



# Left–Right Position in Moving Images: An Analysis of Face Orientation, Face Position, and Movement Direction in Eight Action Films

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## Abstract

There are compositional biases in works of art that have been documented in *static* images. This study extends the analysis to moving pictures. We examined eight films by four different directors (Ford, Leone, Kurosawa, Chahine), each with a male actor in the major role. These directors are also from different countries (USA, Italy, Japan, Egypt). The analysis focused on three compositional aspects: a) the orientation of the face of the actor (which cheek was visible), b) the position of the face within the image (positioned either to the left of the screen showing the left or right cheek or to the right of the screen showing the left or right cheek), and c) the movement of the actor within the scene (moving to the left or to the right). Unlike in paintings there is no evidence that the left cheek was visible more often than the right. However, we confirmed that position and facing direction are related, i.e. the actor tends to face toward the centre of the screen. With respect to the analyses of movement, there was a greater frequency of movements from left to right, and this may explain the lower than expected frequency of the left cheek. Interestingly, we found a cultural trend in that the pattern of results from Western directors did not extend to the films by Chahine, which may be influenced by reading direction.

## Keywords

Film, visual aesthetics, laterality, composition, reading direction

## 1. Introduction

An important aspect in any movie is the composition of the scene, i.e. the placing of objects within a space. Though watching a film provides a different

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experience to that experienced when viewing a painting, directors, like painters, compose images within the limitations of a frame (i.e., the camera shot) selecting the most important elements for inclusion in the image (Anderson, 2013; Arnheim, 1983; Marsh and Wright, 2000). We know that directors make explicit decisions (through the storyboards and scripts created for films) about where the main actor in their movies is positioned in the frame of the scene and whether they should, for example, face left or right. Yet it is unclear if these decisions are intuitive, directorial conventions, or due to the limitations of equipment and technology, particularly in relation to the capture of movement (DeLong *et al.*, 2014). Indeed, the aesthetic criteria used to judge a film may differ from those used to assess a painting, and composition may well be a more important consideration in dynamic images than in paintings (Arnheim, 1974; Cutting, 2002).

The following section reviews the literature on composition and asymmetrical biases in visual art, especially paintings. After that we will introduce the methods used to examine these issues within a set of films.

### *1.1. Compositional Asymmetries in Visual Images*

Empirical research has explored how both asymmetric biases and directional cues can affect the dynamics and balance of an image, and in turn its aesthetic evaluation (Arnheim, 1951; Palmer, 1991). Levy (1976) found that right-handed observers have a preference for images in which the more salient object is placed to the right. She explained this on the basis of a known attentional bias to the left. Furthermore, the left visual field bias may be linked to a tendency to scan from left to right, causing paintings to appear heavier when objects are placed to the right (Arnheim, 1974; Gaffron, 1950). In relation to directional cues in static images, implicit motion is more often from left to right and this may reflect a preference to scan an image from left to right in dextrals (Freimuth and Wapner, 1979; Mead and McLaughlin, 1992). When arranging objects within a rectangular frame, objects positioned to the left or right of the frame were preferred when they faced inward towards the centre ('Inward bias': Palmer *et al.*, 2008). An additional positional bias places more space present in front (anterior) of objects as opposed to behind them when the object faces along the horizontal axis ('Anterior bias', Bertamini *et al.*, 2011a, b). This same phenomenon has been referred to as 'lead room' in cinematography.

Empirical studies provide various explanations for facial orientation biases. The right hemisphere's role in the regulation of emotion accounts for more emotive expressions on the left rather than the right side of the face (Sackheim and Gur, 1978; Sackheim *et al.*, 1978). In Western European portraits, the left cheek rather than the right cheek is more likely to be presented to the viewer, though the effect is weaker for males (the stronger bias in females represent-

ing a greater inclination to express emotion, McManus and Humphrey, 1973; Nicholls, 2000; Schirillo, 2000).

Additionally, Humphrey and McManus (1973) suggested that the left or right facial bias of the sitter might depend on the similarity or dissimilarity in gender or status between the artist and model (i.e. left cheek bias: similar status/gender; right cheek bias: dissimilar status/gender). Alternately, Nicholls *et al.* (1999) argue that people posing for a portrait instinctively know which side of the face most effectively expresses emotion, suggesting that a tendency to present the left cheek when expressing an emotion and the right cheek to conceal emotion has a phylogenetic explanation.

The effect of complex interactions between cultural factors, cognitive functions and brain asymmetries on aesthetic preference is at present inconclusive (Chokron *et al.*, 2009). One of the more compelling arguments for cultural differences in compositional biases is the significance of the relationship between reading direction and aesthetic preference. For example, Pérez González (2012) compared samples of 19<sup>th</sup> century studio portraits from Spanish and Iranian photographers (left to right and right to left readers respectively). Whilst the Spanish sample displayed a preference pattern for left to right direction, the Iranian photographs showed the converse pattern, strongly suggesting that writing direction is linked to compositional organization in visual art. Additionally, whilst people preferred images when the salient object was placed on the right rather than on the left, regardless of their reading direction (Chokron and De Agostini, 2000), reading direction had no effect on the leftward bias in a grey scale task (Nicholls and Roberts, 2002). Dissociations such as these, and the interactions of reading and writing direction on visual laterality in compositional biases provide a strong case for further investigation (Beaumont *et al.*, 1984; Pérez González, 2012).

## 2. The Films

Films provide a rich visual experience, but present more challenges in the analysis of compositional aspects than those found in a static image (moving figures, changes of camera angle, lighting, etc., Hochberg and Brooks, 1996). Therefore, we limited the examination of composition to a group of directors and films from eastern and western cultures. We then focused on the specific positional, facial and directional orientations of the main male actor. The section that follows summarises the films that were chosen and the reasons they were selected.

We chose films made by four critically acclaimed directors from different regions of the world: Akira Kurosawa (Japan, 1910–1998), Youssef Chahine (Egypt, 1926–2008), Sergio Leone, (Italy, 1929–1989) and John Ford (USA, 1894–1973). These directors and their films are associated with their countries

**Table 1.**

Technical and biographical information about the directors, the films (release date and length) and the actors, including the actor's time spent on screen.

Director	Film	Release date	Film length	Actor	Actor's screen time (%)
John Ford <sup>1</sup>	The Searchers	1956	119 min	John Wayne	50.5
	The Man Who Shot Liberty Valance	1962	123 min	John Wayne	27.2
Sergio Leone <sup>2</sup>	A Fistful of Dollars	1964	100 min	Clint Eastwood	50.4
	The Good, the Bad and the Ugly	1966	177 min	Clint Eastwood	28.2
Akira Kurosawa <sup>3</sup>	Yojimbo	1961	110 min	Toshirō Mifune	60.8
	Sanjūrō	1962	96 min	Toshirō Mifune	58.3
Youssef Chahine <sup>4</sup>	Struggle in the Valley (Sira' Fi al-Wadi)	1954	125 min	Omar Sharif	30.8
	Struggle in the Pier (Sira' Fi al-Minaa)	1956	98 min	Omar Sharif	50.6

<sup>1</sup>Born in Cape Elizabeth, 1894 – died in Palm Springs, 1973

<sup>2</sup>Born in Rome, 1929 – died in Rome, 1989

<sup>3</sup>Born in Tokyo, 1910 – died in Tokyo, 1998

<sup>4</sup>Born in Alexandria, 1926 – died in Cairo, 2008

and cultures, although there are undoubtedly intercultural influences between them. For example, Leone referenced Kurosawa when making the “Man with No Name” trilogy, Kurosawa cited John Ford as one of his favourite directors (Ritchie, 1999), and Chahine spent time in California working as an actor (Fawal, 2008). From these four directors we selected a set of films which fit within the action genre, and which were all released between 1954 and 1966 (see Table 1 and Fig. 1).

Though there are differences in narrative, the general themes involve a fight against injustice. All have an internationally recognized male actor in the central role. The main reason to include a director from Egypt, apart from the fact that this allowed us to have films from four different continents, was that in this case the director and the leading actor are Arabic speakers (right to left readers) and therefore the reading and writing direction for their language is opposite to that of the American and Italian directors (left to right readers).

*Yojimbo* (1961) and its sequel *Sanjūrō* (1962) tell the stories of a *ronin* (a masterless samurai) exacting revenge and meting out punishment on corrupt officials and criminals on behalf of their victims. Toshirō Mifune plays the role of the samurai.

In *A Fistful of Dollars* (Leone, 1964, an unofficial remake of *Yojimbo*) a stranger is caught between two feuding clans and schemes to play the two



**Figure 1.** Posters for the films used in the analyses. Each column is for a different Director/Actor pair. From left to right: Leone/ Eastwood (Fistful of Dollars; The Good, The Bad and the Ugly), Ford/ Wayne (The Searchers; The Man Who Shot Liberty Valance), Chahine/Sharif (Struggle in the Valley; Struggle in the Pier), Kurosawa/ Mifune (Sanjūō; Yojimbo). This figure is published in colour in the online version.

sides off each other, whilst *The Good, the Bad, and the Ugly* (Leone, 1966) continues the adventures of the “Man with No Name” as he searches for buried Confederate Army gold. This role is strongly associated with the actor Clint Eastwood.

*The Searchers* (Ford, 1956) follows an American Civil War veteran as he hunts for his abducted niece. In *The Man Who Shot Liberty Valance* (Ford, 1962) a Senator returns home for the funeral of an old friend, revealing the true events behind the debt he owes his friend. John Wayne plays the protagonist in both films.

In Chahine’s *Struggle in the Valley* (*Sira` Fi al-Wadi*; 1954) a dispute between business rivals results in murder and revenge. *Struggle in the Pier* (*Sira` Fi al-Mina*; Chahine, 1956) takes place in the port of Alexandria and focuses on the theme of unjust exile and fate. The leading actor is a young Omar Sharif, prior to appearing in English language productions.

The main reason to include a director from Egypt, apart from the fact that this allowed us to have films from four different continents, was that in this case the director and the actors are Arabic speakers (right to left readers) and therefore the reading and writing direction for their language is opposite to that of the American and Italian directors (left to right readers).

### 3. Analyses

We performed three analyses on the films, from which we obtained three datasets. We call these (a) Orientation of the face, (b) Position of the face and (c) Movement. We report results from each of them in turn. The creation of the dataset involved watching the film and coding the current image of the lead actor (i.e. Wayne, Eastwood, Mifune, Sharif) as belonging to a set of fixed categories. The categories are listed in Table 2. A simple key press marked the transition from one category to a different one. Each key press was recorded

**Table 2.**

All categories of the three datasets in the analyses of the film: (a) Orientation of the face (b) Position of the face, and (c) Movement.

Orientation	Position	Movement
Presents left cheek	Left side/left cheek	Moving to the left
Presents right cheek	Left side/right cheek	Moving to the right
Front facing	Right side/right cheek	Moving to the front
Back of the head	Right side/left cheek	Moving to the back
Absent	None of the above	Absent

with a timestamp and we were then able to compute the duration of each category. Because the process is time consuming not all films were coded by a single person. After completing a first analysis, we decided to add a second wave of coding, with a new set of coders. We refer to these two datasets as ‘waves’. We include the two coding groups (waves) as a factor in the analysis. Note also that a category has no direct relation to other possible ways to segment a film, such as screen shots. For instance if the face and position of the actor was the same between two screen shots that counts as a single event in our analysis.

For each of the three datasets we analysed two aspects of the data. The first was the frequency of each type of event, that is, the number of events that fell into each of the categories. We focused on the comparison between left and right (dichotomous variable) and conducted logistic regressions. The second aspect of the results that we looked at was the average length in time of each type of event. This is a measure in seconds and, unlike the frequency, can be analysed using ANOVA. It is important to note that the two indices could be measuring different aspects. For example, it is possible that a given category does not occur very frequently, but when it is present it is longer in duration than other categories. On the other hand, a strong preference for one type of composition, for instance showing the left cheek of the face, could result in higher frequency as well as longer duration of this type of event.

### *3.1. First Dataset: Orientation of the Face*

In this analysis we categorised the orientation of the face of the leading actor. In every scene a decision was taken to sort the events into one of five types: (a) showing the left side/cheek, (b) showing the right side/cheek, (c) frontal view of the face, (d) back view of the head, (e) face absent (Fig. 2). Therefore every period of time during the film could be coded as belonging to one of these five categories.

#### *3.1.1. Results*

The orientation categories front, back and absent are not theoretically interesting. Therefore, we will focus the analysis on the comparison of left and right orientation. The relative frequency of these categories is shown in Fig. 3.

We ran a logistic regression on the categorical variable Orientation of the face, i.e., whether the left cheek or right cheek was displayed on screen. The predictors were Film (eight levels) and the Coder waves (two levels). We report the overall Hosmer and Lemeshow goodness of fit test for the model  $\chi^2(7) = 3.92, p = 0.789$ . There was a significant effect of Film, Wald =  $\chi^2(7) = 31.09, p < 0.001$ , but no effect of Coder wave, Wald =  $\chi^2(1) = 0.18, p = 0.669$ .

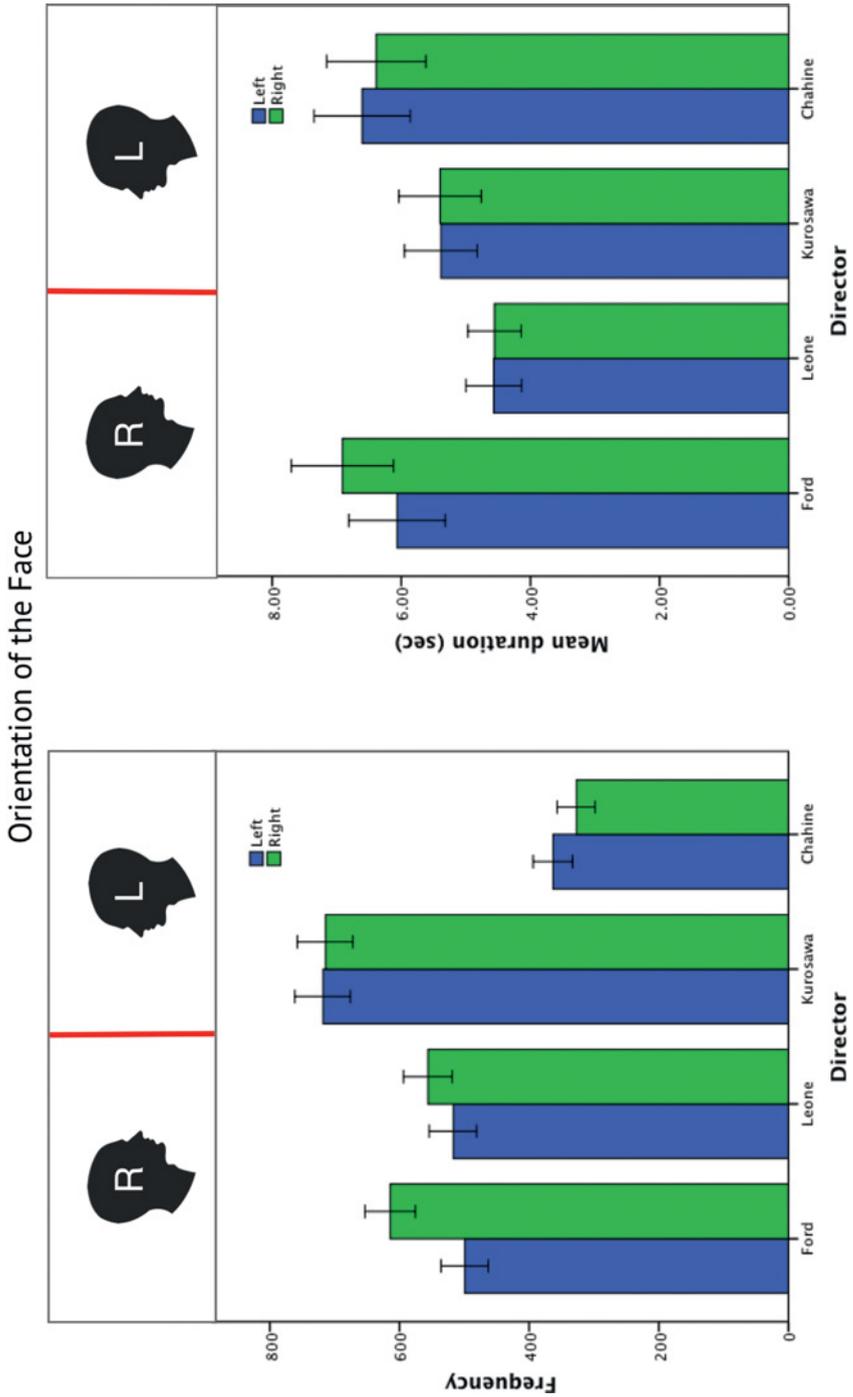


**Figure 2.** Examples of face orientation and body position (from *Yojimbo*, 1961). The red (grey in print) line represents the midline of the screen used to demarcate left and right. The first image shows Mifune on the left of the screen (Position), showing the right side of the face (Orientation). The second image shows Mifune on the right of the screen, showing the left side of the face. This figure is published in colour in the online version.

Given the significant effect of Film, we followed this up with specific tests of orthogonal hypotheses organized by Director. By design the Directors are supersets of the Films, so a contrast between directors is also a contrast between films.

We compared the Western directors (Leone and Ford) to Chahine (excluding Kurosawa). We did this to establish whether there was a pattern of opposing orientation between the Western directors and the Eastern director (Chahine). There was a significant effect of Director, Wald  $\chi^2(1) = 7.88$ ,  $p = 0.005$ . We then compared Ford with Leone. There was no difference, Wald  $\chi^2(1) = 2.46$ ,  $p = 0.117$ . Lastly, to complete the set, we compared Kurosawa with Ford, Leone and Chahine, and found no difference, Wald  $\chi^2(1) = 1.84$ ,  $p = 0.175$ .

In addition to frequency, we also analysed the average duration of each event. The data was binned along the time duration, and we analysed Film



**Figure 3.** Analysis of Orientation of the face. The left panel shows the count of the number of events of each type (left cheek visible or right cheek visible). The right panel shows the average duration of the two events. Error bars are 95% CI. This figure is published in colour in the online version.

(eight levels) Coder wave (two levels) as between factors, and Category (L, R, front, back) as within factors. The time windows of the analyses were arbitrarily chosen to be 10% of the duration of the film.

The ANOVA did not confirm any significant main effect or interaction (Film,  $F(7,128) = 0.19$ , n.s., Coder Wave,  $F(1,128) = 0.09$ , n.s.). The same result was true when comparing just Left and Right orientation. We followed this with the same tests as in the previous analysis. There was no significant effect when comparing Chahine (Eastern) to the two Western Directors, when comparing Leone and Ford, and when comparing Kurosawa to all other directors.

### 3.1.2. Discussion

Overall, there was no systematic orientation bias. Figure 3 shows that overall the frequency of events showing the left and right sides of the actor's face were similar. This was true both in terms of frequency of the events and in terms of average duration of the events. The association between frequency and director, however, suggests that differences exist between the four directors. In particular, Fig. 3 shows that for the Egyptian director, Chahine, there is a bias opposite to the bias for the other directors, particularly those of Ford and Leone. This was confirmed by a direct comparison of frequencies between Chahine on one side and Ford and Leone on the other (excluding Kurosawa). Although small and not significant, the duration data shows the same pattern (Fig. 3). It is therefore possible that we are seeing a difference between Eastern and Western directors, with opposite biases.

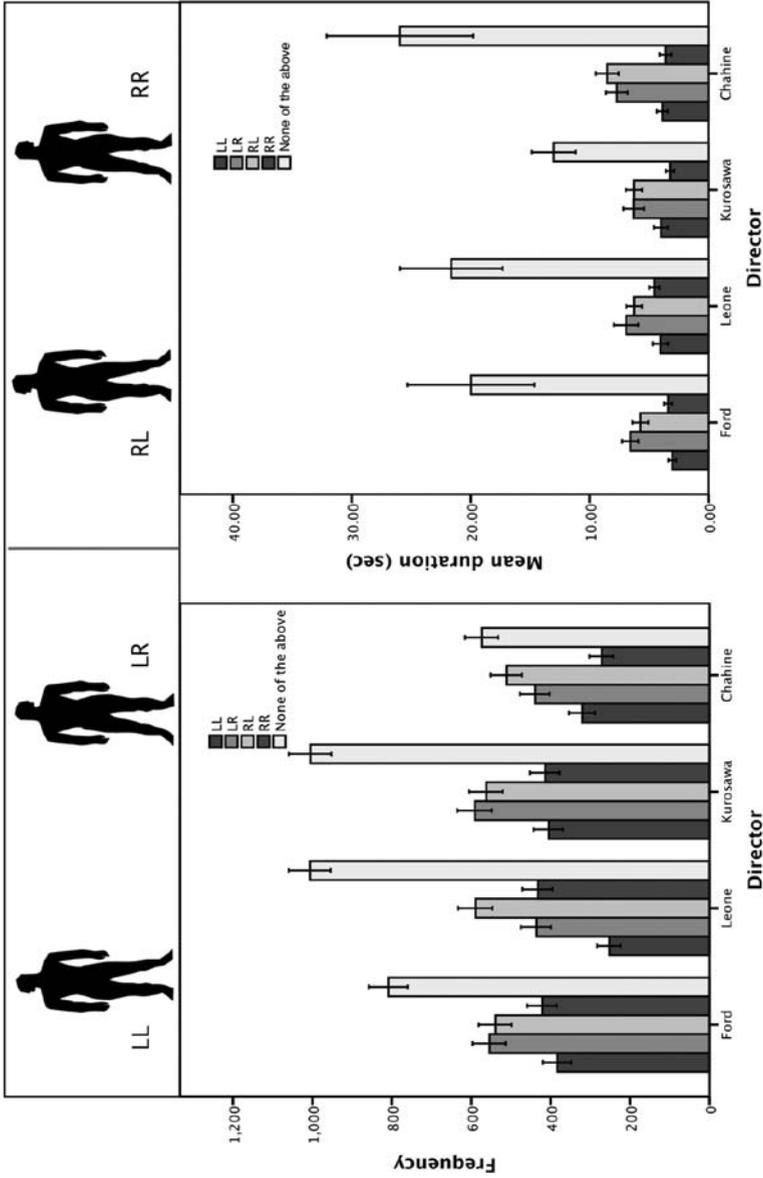
## 3.2. Second Dataset: Position and Orientation of the Face

In the second analysis we categorised the face of the leading actor both in terms of orientation and in terms of position in the image: (a) showing the left cheek and located on the left side of the image (LL), (b) showing the right cheek and located on the left side of the image (LR), (c) showing the left cheek and located on the right side of the image (RL), (d) showing the right cheek and located on the right side of the image (RR), (e) none of the above. Therefore every event during the film could be coded as belonging to one of these five categories.

### 3.2.1. Frequency Results (Position)

The relative frequency and duration of the five categories is shown in Fig. 4. We will focus the analysis on the comparison of the first four (LL, LR, RL, RR). Moreover, we will start by comparing Position on the screen (collapsing the four categories into two). We carried out a logistic regression to see whether the face was more often on the left (LL + LR) or the right side of the screen (RL + RR). This position on the screen was the categorical variable. As

Position & Orientation of the face



**Figure 4.** Analysis of Position and Orientation of the actor's face. The left panel shows the count of the number of events of each type (LL, LR, RL, RR and none of the above). The right panel shows the average duration of the events. Error bars are 95% CI. This figure is published in colour in the online version.

before we included Film and Coder wave as predictors. We report the overall Hosmer and Lemeshow goodness of fit test for the model  $\chi^2(8) = 37.64$ ,  $p < 0.001$ . There was a significant effect of Film, Wald =  $\chi^2(7) = 81.19$ ,  $p < 0.001$ , but no effect of Coder wave, Wald =  $\chi^2(1) = 0.95$ , n.s.

Given the significant effect of Film, we followed this up with specific tests of orthogonal hypotheses organized by Director. By design the Directors are supersets of the Films, so a contrast between directors is also a contrast between films. We used the same contrasts as for the previous dataset.

We compared the Western directors (Leone and Ford) to Chahine (excluding Kurosawa). We did this to establish whether there was a pattern of opposing orientation between the Western directors and Chahine. There was a significant effect of Director, Wald  $\chi^2(1) = 7.62$ ,  $p = 0.006$ . We then compared Ford with Leone, and confirmed a significant difference, Wald  $\chi^2(1) = 30.22$ ,  $p < 0.001$ . Lastly we compared Kurosawa with Ford, Leone and Chahine, and found a difference, Wald  $\chi^2(1) = 10.02$ ,  $p = 0.002$ .

### 3.2.2. Frequency Results (Orientation)

A second set of analyses tested whether the actor displayed more frequently his left (LL + RL), or right cheek (RR + LR). We refer to this as Orientation (left cheek versus right cheek). The first analysis included Film (eight levels) and Coder wave (two levels). We report the overall Hosmer and Lemeshow goodness of fit test for the model  $\chi^2(8) = 3.72$ ,  $p = 0.882$ . There was a significant effect of Film, Wald =  $\chi^2(7) = 33.14$ ,  $p < 0.001$ , but not of Coder wave, Wald =  $\chi^2(1) = 1.52$ ,  $p = 0.218$ , n.s.

As in the previous data set we conducted a series of orthogonal contrasts comparing the differences between the Eastern and Western directors, this time in relation to Orientation of the face. Firstly, we compared Ford and Leone with Chahine, but excluded Kurosawa. There was a significant effect of Director, Wald =  $\chi^2(1) = 10.94$ ,  $p = 0.001$ . We then compared Leone to Ford. There was no significant difference between the two, Wald =  $\chi^2(1) = 0.13$ , n.s. Finally, we combined the data from the two Western directors and Chahine and compared them to Kurosawa. There was no effect, Wald =  $\chi^2(1) = 1.06$ , n.s.

### 3.2.3. Frequency Results (Inward Bias)

Figure 4 shows all categories; there seem to be higher frequencies for RL and LR compared to LL and RR (thus generating a bell shaped pattern). This was expected as a result of a tendency for actors to face towards the centre of the scene, meaning that when located on the right of the screen a person is more likely to face left (and vice versa). In static images this bias has been reported as inward bias (Palmer *et al.*, 2008) or anterior bias (Bertamini *et al.*, 2011a).

Excluding the None of the above category, the overall frequency was 59.3% for inward cases, compared to 40.7% for outward cases. We decided to check whether this bias was different for different Directors using the same three tests used in the previous analyses. None of the three was significant (the Wald =  $\chi^2(1)$  were 2.06, 3.80 and 0.76, respectively, all n.s.).

#### 3.2.4. Duration Results

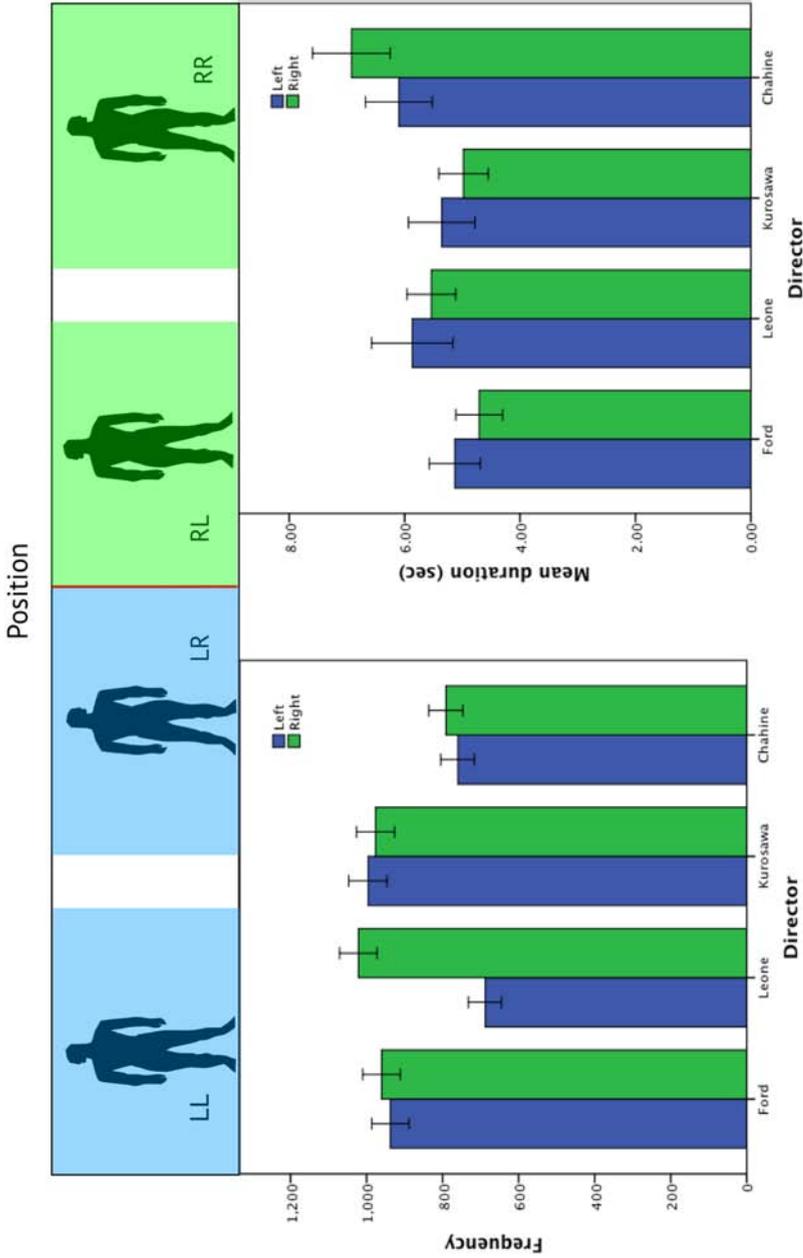
In addition to frequency, we also analysed the average duration of each event. The data was binned along the time duration, and we analysed Film (eight levels) Coder wave (two levels) as between factors, and Orientation (L or R) and Position (L or R) as within factors. The time windows of the analyses were arbitrarily chosen to be 10% of the duration of the film.

The ANOVA confirmed a main effect of Film [ $F(7,120) = 2.53$ ,  $p = 0.018$ ,  $\eta_p^2 = 0.129$ ] and a marginal interaction between Film and Coder Wave [ $F(7,120) = 2.44$ ,  $p = 0.023$ ,  $\eta_p^2 = 0.125$ ]. Importantly, Coder Wave did not interact with any other factor. There was also an interaction between Position and Orientation [ $F(1,120) = 96.38$ ,  $p < 0.001$ ,  $\eta_p^2 = 0.445$ ]. This interaction is due to the inward bias visible in Fig. 4.

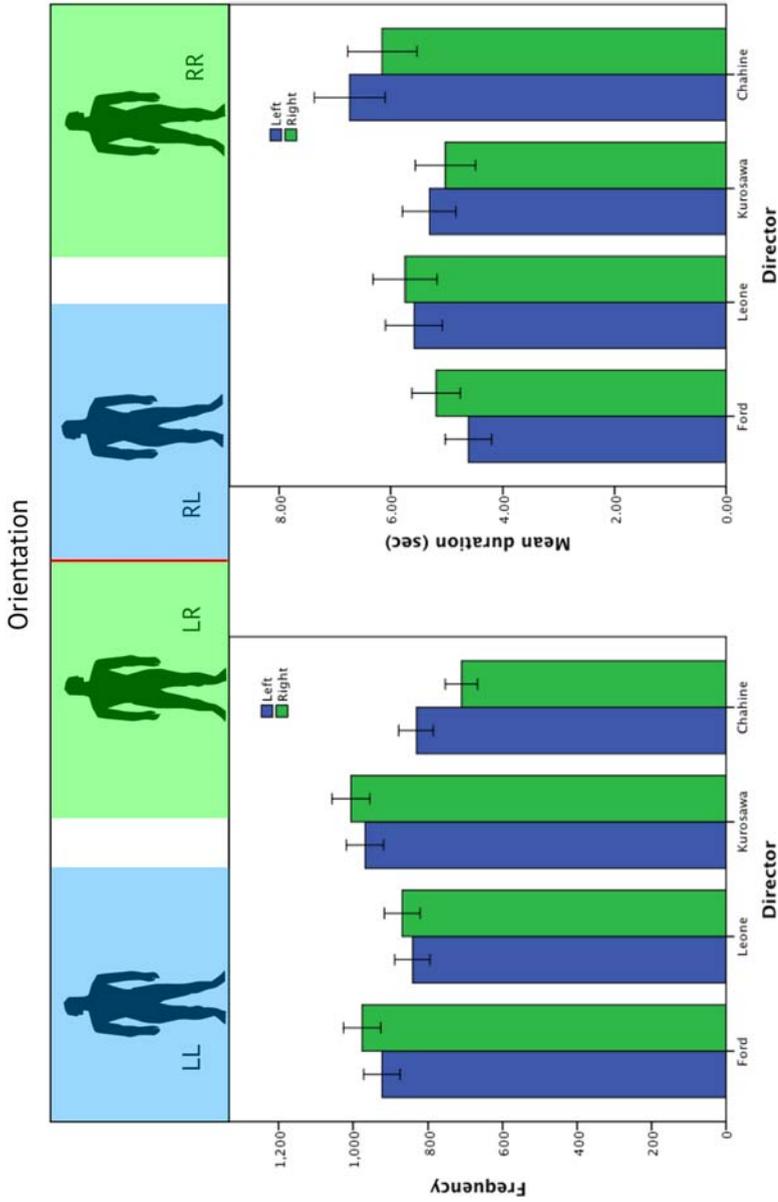
We followed this analysis with specific tests for the Directors as in previous analyses, starting with Position (Fig. 5). When comparing Chahine (Eastern) to the two Western Directors, there was a main effect of Country [ $F(1,108) = 5.10$ ,  $p = 0.026$ ,  $\eta_p^2 = 0.045$ ] and an interaction between Country and Position [ $F(1,108) = 5.18$ ,  $p = 0.025$ ,  $\eta_p^2 = 0.046$ ]. There was no effect of Position (L versus R) when comparing Leone and Ford, and no difference between the two Directors. Finally, we compared Kurosawa to all other directors. There was an effect of Position [ $F(1,108) = 5.88$ ,  $p = 0.017$ ,  $\eta_p^2 = 0.039$ ], and an interaction between Position and Director [ $F(1,108) = 5.67$ ,  $p = 0.019$ ,  $\eta_p^2 = 0.037$ ].

The same analysis was done for Orientation (Fig. 6). When comparing Chahine (Eastern) to the two Western Directors, there was a trend for Country [ $F(1,107) = 3.61$ ,  $p = 0.060$ ,  $\eta_p^2 = 0.033$ ] and an interaction between Country and Orientation [ $F(1,107) = 11.95$ ,  $p = 0.001$ ,  $\eta_p^2 = 0.100$ ]. There was an effect of Orientation (left versus right) when comparing Leone and Ford [ $F(1,70) = 5.68$ ,  $p = 0.020$ ,  $\eta_p^2 = 0.075$ ], but no effect of Director. Finally, there were no significant effects when compared Kurosawa to all other directors.

Finally, we analysed again the average duration of the inward and outward events. This ANOVA included the factors Inward bias (consistent and inconsistent) and Director (Ford, Leone, Kurosawa, Chahine). There was no effect of Director, and an effect of Inward bias [ $F(1, 144) = 81.02$ ,  $p < 0.001$ ,  $\eta_p^2 = 0.36$ ]. This supports that the inward bias was present also in terms of durations, with longer events in which the actor is facing towards the centre of the image.



**Figure 5.** Analysis of Position and Orientation of the actor's face, collapsed to show just the Position. The left panel shows the count of the number of events of each type (left is the combination of LL, LR, right is the combination of RL, RR). The right panel shows the average duration of the events. Error bars are 95% CI. This figure is published in colour in the online version.



**Figure 6.** Data from the analysis of Position and Orientation of the actor's face, collapsed to show just the Orientation of the face (presenting the left cheek, or presenting the right cheek). The left panel shows the count of events of each type (left is the combination of LL, RL, right is the combination of LR, RR). The right panel shows the average duration of the events. Error bars are 95% CI. This figure is published in colour in the online version.

### 3.2.5. Discussion

The analysis of the position of the face revealed a strong inward bias: the leading actor tends to face towards the centre of the image. This is consistent with the picture perception literature (Bertamini *et al.*, 2011a; Palmer *et al.*, 2008). Another finding was that the overall pattern for the face orientation (visible cheek) was the same as that of the first dataset. This analysis overlaps in part (but not completely) with the first dataset, and it is interesting to note the similarity with the previous results: For Western directors/actors there is a slight tendency to show the right cheek, but this reverses for the Egyptian director/actor. We will return to this in the final discussion.

### 3.3. Third Dataset: Movement

In this analysis we categorised the movement of the leading actor. We used the following categories: (a) the person is performing a movement (walking, running, riding) towards the left (from the viewpoint of the camera), (b) the person is performing a movement (walking, running, riding) towards the right (from the viewpoint of the camera), (c) the person is present but static, (d) none of the above. Therefore every event during the film could be coded as belonging to one of these four categories.

#### 3.3.1. Results

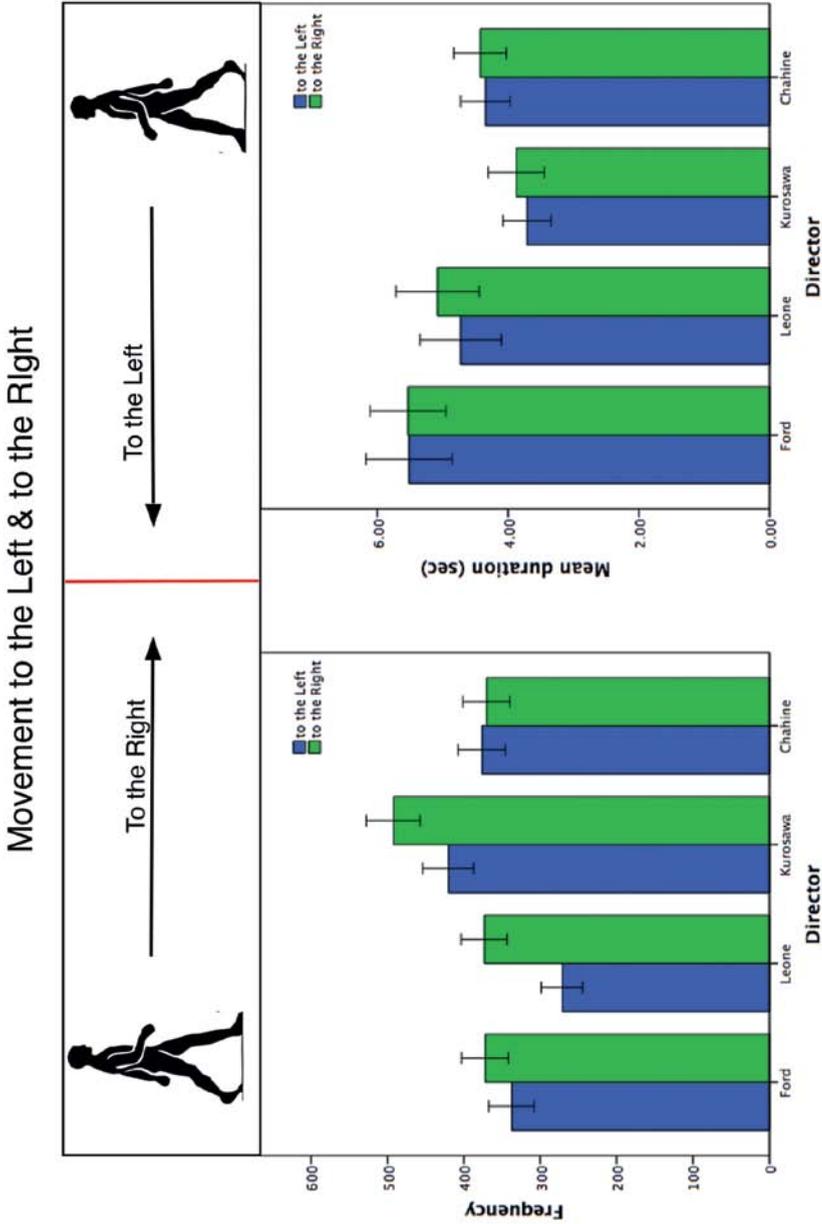
The relative frequency of the four categories is shown in Fig. 7. Because the last two are not theoretically interesting we will focus the analysis on the comparison movement to the left and movement to the right.

We conducted a logistic regression on Movement (movement to the left or to the right) with Film (eight levels) and Coder wave (two levels) as predictor. A Hosmer and Lemeshow goodness of fit test  $\chi^2(8) = 3.13$ ,  $p = 0.926$ . There was a statistically significant effect of Film, Wald =  $\chi^2(7) = 14.33$ ,  $p = 0.046$ , but no effect of Coder wave, Wald =  $\chi^2(1) = 0.15$ ,  $p = 0.699$ , n.s.

As in the previous data sets we conducted a series of orthogonal contrasts comparing the differences between the Eastern and Western directors. Firstly, we compared the Eastern and Western directors, but excluded Kurosawa to test whether there were differences in the actor's movements to left or to the right.

Firstly, we compared Western directors (Ford and Leone) to Chahine, and confirmed a difference, Wald =  $\chi^2(1) = 5.76$ ,  $p = 0.016$ . We also found a marginal difference between Ford and Leone, Wald =  $\chi^2(1) = 4.05$ ,  $p = 0.044$ . Lastly, there was no effect also when comparing Kurosawa to the other directors (Ford, Leone, Chahine), Wald =  $\chi^2(1) = 0.175$ , n.s.

In addition to frequency, we also analysed the average duration of each event. The data was binned along the time duration, and we analysed Film



**Figure 7.** Analysis of Movement. The left panel shows the count of the number of events of each type (motion to the left and motion to the right). The right panel shows the average duration of the events. Error bars are 95% CI. This figure is published in colour in the online version.

(eight levels) Coder wave (two levels) as between factors, and Category (movement to the left, movement to the right, neither) as within factor. The time windows of the analyses were arbitrarily chosen to be 10% of the duration of the film.

The ANOVA did not confirm any significant main effect or interaction [Film,  $F(7,1117) = 0.48$ , n.s.; Coder Wave,  $F(1,1117) = 0.33$ , n.s.]. The same result was true when comparing just Left and Right movement. We followed this with the same tests as in previous analysis. There was no significant effect when comparing Chahine (Eastern) to the two Western Directors, when comparing Leone and Ford, and when comparing Kurosawa to all other directors.

### 3.3.2. Discussion

The action in the films that we analysed was biased to take place from left to right in the Western directors. It should be noted that the analysis only coded the action of the main character, and secondary characters could provide movement in the complementary direction. However, a bias for movement to the right is consistent with the picture perception literature (Freimuth and Wapner, 1979; Gaffron, 1950; Mead and McLaughlin, 1992). Our results therefore extend the finding to action films. Another very interesting aspect of the data is the fact that the bias for movement to the right was absent when considering Chahine. Given that the bias is absent in the Egyptian director the implication is that the bias is related to culture and possibly to reading direction. In addition, the movement bias may be related to the orientation of the face. A bias to move from left to right implies a bias to show more of the right side of the face. Comparison of Fig. 6 with Fig. 5 supports this interpretation.

## 4. Final Discussion

In this study we analysed eight films by four directors: Ford, Leone, Kurosawa, Chahine. We compared three compositional aspects: the orientation of the leading actor's face (which of the actor's cheeks was visible to the viewer), the position of the leading actor on the screen (left or right side of the frame), and lastly, the leading actor's movement (from left to right or from right to left). It is interesting to compare the results based on images in films with what has been found for images in paintings. In paintings, the left cheek rather than the right cheek is more likely to be presented to the viewer, though the effect is weaker for males (McManus and Humphrey, 1973; Nicholls and Roberts, 2002; Schirillo, 2000). This effect has been confirmed using photographs (Bruno and Bertamini, 2013; Bruno *et al.*, 2014).

In the analysis of the leading actor's facial orientation, there was no evidence of a clear cheek orientation bias: overall left and right sides of the actor's face were equally visible. This was true both in terms of frequency of the events

and in terms of average duration. However, this lack of overall bias may have originated from two opposite biases in Western and Eastern directors. We found a link between the pattern of frequencies and directors. For Leone and Ford there was a tendency to show the right cheek, for Chahine there was a tendency to show the left cheek. This interaction may reflect cultural difference between directors, traditions, or perhaps a role of writing direction between Arabic and European languages. Japan in many ways is a special case, both in terms of its complex writing pattern, and in terms of the large Western influences in the 20th century. This could explain the intermediary position in the analysis of the films by Kurosawa (see Figs 3 and 4).

Although in paintings there is an overall left cheek bias, McManus (1979) has also suggested that a right cheek bias for self-portraits may emerge in relation to a perceived kinship between the artist and model. Thus, in the case of a male painter, the painter himself, male relations, and males in general were painted so that the right side of the face was presented to the viewer. With four male directors and four male leading protagonists in our films, one could make a parallel interpretation with the results of our study. However, the differing pattern in the individual directors was not consistent with this interpretation.

In terms of scene composition, previous research suggests that observers have preferences for pictures where the focus of interest is on the right-hand side (Levy, 1976; McLaughlin *et al.*, 1983). In relation to this, it is suggested that other than conveying a story, directors (working within the constraints of a frame) will use artistic conventions and visual cues to focus the viewer's attention on salient objects (Carroll and Seeley, 2013). Thus, in the second analysis, we tested whether the leading actor's face was more often on the left or the right side of the screen. Overall there was no evidence of a positional bias in terms of frequency of where the face was positioned or duration of those events, but with a strong bias in Leone. The data for Chahine did not show a pattern opposite to the other directors as in the first analysis.

Our second analysis focused on the combination of position (left or right side of screen) and facial orientation (left or right cheek visible). It is known that people, and also objects with an anterior and posterior structure, tend to be represented with the anterior part facing towards the centre of the image, or more generally so that the anterior has more space from the margin than the posterior (Bertamini *et al.*, 2011a; Palmer *et al.*, 2008). The data from the films supported the presence of this bias: when the face was on the left the right cheek was more often visible, and when it was on the right the left cheek was more often visible. This finding of a bias for the actors to face inwards towards the centre of the screen extends the effect reported in relation to static images to films (Bertamini *et al.*, 2011b; Palmer *et al.*, 2008).

Some aspects of the results were similar for the first and second analysis. There are cheek orientation differences between the Western actors and the

Egyptian actor, who tends to present his left cheek more often. If we focus on the Western directors, given a strong inward bias, and a tendency to show the right cheek more often than the left cheek (Fig. 6), one would expect the face to appear more often on the left (showing the right cheek to face inward). This was not the case and the tendency was instead for the face to be on the right side. This is not impossible because, as shown in Fig. 4, when orientation and position were inconsistent with the inward bias (face looking out of the frame) there were more faces on the right side. As noted before, the pattern for Chahine is reversed.

The presence of an inward bias makes sense, as actors in conversation will frequently face each other. But there may be other factors and considerations that affect composition. Cinematic cues, such as the actor glancing into off-screen space to imply additional space or action taking place beyond the limitations of the frame may be a consideration (Marsh and Wright, 2000).

The third and final analysis focused on the frequency and duration of the actor's movements on screen (i.e., moving from left to right, and right to left with respect to the camera). We found a bias for movement from left to right consistent with the literature on implied motion in pictures (Freimuth and Wapner, 1979; Gaffron, 1950; Mead and McLaughlin, 1992). However, there was a notable absence of the left to right movement bias in the Egyptian films. This difference could be the consequence of a cultural influence, linked to reading direction. The influence of cultural factors on spatial cognition such as reading direction has been offered as an explanation in our understanding of movement in the visual field. In European paintings, motion is implied from left to right (Freimuth and Wapner 1979; Mead and McLaughlin, 1992).

Reading direction may influence lateral positioning preferences across cultures (Nachshon, 1981; Nachshon *et al.*, 1999; Pérez González, 2012). Reading direction may influence how the eye scans each frame of a film, affecting viewer perception of the compositional order of the film as a whole. In relation to the films of Chahine and Kurosawa, this may well have implications for the way that film is read. In European cultures, people read from left to right, and in Arabic countries people read from right to left. Japanese people primarily read from top to bottom and right to left (Morikawa and McBeath, 1992; Suitner and McManus, 2011). The influence of reading direction and its inherent complications merit more investigation with regard to perception of compositional asymmetries, particularly in relation to Japanese and Arabic films.

The results from the third analysis showing a preferred direction of movement from left to right can be linked to the results about face orientation. The left to right bias of movements may cause the right cheek to be shown more often than the left cheek. This would explain the difference with respect to the

more frequently observed left cheek bias in portraits (Schirillo, 2000) in which no movement is present or even implied.

In this study we have explored compositional properties from eight action films. The films were selected from a classic period of cinematography for action films, and represented four countries, each with a different cultural heritage. Whilst we acknowledge that cultural influence will undoubtedly have determined aspects of the film production and staging, the compositional differences between the Western and Eastern films is interesting. We found differences with respect to known biases in portraiture, namely the lack of a left cheek bias. However, this may be explained by a bias to present motion from left to right in Western cultures. This first analysis of a small sample of films has raised questions in relation to aesthetic preference and compositional biases in this medium. Whether the differences in compositional preferences in the Egyptian films and Japanese films can be further understood in terms of cultural influences such as writing and reading direction on aesthetics warrants further investigation.

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