TRAMES, 2002, **6**(**56/51**), 4, 283–296

https://doi.org/10.3176/tr.2002.4.01

BINOCULAR RIVALRY AS A FUNCTION OF SPATIAL QUANTISATION OF THE IMAGES OF FACES: PRECATEGORICAL LEVEL CONTROLS IT

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Abstract. Spatially quantised images of human faces, dichoptically paired with their non-quantised original versions were presented to produce binocular rivalry. It was found that the relative stimulus dominance in rivalry was a monotonically increasing function of the coarseness of quantisation. Whereas all rivalrous stimuli (1) were derived from the original images that belonged to invariant perceptual object category and had invariant exemplar *identity*, (2) had equal and invariant overall *luminance*, and (3) were characterised by the invariant set of (vertical and horizontal) *contour orientations* of the edges of elements of the quantised images then the main determinants of dominance in rivalry should be related to the differences in spatial frequency content and/or wholistic pattern configuration of the rivalrous stimuli. Whereas the meaningfulness and ease of interpretation (face-like quality) of the image decreases with coarseness of quantisation then the concomitant increase in rivalry dominance must not depend on high-level categorical or identity processing but on some intermediate-level processes where the physical-configurational (Gestalt-) description of the image is sought for.

1. Introduction

Preamble. The concept of consciousness holds one of the central roles in social science and humanities. But its connotations in modern scientific research may be quite surprising for many philosophers, sociologists, linguists and psychologists. The phenomenal aspects of consciousness that are related to immediate awareness of the perceptual objects have become a subject matter of research of a very active and rather numerous international group of researchers who regard consciousness as an experimental variable that can be studied by neuroscientific and psychophysical methods. Several specialists such as Bernard Baars, Francis Crick, Christof Koch, Gerald Edelman, Nikos Logothetis and others stress the importance of this strategy in taking steps towards clarification of this quite controversial concept. Some leading philosophers like John Searle, Paul Churchland, David Chalmers also believe in importance of empirical research on this subject. Understanding the nature of consciousness is one of the biggest challenges before science. It is still unsurpassed despite many centuries long quest for understanding.

In the present article I will show one example how experimental methods can be used for getting empirical data about the ways our brain/mind processes deal with perceptual information so as to create phenomenal experience for some of it and deprive some of it from this property. First, I will introduce the phenomenon. Subsequently an exploratory experiment will be described and its results interpreted. Hopefully, introduction of an exploratory experimental study of consciousness-related processes to the readers who may be more familiar with traditional speculative approaches could enrich their set of perspectives for dealing with this elusive property of living creatures – consciousness – theoretically.

The phenomenon. If two sufficiently different images are presented dichoptically – one to the right eye and the other to the left eye –, they will not blend into a combined percept that would include explicit information from both eyes simultaneously. Instead, the images begin to alternate in the awareness of the observer. Conscious perception "accepts" images one at a time. This phenomenon has been known as *binocular* or *interocular rivalry*. Typical rates of alternation or reversal have values from about 0.5 to about several seconds. In order to experience wholistic exclusive rivalry (i.e., where all what is experienced corresponds to the input from one eye only), the sizes of the competing images should not be larger than about 2 degrees of the visual angle.

Binocular rivalry has become one of the mainstream experimental paradigms in tackling important problems of visual cognition such as what is the nature of the mechanisms of visual awareness, figure-ground segregation, feature binding, and interactions of perception and attention (Andrews 2001, Blake and Logothetis 2002, Bonneh et al. 2001, Crick 1994, Fries et al. 1997, Kreiman et al. 2002, Leopold and Logothetis 1996, 1999, Sasaki and Gyoba 2002, Sheinberg and Logothetis 1997, Sengpiel 1997, Tong and Engel 2001, Tononi et al. 1998, Wilson et al. 2001, Wolfe 1996). The main emphasis has gradually shifted from the analysis of the involvement of relatively low level mechanisms such as brightness contrast, local lateral inhibition, or mutual inhibition of alternative monocular channels, to the analysis of relatively higher level processes of figural selection, object coding, and spontaneous attention (Logothetis, Leopold and Sheinberg 1996, Sengpiel 1997). Indeed, what seems to be the basis of rivalry in conscious vision is, according to what some authors claim, primarily related to the formation and selection of cognitive representations for unequivocally interpretable objects regardless of from which one of the two eyes the input is coming, rather than to the low-level competition between the sensory signals provided by different eyes (Logothetis Leopold and Sheinberg 1996, Kovács et al. 1996, Kreiman et al. 2002). Some other recent studies have found evidence for the more traditional view that peripheral processes involving competition between alternative monocular inputs are responsible for producing interocular rivalry (Andrews 2001, Tong and Engel 2001, Wilson et al. 2001). Some compromise views have been suggested as well (Blake and Logothetis 2002). Therefore, experimental manipulations that introduce variability to the respective levels of visual depiction and processing should be useful in research that is targeted at solving the continuing controversy. If we accept that in binocular rivalry an invariant physical stimulation allows multistability of conscious contents that are derived from this stimulation (a "consciousness as a variable", approach) then we can pose questions about what are the properties of stimulation and conditions of observation that determine the selection of representational contents for conscious perception. If some of the perceptible properties dominate over others then perhaps these properties could provide us with clues to the primary functions of awareness-related levels of mental information processing. One of the aims of the present study is to introduce a new type of stimulus for research on rivalry. It allows a parametric manipulation of the values of stimulus variables that are characteristic of local sensory and holistic perceptual levels of form (see further on).

Although the focus of current rivalry research has shifted to neural correlates of rivalry, there is a serious methodological problem. Perceptual rivalry in humans is a phenomenon of alternating contents of awareness in the conditions where optical visual input from two stimulus objects remains invariant. Usually quite complex objects such as faces, landscapes, houses, cars or complex textures are used as stimuli. Unfortunately we do not know as yet what are the sufficient neural correlates of conscious awareness of different qualities involved in a single non-rivalrous stimulus, let alone rivalry. What are the sufficient and necessary conditions of neuronal activity to represent one or another aspect of a stimulus in consciousness – we do not know. It is important to get more information about psychophysical determinants of rivalry with the emphasis put on stimulus-related variables that control the phenomenology of rivalry. This should be profitable first of all for the modern investigations of brain processes that underlie rivalry. By knowing more about precisely *what aspects* of the stimulus object control and drive rivalry we can be more confident about what aspects of phenomenology correlate with definite neuronal processes and where in the brain all this takes place, given that we will use respective stimulus objects in neuroscientific research. In what follows we will provide an example about how to use this general strategy in visual awareness research in general and binocular rivalry research in particular.

Spatial quantisation and the idea of the experiment. It has been found that the stimuli that are meaningful and/or easily interpretable as coherent objects tend to dominate in rivalry over less articulated and less meaningful stimulation (Walker 1978, Uttal 1981, Sengpiel 1997). The problem, however, with many experimental paradigms is that the concept of meaningfulness of perceptual stimulation includes possible confounds of *categorical* meaningfulness (e.g., DOGS), *identity-level* meaningfulness (e.g., MY HUSKY), and meaningfulness and interpretability in terms of the stimulus as the *physical (Gestalt-)* object that can be discriminated from its perceptual context as a whole (e.g., an AREA IN THE VISUAL FIELD STANDING OUT FROM THE BACKGROUND AS A FIGURAL OBJECT, only subsequently to be identified as husky with a characteristic pose). In the latter case segmentation of the scene or object into Gestalt-like entities can be well accomplished even though the image may be degraded so that the immediacy and ease of establishing its identity or category is impaired. It would be therefore useful to find stimulus environments where the above variables can be not only controlled, but also parametrically varied. The method of spatial quantisation of visual images into square-shaped pixels provides us with such a procedure (see Figure 1). By gradually increasing the coarseness of spatial quantisation of an invariant source-image up to a critical value we are able to keep the original category and identity invariant, but decrease the interpretability (category-likeness and typicality) of the image and increase uncertainty of its categorical processing. By coarsening the pixelisation of the image we also considerably change its *physical configuration* and *spatial-frequency content*. (See, e.g. investigations by Harmon and Julesz 1973, Bachmann 1987, 1991, Costen et al. 1994, 1996, Uttal et al. 1995 a,b, Bachmann and Kahusk 1997). On Figure 1 two examples of the typical spatially quantised images can be seen.

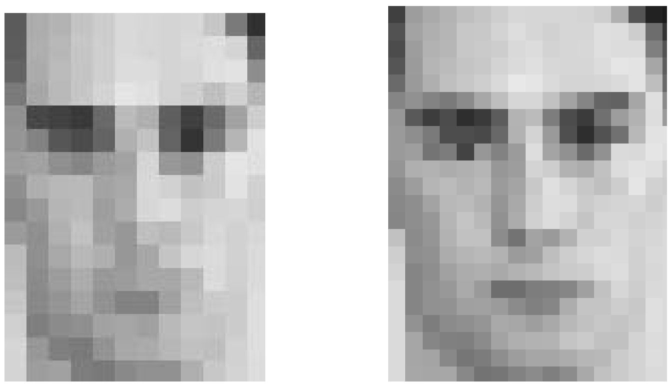

Figure 1. Examples of typical spatially quantised images of visual objects – in this case two quantised versions of an invariant source-image of human face, quantised at two different levels of pixels image^{-1}. Single instances of quantised stimuli were presented to one eye, to compete dichoptically with the simultaneously presented non-quantised original source-image in the other eye so as to create rivalry.

By performing quantisation of the visual image of an object over systematically changing values of coarseness (pixels-per-image) we can keep invariant the values of several important determinants of the level of recognition and rivalry: global luminance, orientation of the edges of the constituent subparts (pixels) of the image, identity of the original source-image, and the general category of the class of the objects that provides the best candidate for the quantised object to be included in. All of the above listed variables do not change with variations in coarseness of quantisation up to a critical level. On the other hand, at the same time when the above variables are kept invariant, the values of some other important variables can be systematically varied by changing the quantisation value. They are disparity of the image elements vis-à-vis the (pseudo)corresponding elements of its nonpixelised version, wholistic pre-categorical Gestalt configuration, relative spatial frequency content of the stimulus, relative amount of the well-defined contour at the high-frequency end of the spatial-frequency spectrum, and interpretability or category-likeness of the stimulus. What can be said about using this variety of stimuli for research on binocular rivalry?

If the original, unquantised source-image will be presented for binocular rivalry against its quantised versions then several predictions related to the outcomes of rivalry can be put forward. The predictions relate to what should happen to rivalry if the quantised stimuli are spatially pixelised over progressively coarser levels (i.e. over decreased number of isoluminant pixels per image that comes about due to increase in size of each elementary square-shaped pixel). The primary aim of the present study will be to compare the relative impact of different factors – and first of all of the perceptual interpretability – on rivalry. We will find out what aspect of image description determines the strength of a visual pattern in terms of its capability to exert rivalry over its competitor and therefore gains priority access to the putative neuronal systems that underlie conscious perceptual processing. If rivalry shows us what aspects of images provide decisive material for specifying the winning conscious representation, then it should be easier for researchers to constrain the search for the mechanisms of visual awareness in general and object recognition in particular. In this first explorative attempt that stems from this strategy, we set several alternative and not necessarily exclusive general hypotheses and leave more specific predictions for subsequent studies. We will explore what particular aspects of rivalrous images determine domination in the conditions where several known determinants of the dynamics of rivalry are involved at once. If in the psychophysical exploration we will reveal the primary factors that more readily lead to conscious perception as compared to other factors, then it would be easier to choose the characteristics and parameters of stimuli for research that is more focused on the underlying mechanisms and where modern brain imaging techniques are utilised.

Let us list the experimental predictions that form the basis of our exploratory study. 1. Category-likeness. Since the category likeness and good categorical interpretability of the image will decrease with coarseness of quantisation, then it would be natural to expect decrease in the amount of time during which the quantised image is perceived (and increase of the time the nonquantised one is perceived) if coarseness of quantisation will increase. This first hypothesis capitalises on the classic observations about meaningfulness and interpretability as sources of perceptual domination in rivalry (Walker 1978, Uttal 1981). 2. Amount of contour. Images that contain more detail and/or texture such as those provided by edges and lines tend to dominate in rivalry (Breese, 1899; Levelt, 1968). Whereas original images and fine-quantised images contain more detailed visual information than coarse-quantised images then our second hypothesis predicts decrease in relative time a stimulus is visible with increase in coarseness of spatial quantisation of that stimulus. 3. Wholistic configuration. With increase in coarseness of quantisation we gradually introduce more and more changes into the wholistic configuration of the image that will be therefore progressively more different from its original, unquantised source-image version which is the input for the other eye. Even if the categorical information will be lost or considerably impoverished at certain point of quantisation change, the *physical* individuated configuration will change progressively even beyond the point of loss of category. If the intermediate-level interpretive processes that seek suitable figural (Gestalt-) description of an image (regardless of its identity and/or meaningfulness) would be more important in driving rivalry as compared to the mechanisms of higher-level perceptual categorization then we would expect relatively stronger rivalry dominance with more coarse images than with less coarse ones. This constitutes our third hypothesis. 4. Spatial frequency content. The more cycles of contrast (e.g. alternating dark and light bars of an image) there are within a unit spatial extent of an image, the higher the spatial frequency of that image. Low spatial frequencies are known to rival in a more unitary fashion than high spatial frequencies (Hollins, 1980). Combining patches of alternative images simultaneously from the input of different eyes into what is perceived as a whole is more likely to occur if the spatial frequency of the images is high. It is therefore logical to expect different dominance patterns and rivalry rates also for coarse quantised and for finely quantised stimuli.

2. Experiment

Method and design. Pairs of different stimuli, generated from the same original facial image (source-image) were presented to the participants – one stimulus for the right eye, another for the left eye. One eye was always stimulated by the unquantised source-version of the face, the other eye was stimulated by one of the spatially quantised versions of the same original source-face which was quantised at different levels of spatial quantisation. The two conditions of the order of presentation (1. from fine to coarse quantisation; 2. from coarse to fine quantisation) were counterbalanced between the participants. There were two main stimulus cues for participants to rely upon in order to be able to report which of the stimuli was perceived: (1) the “angular” and “checkered” appearance of the quantised facial image in comparison with the smooth appearance of the unquantised version of the source-image; (2) the colour of the background of the image, which was different between the eyes (red versus green). The occurrence of each of the coloured backgrounds and quantisation properties of the images that were presented to each eye were counterbalanced throughout the experiment. Each trial consisted in one-minute observation episode with rivalling stimuli. Each subject participated in 32 trials so that all combinations of the eye (right or left) which was stimulated by the quantised images and background colour for this particular eye were used.

There were eight levels of spatial quantisation: 5, 5.7, 7.2, 9.5, 13.2, 17, 25, and 78 pixels image^{-1} along the horizontal inter-auricular dimension. Moving along the reverse order of these quantisation levels means moving towards progressively more coarsened physical image description. Sixteen participants were used; eight of them were presented with quantised images in the ascending order of the exact value of quantisation (from 5 to 78) within each of the combinations of quantised versus nonquantised images and background colours per right and left eye. The remaining eight participants were taking part in the experiment with descending order of the exact value of quantisation (from 78 to 5). The stimuli were prepared as transparent slides made from the computer printouts of the nonquantised or spatially quantised versions of the human face (a bald, non-celebrity, man without beard, without moustache, and without spectacles). The stimuli were presented through the channels 1 and 5 of the five-channel dichoptic tachistoscope. The arrangement of the internal mirror system of the T-scope enabled participants to view only one stimulus with each eye. The size of each stimulus image was 5.5 degrees of the visual angle along the vertical dimension and 3.4 degrees along the horizontal dimension. In addition to the stimulus slide with facial image, each channel contained also a coloured acetate filter to create a coloured background for the stimulus image (red or green). The overall average luminance value of each of the channels was approximately 15 cd $(m^2)^{-1}$. Because of technical limitations in measuring out the exact value of luminance exclusively for the luminous part of the tachistoscope visual fields (seen on the darker background), this estimate somewhat underrates the concomitant brightness of the tachistoscope channels. Informally, brightness impression from the more intense luminance region within the tachistoscope channel that contained the stimulus equals that of the properly measured luminous field with about 35 cd $(m^2)^{-1}$. Whereas the quantisation procedure as the procedure of local luminance averaging maintains the overall average luminance of the different quantised stimuli that originate from the same source-image at the same level then change of the stimuli between the stimulus conditions did not cause any change in the overall intensity of the input from a particular ocular channel.

Responses of the participants were recorded by the specially designated computer keys. A computer programme was written in order to measure out the cumulative duration of each of the three possible perceptual events: (1) exclusive visibility of the stimulus that was presented to the left eye; (2) exclusive visibility of the stimulus that was presented to the right eye; (3) fusion or mosaic-like blending of the patches simultaneously from the two images. The principal independent variable consisted in the level of spatial quantisation of the images that were presented to one eye and acted as a rival stimuli to the nonquantised source-version of the image of the same face which was presented to the other eye. The dependent variables were (1) the duration of the time interval that it took to perceive one of the rivalling stimuli exclusively (with the other one being suppressed) and (2) the duration of the time interval where fusion or mosaic-like blending of the patches of both of the rivalling images was perceived.

Participants were chosen among the undergraduates of the University of Portsmouth (UK). All participants had uncorrected vision and they did not suffer from colour blindness. Eight males and eight females aged between 19 and 26 years took part in the experiment.

Procedure. It was explained to the participants that they would be asked to look at a number of stimuli and press buttons to indicate what they were seeing. They were asked to look into oculars of the tachistoscope and report their perceptual experiences. At first, the images presented to both eyes were slides of the original, unquantised, face and the fusion of images was explained to and achieved by the participants. During the five minute training session with mutually different stimuli all participants were able to understand and experience the phenomenon of rivalry and report both exclusive perception of the alternative stimuli and also the blending of patches from different images or fusion. They were trained to pay attention to both, the angular (“blocked”) appearance of the quantised image and to the colour of the background light of the images. Angular appearance versus smooth appearance and green film of the image versus reddish film of the image were the discriminative cues that would help to understand which of the stimuli (or a mixture of both) they were perceiving at any one time. (In case of fusion, colour mixture was often reported and muddy brown colour experienced instead of red or green.) Participants were shown the computer keys that they would have to press during the experimental trials in order to indicate what they were seeing and trained to use them.

In the main experiment each participant was presented with the succession of thirty two trials according to the individual schedule. The times for which each type of percept (quantised image, nonquantised original source-image, fused/blended image) was experienced during each of the one-minute trials were recorded to the nearest thousandth of a second. At the end of the experiment a simple finger-to-eye test was conducted with each participant in order to determine eye dominance (if any). Once they had completed the experiment, participants were debriefed and thanked for their time. All procedures were conducted in accordance with the ethical standards of the British Psychological Society.

3. Results and discussion

A highly significant, positive correlation was observed between quantisation coarseness (i.e. size of the pixels that formed the element-squares of the image mosaic) and mean perception time of perceptual dominance in exclusive rivalry condition ($r_8 = 0.236$; $p < 0.0001$). The results of ANOVA supported the highly significant effect of the level of quantisation ($F_{8.\ 511} = 4.518$; $p < 0.0001$). The more coarse the quantisation, the longer the cumulative time interval during which the respective quantised stimuli are exclusively dominant over the rivalling source-images and the shorter the time interval for which the stimuli are fused or blended in a piecemeal fashion. Figure 2 illustrates the average times of exclusive dominance in rivalry as a function of the level of spatial quantisation. It is clear that from 78 to 13.2 pixels/image, dominance in rivalry increases rapidly, but this increase slows down thereafter. The results support both our third and fourth hypotheses, but reject our first and second hypotheses. Decrease in interpretability and gradual loss of face-likeness does not matter so much as do the physical-objective properties of the image in determining the relative dominance of a pattern in rivalry. Despite the conjoint loss of both visual-categorical quality and richness of local detail, coarse-quantised images became more dominant in explicit representation (i.e. awareness).

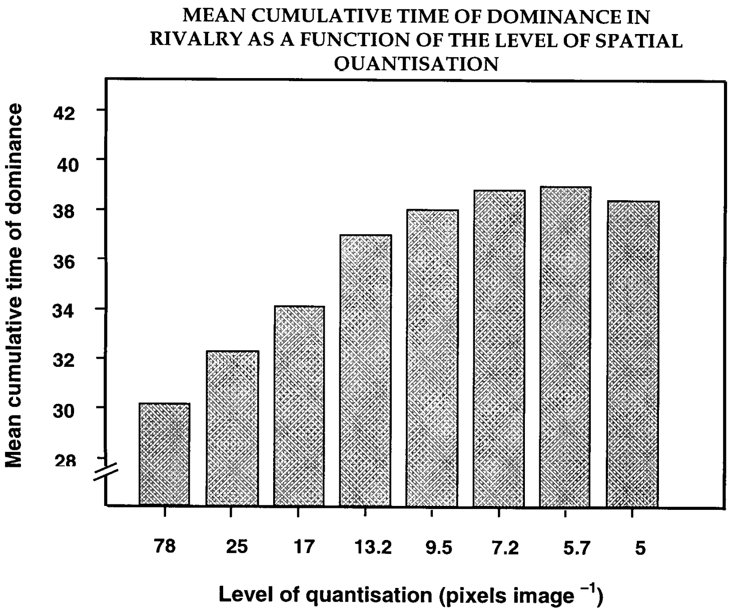

Figure 2. Mean cumulative time (sec) of exclusive perception of rivalrous images as a function of the level of spatial quantisation. The smaller the value of pixels image^{-1}, the more coarse the quantisation. The coarser the quantisation, the longer the time the stimulus is dominant in rivalry. Notice the levelling off of the increase in dominance after the level of quantisation has reached 13.2 pixels image^{-1}.

It is interesting to notice that the levelling off of the increase in dominance in rivalry at quantisation values between 13.2 and 9.5 pixels/image^{-1} points to the similar values of quantisation found to be critical in another experimental context.

An abrupt change in identification rate has been found in the studies of the effects of quantisation on perceptual identification (e.g., Bachmann 1991, Bachmann and Kahusk 1997). In other words, the quantisation level with which the recognisability of a pattern as an individuated face with definite identity will be "catastrophically" impaired is also the value of quantisation where its effect on rivalry tends to stabilise, having achieved the highest impact on the processes that lead to its explicit perceptual dominance. If face-likeness is communicated by the quantised image, but individuation is difficult, the system seems to do its best to keep the image under perceptual scrutiny (and in awareness) and does this the more, the more difficult it is to individuate the face-like image. After crossing the quantisation value that is considered as critical for identity-related individuation, the “conscious effort” will not result in any increase in dominance. (The ANOVA followed by a pairwise comparison showed that the assumption of the homogeneity of covariance was violated by the Mauchly’s sphericity test; a more conservative Greenhouse-Geisser F-value was therefore used. A highly significant main effect of quantisation ($F_{7.2.205} = 8.274$; $p < 0.0001$) was supplemented by significant differences between the neighbouring quantisation values in pairwise comparisons between 78 and 25 pixels/image ($p = 0.034$), and 17 and 13.2 pixels/image ($p = 0.010$), however no significant difference was found between 13.2 and 9.5 pixels image ($p = 0.292$, n.s.), 9.5 and 7.2 pixels/image ($p = 0.463$, n.s.), 7.2 and 5.7 pixels/image ($p = 0.547$, n.s.), and 5.7 and 5 pixels/image ($p = 0.510$, n.s.).)

It is important to notice that pixelisation values of 13.2 and 9.5 pixels per image create images that do not include much local contour information that would be helpful for fusion of the source image and quantised image by the mechanisms of stereopsis. (Consider, for example, that with this level of quantisation the size of a local square-shaped area as defined by its vertical and horizontal edges is in the range of about 0.1–0.4 degrees of the visual angle in our experiment. On the other hand, the sharp-edged luminous frames within which the dichoptic stimuli are presented are fused with the level of precision that exceeds the former value by several orders of magnitude.) Huge disparities and inter-ocular configurational differences of local image areas that introduce extremely complex and spatially widely varying nonhomogeneities into the interocular correspondence values of pixels most probably exclude any sensible explanations of the rivalry in terms of the local correspondence mechanisms of stereopsis (e.g. Blake 1989).

Taken together, our results support the importance of the following image properties as factors in binocular rivalry for exclusive dominance in perceptual awareness: 1. Gestalt-like wholistic structure at the pre-categorical level; 2. low spatial frequency at the coarse end of the image spectrum; 3. smaller number of image elements in a relatively well-articulated image that is partitioned into clearly differentiated regions. The results can be interpreted as evidence for the importance of the extent to which the covert search for the perceptual specification of a visual pre-categorical object can be executed, on the expression of dominance in perceptual rivalry. If the Gestalt entity that is clearly distinguishable as a physical structure becomes ill-defined from the point of view of the ease with which its possible category or identity could be stated (higher-level representational nodes contacted?), then it seems to become also the strongest stimulus for inviting rivalry and suppressing the other, categorically well-defined competing stimulus that is qualified with lesser uncertainty. If it were simply for coarsening of the spatial frequency content of the image with increased coarseness of quantisation (without any involvement of pre-categorical physical Gestalt factors) then it would be difficult to explain the above-mentioned irregularities in the effects of the level of quantisation. (By the way, it would be hard to use traditional, Fourier-filtered, low-pass images in this type of binocular rivalry because of the good fusion potential of the low-pass filtered images with broad-band originals; the latter already include the frequencies of the former and, moreover, the spatial phase information of contrast minima and maxima is also coinciding.) The involvement of attention-related, higher cognitive levels in binocular rivalry have received support in other studies. Recent results from Sasaki and Gyoba (2002) have shown that the perception of a set of orthogonally oriented Gabor patches in the conditions of dichoptic rivalry depended on whether attention was directed to respective patches or not. Interestingly, if competing patterns were presented to the suppressed eye, they gained dominance primarily over the spatially corresponding patches from the other eye that were attended rather than unattended. Thus not the stimulus content in itself, but selectivity of attentional resources directed at selective spatial locations is what drives rivalry. In our case, attentive analysis of images with higher uncertainty of perceptual interpretation should use more resources and thus lead to dominance in rivalry.

No significant interaction was found between whether the stimulus was presented to the dominant or nondominant eye and the level of quantisation ($F_{7.7.373}$ = 0.602, n.s.). The effect of eye dominance was therefore additive to the effect of the level of quantisation. The impact of seeing more the coarse-quantised image on the rate of exclusive dominance in rivalry did not depend on whether the image was presented to the dominant or nondominant eye. (The effect of eye dominance was paradoxical, however negligible: 17.46 seconds average exclusive dominance time for the dominant eye and 18.70 seconds for the nondominant eye.)

By using alternative spatially quantised images of a visual object that belongs to invariant category and that originates from the source-image with invariant identity, and also by controlling the overall average level of luminous intensity between the quantised images, we were able to test the relative impacts of the following pure and confounded factors on the rate of dominance in binocular rivalry: (1) physical wholistic Gestalt configuration and/or spatial frequency content, (2) amount of well-defined contour of the edges of constituent elements of the pixelised images, (3) visual category-likeness and/or ease of interpretability of the rivalrous image. It appears that the relative dominance in rivalry depends neither on the amount of contour nor on the face-likeness of a stimulus, but may depend on the mechanisms that are responsible for building up the intermediate-level, (Gestalt-) representation of wholistic visual objects as coherent physical entities and searching for the specification of these images in terms of their perceptual gist. These mechanisms may be based either on coarse shape-sensitive or configurational representational processing modules like the ones tuned to geons (e.g. Biederman 1995), or low-pass spatial frequency analysing processes that precede the high-pass processes (e.g. Watt 1988), or both. Neither the well-defined, low-uncertainty identity or category information seems to be overly important in determining the rate of rivalry in terms of stimulus dominance in awareness, nor the local contour information that carries orientational and stereoptic cues. Instead, some intermediate-level covert activity of search for the pre-identity, physical description of the object as a whole seems to be crucial. Although the face-likeness, interpretability and the amount of contour decrease with coarseness of quantisation, respective coarse-quantised images tend to create most exclusive perceptual rivalry which they dominate. Perhaps then the neural correlates of consciousness should be sought for not so much in the cortical modules that are responsible for maintaining well-established perceptual representations, but in the mechanisms that drive the *search* of sensible representations instead (e.g. Crick, 1984).

If the speculation about the search of the single best current perceptual *interpretation* for the adaptively significant sensory signals at hand as the main function of consciousness is correct (e.g., Crick and Koch 1995) then the typical aim of perceptual consciousness can be a neither too specific representation (a too detailed one loses meaning) nor a too abstract and general one (this cannot help in locomotion and acting). The perceptual gist of the image is what has to be established first, to be later supplemented by the detail and individuated identity. This putative principle of a search for the gist first (e.g. Li et al. 2002, Liu et al. 2002) enables images that are "less powerful" categorically, but salient, however uninstantiated visually, to drive dominance in rivalry. This is because a search for the gist should be the priority of processing, given the physically distinctive object whose gist has not been resolved as yet.

In the light of our present results, some recent data about the earliest levels of brain hierarchy where neural correlates of the perceptual dominance in rivalry have been found probably refer to the intermediate precategorical representational levels as the levels first associated with the potential to mediate visual awareness. Respective levels have been found to be situated in paraoccipital, inferotemporal and medial temporal areas of the cortex (Leopold and Logothetis 1996, Sheinberg and Logothetis 1997, Kreiman et al. 2002).

By virtue of "distilling" just one alternative version of perceptual interpretation out of the physically invariant input, the mechanisms that subserve rivalry should be quite strongly overlapping with the very mechanisms that steer the flow of perceptual consciousness. Spatially quantised stimuli as a version of distorted and hidden, however Gestalt-like images that strive for their gist should feed these mechanisms quite well.

Acknowledgements

We would like to extend our sincerest thanks to Mr. Paul Waby for writing the computer program and setting up the chronometric part of the experiment.

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