa not only because he is highly admired as a director but also because in these films there are no cars and no Roman alphabet writing. We wanted to avoid the special case of detection of inversion for text and focus instead on the change in handedness and in composition of the visual images.



Figure 1. The original posters for the films *Yojimbo* (left) and *Sanjuro* (right). In the *Sanjuro* poster Mifune is holding his sword with his left hand. Possibly the image was reversed to fit the composition of the poster, but we could find no information on this (and therefore it may be that this has gone unnoticed before).

4 Familiarity

It is well known that having been exposed to a stimulus may affect responses to it at a later time. There is a large literature on implicit learning or learning without awareness (eg, Seger 1994). Importantly for aesthetics, prior exposure also affects preference and affective responses, a phenomenon known as "mere exposure" (Zajonc 1968; 1980). Mere exposure has been studied in relation to actual works of art (eg, Berlyne 1970). Cutting (2003; 2007) discussed the application of the idea of mere exposure to the formation and maintenance of artistic canons and provided evidence to support this view in the case of French Impressionism.

If exposure is critical for the evaluation of a film, then viewers that have seen the film before may behave differently from viewers that have not seen the film. Unlike a laboratory study, we cannot randomly assign people to the two groups. Moreover, what people may be unaware of is not which film they have seen in the past but the specific details of the film. If so, it is possible that people who remember having seen the film before may not notice that the film is now different (mirror reversed) and yet evaluate the film differently than those who see the film in the original orientation (because only the latter are being exposed to the same film again).

5 Expectations about how easy it is to notice a left-handed world

In addition to the study of the experience of watching a left-right reversed film, we wanted to know what intuitive beliefs people have about how easy it is to detect a left-right reversal. To do this, we used a simple questionnaire with three different scenarios. One group of participants ($N = 35$) was asked whether it would be easy or difficult to notice that the world has been left-right reversed. Another scenario described a museum in which all paintings have been mirror reversed ($N = 35$), and a third described a film ($N = 35$). The wordings of the questions are presented inside the graphs of Figure 2. For instance the question about the film was: "Imagine that you went to see a new film, and in the film the entire world has been changed into its mirror-reversed version. Most things would be the same except that most people in the film would now use their left-hand to eat, shake hands, point, and so on. How long do you think it would take for you to notice?"⁽¹⁾ Participants circled one of three answers: "Immediately", "Some time", "Never". If they answered "Some time," they were then asked how long. This first question was followed by a second question: "Now, please answer the same question but this time the film is a film that you had seen before in the non-reversed version. How long do you think it would take for you to notice?" This follow-up question was included only for the film and the museum scenarios, as the world cannot be unfamiliar.

The 105 participants were students from several classes at the University of Liverpool, including some with mature students. The majority were females (86), and the mean age was 24 years. Figure 2 shows the percentage of responses in each category. The "some time" category has been split into "less than an hour" and "more than an hour" on the basis of the specific predictions made by the participants.

In all cases a majority of respondents predicted that they would notice the reversal immediately or that it would take them less than an hour to notice it (world, 63%; museum, 63%; film, 63%). This majority increased when they were asked to assume that the paintings in the museum or the film were familiar to them (museum, 100%; film, 74%). We are not going to speculate about the differences between the three scenarios, as they may require further research. Our purpose was simply to see whether people's intuition was that this task was easy or hard. We can conclude from the data that the task is judged to be non-trivial (overall "immediately" responses were 27%) and that a few minutes may be necessary to notice the change, but this task is not impossible (overall "never" responses were 16%).

6 Left-right reversal

This study is the first investigation of the experience of watching a film after a manipulation that reverses the left-right orientation of the image. The first empirical question to answer is whether the spectators will notice the mainly left-handed world of the story, and whether having seen the film before, would increase the detection of the change. If the outcome were to match the expectations, based on the data presented above, a majority of people will detect the reversal, and this majority will be larger in the case of people who had seen the film before.

The sample in our study was made up of people who came to a free screening in a cinema located in the centre of Liverpool, UK. This sample was completely different from the sample who answered questions about how long it would take to notice a reversal (see section on expectations). Participants knew that in exchange for free entrance they had to fill out a

⁽¹⁾The question mentioned the change of handedness for clarity, but we also replicated this pattern of expectations from an additional sample of 35 people for whom the question was shorter and did not mention handedness.

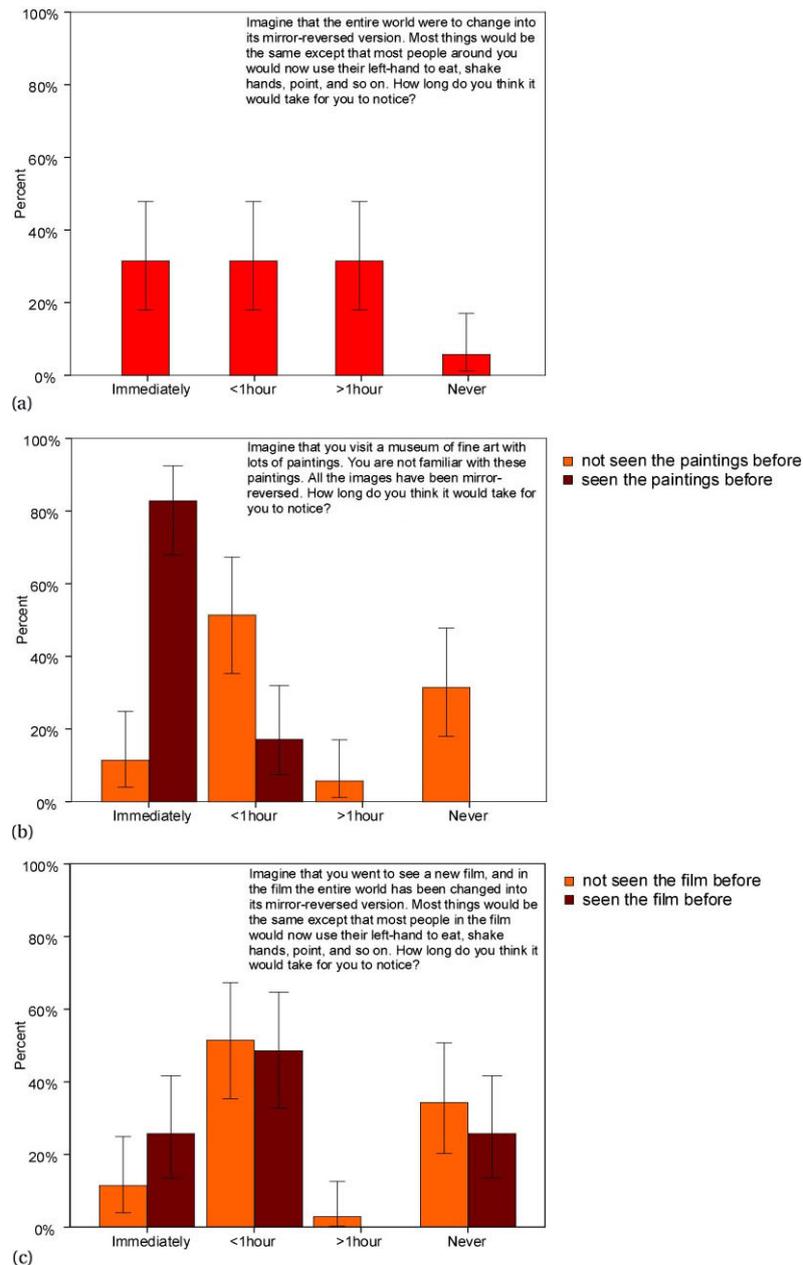


Figure 2. Distribution of people's expectations about how long it would take to notice a left-right reversal. There are three scenarios: (a) world, (b) museum, and (c) film. The wording of the question is included in the panels. For the museum and the film a follow-up question asked to repeat the prediction assuming that the paintings or the film were familiar. Error bars are 95% confidence intervals for percentages.

questionnaire at the end, and they knew that this was part of a study. The questionnaire was designed to collect information about how much they liked the film overall and specifically about the acting and the scenography. It also asked the level of engagement with the story, and space was provided for people to make comments on anything they had noticed about the film. We collected information about sex, age, level of education, where they were sitting in the theatre, whether and when they had seen the film before, and whether they considered themselves fans of Kurosawa. Given the importance of previous exposure for aesthetics (eg, Cutting 2003), the difference between people who had seen the film before and those who did not is particularly important.

We predicted that many people would not notice the reversal manipulation. This prediction was based on the fact that mirror images of objects have similar perceptual effects (eg, Biederman and Cooper 1991) and that people do not easily distinguish an original painting from its reversed image (Gordon and Gardner 1974; Bennett et al 2010), although they do better when the paintings are highly familiar (Blount et al 1975). However, our study was different from anything done before, and it is essential to measure the actual frequency of detection. In addition, judgments about the film's quality may depend on the reversal despite the lack of awareness of the manipulation. In particular, we were interested in the question about scenography.

7 Method

7.1 Design

There were four screenings for four groups of observers. On Monday *Yojimbo* was shown in the original orientation ($N = 43$) and *Sanjuro* was shown reversed ($N = 36$), and on Wednesday *Yojimbo* was shown reversed ($N = 50$) and *Sanjuro* was shown in the original orientation ($N = 43$). *Yojimbo* was always screened at 3:00 PM and *Sanjuro* at 6:30 PM. This choice meant that time of day was confounded with film, but orientation and film as well as orientation and time of day were balanced.

7.2 Participants

Ninety-three people watched *Yojimbo*, and seventy-nine watched *Sanjuro*. The majority were males (66%), and age ranged from 16 to 74 with a mode of 20. Highest level of education was varied, but a large proportion had a university degree (46%) or a doctorate (26%). A minority (19%) had seen the film before, but almost half of the participants (47%) answered yes to a question about whether they considered themselves a fan of Kurosawa.

7.3 Stimuli and procedure

The cinema was located within the Foundation for Art and Creative Technology, a complex that includes three cinema screens as well as art galleries. The theatre was small (10 m x 10 m) and had a capacity of 50 people. The screen was 8 m wide. The image was of DVD quality, and the projector was a Christy Digital CP2000. Participants were permitted to choose a seat and were asked to complete the questionnaire after the film was shown.

Participants had to choose a value between 1 (terrible) and 9 (wonderful) on the following four items: "Overall the movie was", "The quality of the acting was", "The quality of the scenography (use of space, set, costume, lighting, etc) was", and "The performance of Toshiro Mifune (main character) was". The fifth question was about level of engagement, and the scale went from 1 (indifferent) to 9 (engaged). There was also an open question at the bottom of the page: "A final open question: Is there anything else in particular you would like to tell us about the movie that you have just seen?"

8 Results

8.1 Detection of reversal

Approximately half of the viewers (49%) wrote comments on the questionnaire in addition to answering the questions, and many others talked with the experimenter after the screening. Only two individuals wrote in their comments that they had noticed that the film was mirror reversed. One of them could speak Japanese and therefore reported that the Japanese characters were reversed. This puzzled her, but her comments were only relative to the text, not the film itself. Only one person therefore genuinely detected the manipulation in the film. This person was a fan of Kurosawa who had not only seen the film but seen it repeatedly. She was also in contact with the family of Toshirō Mifune and carried with her a signed photograph and a small container with some of his ashes. We excluded both individuals from the subsequent analyses.

The almost total lack of detection of the reversal is remarkable. Except for the one individual mentioned above, none of the people who had seen the film before or that classified themselves as fans of Kurosawa detected that they were watching a film that was different from what they had seen before; nor did they detect the fact that they were watching a world populated mainly by left-handed people.

Next we consider the four separate aspects of the film that viewers judged. Given that we had only four screenings in total, reversal, film, and day of the week could not be completely crossed in the design. In all the analyses reported we included reversal (original or reversed) and film (*Yojimbo* or *Sanjuro*) as factors, but analyses performed with reversal and day of the week as factors produced exactly the same pattern of significant results. Mean scores are shown in [Figure 3](#).

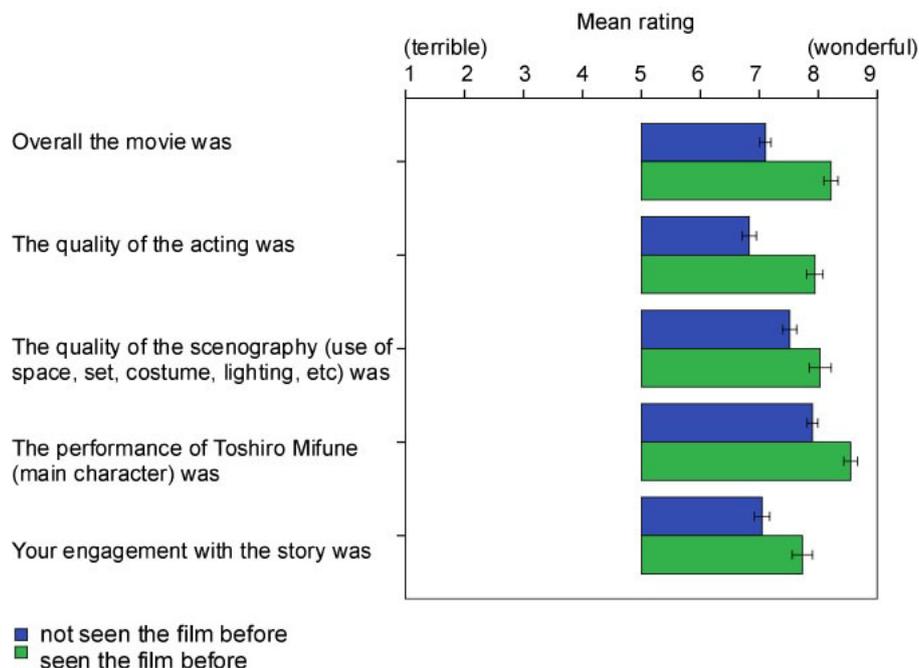


Figure 3. Mean rating values on the questionnaire items as a function of whether viewers had seen the film before. Errors bars are 1 SEM.

8.2 Overall impression of the film

The first question was about the overall rating of the film. Perhaps unsurprisingly ratings were, in general, high. The mean was 7.32 on a 9-point Likert scale.

We performed an ANOVA with the following factors: Film (*Yojimbo* or *Sanjuro*), Reversal (original or reversed), Exposure (the group who had seen the film before and the group who had not), and Sex. The only significant effect was exposure: people who had seen the film before gave higher scores ($F(1,148) = 10.63, p = .001$).

This effect is likely to be a selection phenomenon: all but one of those who had seen the film before claimed also to be fans of Kurosawa. It is also possible that in addition to the selection issue, there was an effect of previous exposure. To test that possibility, we selected the subset of people who were fans ($N = 80$). Within this group only 30 (37%) had seen the film, and we compared the fans that had seen the film before with the fans that had not. We reasoned that for a fan of Kurosawa seeing a film that they had not yet seen should be a treat and therefore they should give higher scores (and nobody in either group was disappointed given the high scores). Conversely, if seeing a film that one has seen before is the important factor, then the previously exposed group should have the higher score. The latter was the case ($t(77.66) = 4.51, p < .001$), supporting the idea that previous exposure is a contributing factor.

8.3 Acting

There were two questions about acting, one about the whole film ("The quality of the acting") and one about Mifune ("The performance of Toshiro Mifune"); the means were 7.04 and 8.02, respectively. The latter value is the highest mean for all questions and is close to ceiling on the 9-point scale.

We performed a mixed ANOVA with the following factors: Question (overall or Mifune), Film (*Yojimbo* or *Sanjuro*), Reversal (original or reversed), Exposure (the group who had seen the film before and the group who had not), and Sex. There was a difference between the two questions ($F(1,148) = 28.18, p < .001$), an effect of Exposure ($F(1,148) = 6.90, p = .010$), and an interaction between the two ($F(1,148) = 9.52, p = .002$). Despite the interaction, the trend for exposure was in the same direction for both questions (higher values from people who had seen the film before). Therefore, the results relative to acting show something similar to the results on overall impression of the film.

8.4 Scenography

As discussed in the introduction, because of the existing literature on effects of spatial composition for paintings, this was the question we were most interested in. We performed an ANOVA with the following factors: Film (*Yojimbo* or *Sanjuro*), Reversal (original or reversed), Exposure (the group who had seen the film before and the group who had not), and Sex. There were no significant main effects, but there was an interaction between Reversal and Exposure ($F(1,148) = 4.27, p = .040$). This interaction is illustrated in [Figure 4](#).

As we have seen in the analysis of the overall quality of the film and the acting, viewers who have seen the film before tend to rate the film higher. However, in the case of scenography those who had seen the film before gave a higher rating only to the original version, the effect of previous exposure was absent for the reversed version ([Figure 4](#)).

To find further support for a role of previous exposure, we reasoned that any effect of exposure should weaken over a long period of time. We used the information about when the film had been seen and used the median to split the previously exposed group into two new groups: those who had seen the film within the last 5 years and those who had seen the film more than 5 years ago. Overall, the means for the two groups did not differ ($t(20.94) = -1.83, ns$). Interestingly, the effect of exposure was present for the first group ($t(13.87) = 2.45, p = .028$) but not the second ($t(12.61) = 0.19, ns$), supporting the idea that (recent) previous exposure is linked with higher ratings for the original version, even though none of these viewers detected the reversal.

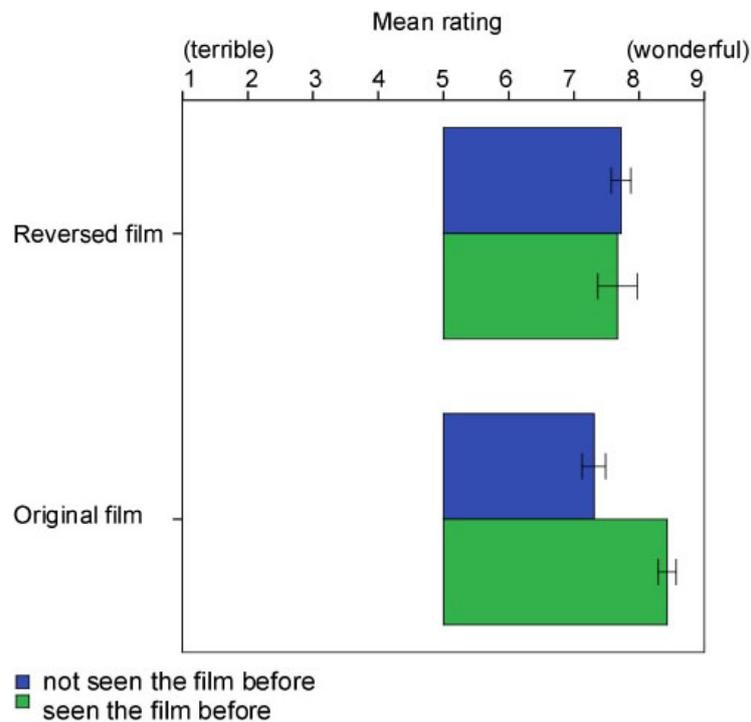


Figure 4. Mean rating values for the question relative to the scenography as a function of whether viewers had seen the film before and separately for the original and the reversed versions. Error bars are 1 SEM.

8.5 Engagement

We performed an ANOVA with the following factors: Film (*Yojimbo* or *Sanjuro*), Reversal (original or reversed), Exposure (the group who had seen the film before and the group who did not), and Sex. There were no significant main effects or interactions.

9 Seating

It is interesting to analyse briefly the information about where in the cinema people were sitting. One may expect that higher ratings would be associated with sitting near the centre, and therefore more in line with the projector. We coded the five aisles from -2 on the right (near the entrance) to 2 on the left and plotted mean scores as a function of aisles. These plots displayed a symmetrical distribution with a peak near the centre. We performed an ANOVA for each of the questions and looked for evidence of a quadratic trend. For the questions about acting and scenography the quadratic term was significant ($F(1,163) = 6.69, p = .022$, $F(1,163) = 15.18, p = .004$, respectively) and there was a similar trend for the question on the overall impression of the film ($F(1,163) = 4.41, p = .059$). Because people could choose their seats in the theatre, there are two possible explanations for the higher scores near the centre. The first is that people who are more interested in the film sit in the middle, and the second is that people who sit in the middle have a better experience. We cannot separate these two in our study, but what is important is to check that location in the theatre was not confounded with previous exposure. If it were the case that people who had seen the film before tend to sit in the centre of the theatre, then the fact that they give higher scores may not necessarily depend on previous exposure but simply on where they were sitting. Therefore, we compared the location (as coded in terms of aisles) for the two groups (those who had seen the film before and those who had not). There was no significant difference between the two groups in terms of location to the left or the right ($t(166) = -0.34, ns$) or in

terms of eccentricity (aisles were recoded for eccentricity by removing the sign) ($t(166) = -0.61$, ns). Therefore, the higher ratings from people who had seen the film before, which was discussed earlier, are unlikely to be an indirect consequence of where the viewers were sitting.

10 Replication with short clips

We conducted a study in Italy to replicate and extend the basic finding. We selected two 5 min clips from *Yojimbo* (A and B) that were similar in content (they both begun with an interior scene, relatively rich in dialogue, and ended with a combat scene, rich in action). We recruited four groups of 120 students each from four undergraduate courses at the University of Parma. One group saw clip A (original orientation), then clip B (reversed); one saw clip A (reversed), then clip B (original); one saw clip B (original), then clip A (reversed); and one saw clip B (reversed), then clip A (original). Afterwards, participants were required to compare the two clips. Specifically, a questionnaire asked them to rate how much they preferred the scenography of the second clip over the first using a nine point scale. They were also given an open question as in the Liverpool study. One interesting aspect of this study was the absence of subtitles. In the Liverpool study participants may have paid less attention to the images if they concentrated on reading them. In this control study we used the Japanese soundtrack with no subtitles. Consistent with the earlier study, none of the participants reported noticing that one clip was reversed. With respect to the role of familiarity, out of 480 participants, only 2 reported having seen the film before. For this reason, a comparison with the main study is impossible, although, interestingly, these two students reported preferring the scenography of the original version over that of the reversed one. An ANOVA with factors Clip (A or B), Version (original or reversed), and Sex revealed an overall preference for clip A over B ($F(1,433) = 11.25$, $p = .001$), but no effect of version. It is interesting that even when two clips were compared directly against each other's, the reversal was not noticed.

11 Discussion

Our study revealed unequivocally that it is possible to watch a film mirror reversed without noticing the reversal, and with similar levels of engagement. One person noticed the reversal of the Japanese characters, and one noticed the reversal in the images, but everybody else failed to report the reversal. On the one hand, it is true that we did not ask explicitly whether the images were reversed, and therefore cannot claim that people would have been at chance once asked. On the other hand, participants knew that they were part of a study and knew that the event was organised by researchers from the University of Liverpool, and they were on average highly educated. Both *Yojimbo* and *Sanjuro* lasted more than 1.5 hours, and during this time viewers watched a world of left-handed people without detecting that this was unusual. In addition to the change in handedness, a few other aspects of the modified images might have looked wrong, specifically the asymmetry in facial expressions, the folding of the clothes, how swords were carried, and the direction of lighting and movement, as discussed in the introduction. These are all subtle changes but together they add to a considerable amount of information. In a similar study in Italy two clips were directly compared (one of them reversed), and even this direct comparison did not lead to detection of the reversal.

This lack of detection may be related to the fact that when viewing a film, the viewer is engaged with a story, and that such a story is unaffected by mirror reversal. A separate group of people judged how quickly they would notice a left-right reversal of the world, pictures in a museum, or a film. A majority predicted that it would take less than an hour to notice the reversal in each of the three scenarios. In the case of a film this expectation was not matched by people's actual performance in our study.

Almost one participant in five had seen the film before, and almost half (47%) declared themselves fans of Kurosawa. Nevertheless, with the exception of one individual, having seen the film before or being familiar with the work of Kurosawa did not make it easier for the viewer to notice that the film was different. For instance, even though Mifune is a famous actor and many viewers would have been familiar with his roles in many of Kurosawa's films, it did not matter whether he was right handed (original version) or left handed (reversed version).

The choice of films by Kurosawa allowed us to test films from a famous and highly admired director, but it also had the advantage that the setting in 19th-century Japan meant that there were no cars and no Roman alphabet writing in the images. Detection of inversion for words is a special case, and we consciously designed our study to avoid this aspect. Instead we were interested in reversal of the image, and therefore the change in composition. This aspect was targeted specifically by the question on scenography.

The ratings of the quality of the scenography (defined as the use of space, set, costume, and lighting) for the original version or reversed version differed as a function of previous experience; only the viewers who had seen the film before rated the original more highly than they did the reversed. The phenomenon of mere exposure (Zajonc 1968) can help to interpret this finding. It is known that observers prefer stimuli that they have seen before even though they do not remember them (eg, Seamon et al 1995; Johnson et al 1985). However, our situation is different and unique. Participants did remember having seen the film; what they did not remember was the orientation of the images. We found that people who had seen the film before reported liking the scenography more than people who had not seen the film before, but only when the film was shown in the original orientation (even though they did not consciously recognise that the reversed version was different). We interpret this finding as evidence of a composition-specific exposure effect. This interpretation is supported by the fact that the preference for the original version in people who had seen the film before was specific to people who had seen the film relatively recently (in the past 5 years). However, given the limited sample size of the subgroup of observers who had seen the film before, this issue does need further research.

Studying the experience of watching a film in a cinema is challenging but rewarding. People who come to a cinema are a sample from a population of people with an interest in films (and specifically with an interest in the works of Kurosawa in our case) and therefore more diverse than participants recruited within the university community. Finally, questions about the role of asymmetric biases in visual art as well as questions about the role of previous exposure can be tackled, and our study is hopefully the first of many.

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