

The accentuation principle of figure–ground segregation and the downbeat illusion



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ABSTRACT

Pinna and Sirigu (2011) demonstrated a new principle of grouping, called the accentuation principle, stating that, all else being equal, elements tend to group in the same oriented direction of the discontinuous element placed within a whole set of continuous/homogeneous components. The discontinuous element behaves like an accent, i.e. a visual emphasis within the wholeness of components as shown in the next section.

In this work, the accentuation principle has been extended to new visual domains. In particular, it is shown how this principle affects shape perception. Moreover several visual object attributes are also highlighted, among which orientation, spatial position, inner dynamics and apparent motion that determine the so-called organic segmentation and furthermore tend to induce figure–ground segregation. On the basis of the results of experimental phenomenology, the accentuation can be considered as a complex principle ruling grouping, figure–ground segregation, shape and meaning formation.

Through a new musical illusion of downbeat, it is also demonstrated that this principle influences perceptual organization not only in space but also in time and, thus, in both visual and musical domains. This illusion can be heard in eight measures of Pagodes, a solo piano music by Claude Debussy (1862–1918), where a strong physical–perceptual discrepancy in terms of upbeats and downbeats inversion is strongly perceived in both staves.

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1. Introduction

In line with the same phenomenological meaning as intended by Gestalt psychologists (see Metzger, 1963, 1975; Wagemans et al., 2012a, b), Pinna & Sirigu (2011) demonstrated a new principle of grouping, called the accentuation principle, stating that, all else being equal, elements tend to group in the same oriented direction of the discontinuous element placed within a whole set of continuous/homogeneous components. The discontinuous element behaves like an accent, i.e. a visual emphasis within the wholeness of components as shown in the next section. By introducing a new illusion of musical suspension, they also demonstrated that the accentuation principle strongly influences the grouping of elements (notes/intervals) within the musical domain.

The purpose of this work is to extend the previous results by providing further phenomenological evidences of the effectiveness of the accentuation principle in several new conditions of visual organization, like figure–ground segregation and motion/event perception, and by

reporting a new illusion of musical downbeat not derived from musical illusions already known (Deutsch, 1975, 1992a,b,c, 1999, 2009a,b; Pinna & Sirigu, 2011; Vicario, 2005).

The aim of this work is to demonstrate and argue that the accentuation is a new principle necessary to explain a great deal of phenomena that cannot be accounted for by previous known principles. Firstly, we wish to demonstrate that accentuation is a principle going beyond grouping.

In particular, with this work we mean to bring to the reader's attention how the general validity of accentuation goes beyond the possible suggested alternative principles or explanations like symmetry, configural orientation effects, the center of mass/gravity, prior knowledge or past experience, and attentional attraction. In fact, in this article we wish to show that each of these above known principles can predict only one or very few conditions here illustrated but not all of them, unlike the accentuation principle can do. Finally, we intend to prove that the accentuation principle is a more complex and sophisticated attribute if compared to the alternatives listed above and with respect to the grouping principles suggested by Gestalt psychologists. In layman's term, we would also like to stress that accentuation is involved not only in grouping but also in determining many shape attributes such as

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orientation, spatial position, inner dynamics and apparent movement which seem to be essential in eliciting the organic segmentation and in inducing figure–ground segregation.

1.1. The principle of accentuation and the perceptual grouping

The accentuation principle (Pinna & Sirigu, 2011) was shown in conditions like those illustrated in Fig. 1, where the black filling of the two circles of Fig. 1-left and -right appear like accents falling on a specific element within a wholeness of empty circles homogeneously distributed. The accents (the filled circles) emphasize two specific components placed within the whole shapes of empty elements, polarize the grouping of elements converging on the accentuated circle and highlight specific location of the two whole shapes.

The accentuation of the circle in each of the two conditions favors its phenomenal prominence among the set of empty circles. As a consequence, the gaze is promptly attracted by the dissimilar element. Therefore, the similarity principle as defined by Wertheimer (1923) plays a role in determining the grouping/segregation between the filled and the empty elements (cf. also Ben-Av & Sagi, 1995; Claessens & Wagemans, 2005; Gepshtein & Kubovy, 2005; Kubovy, Holcombe, & Wagemans, 1998; Kubovy & Wagemans, 1995; Kurylo, 1997; Oyama, 1961; Rock & Brosgole, 1964; Zucker, Stevens, & Sander, 1983). However, not only does the dissimilar circle pop up, as a segregated element within the set of empty ones, but also it polarizes the grouping of the other circles on its position. The circles group according to the direction determined by the location of the filled circle within the whole shape of elements. As a consequence, in both Fig 1-left and -right the filled circle becomes the vertices of the directional organization of the empty ones. In Fig. 1-left the circles tend to group vertically, i.e. along the diagonal of the diamond, or along the oblique sides of the diamond shape creating arrows of elements converging on the vertex accentuated by the filled element. In Fig. 1-right the grouping of the elements follows the position and direction of the dissimilar circle, i.e. along the oblique sides of what is perceived as a rotated square. The only exception is the line of circles where the filled circle is positioned; in fact, they group accordingly to the side of the whole figure so that the filled circle stays in the center of the line. In summary, the accents induce different groupings of the elements in Fig. 1-left and -right that emphasize the vertices/diagonal or the sides of the figures.

In favor of the accentuation principle, it is worthwhile noticing that the resulting groupings cannot be explained on the basis of the similarity principle, whose expected outcomes are only the grouping/segregation of the filled and unfilled elements in two separated groups. Moreover, the grouping of Fig. 1-left along the diagonal of the diamond occurs against the proximity principle. These two counterarguments suggest that the perceptual organization induced by the accentuation is independent from the ones induced by the principles of similarity and proximity.

Furthermore, not only is the accentuation independent but also more complex. In fact, it involves both the form of grouping and the

form of shape (Palmer, 1999; Pinna, 2010a; Rock, 1983, 1987). As a matter of fact the two accentuated locations of Fig. 1 highlight, both geometrically and phenomenally, different components and attributes of the whole shapes. Geometrically, they are angles or sides; phenomenally, they are attributes such as sidedness and pointedness. As such, the accent on the top vertex of Fig. 1-left polarizes, not only the directional organization of the elements, but also the whole shape by highlighting the diagonal direction and the top angle or vertex, i.e. the perceptual pointedness, that makes the whole shape to appear unequivocally as a diamond. By changing the position of the accent, as illustrated in Fig. 1-right, the sidedness appears now stressed and the shape is described as a square rotated by 45°. This entails that diamonds like these and squares rotated by 45°, though geometrically equivalent, are phenomenally two different figures: the former is a diamond while the latter is a square. This occurs not because they have two different names, but because of their phenomenal properties, i.e. pointedness and sidedness.

An alternative explanation for Fig. 1 is that people perceive the reference frame that preserves symmetry within the configuration (e.g., Palmer, 1980, 1983, 1985, 1989, 1999). Therefore, Fig. 1-left may be perceived as an upright diamond because that interpretation allows for vertical symmetry and Fig. 1-right appears like a rotated square because that interpretation also preserves vertical symmetry with a 45° rotated reference frame.

Although this explanation can be plausible for Fig. 1 by making not necessary the accentuation of the black circle, there are conditions and variations (Fig. 2) that cannot be accounted for without invoking the accentuation principle.

In Fig. 2a, in spite of the vertical and horizontal configural orientation effects (Attneave, 1968; Palmer, 1980), alternated rows of figures are perceived as rotated squares or as diamonds by virtue of the position of the small circle (both empty or filled) placed near (either inside or outside) the angles or the sides of each figure (see also Pinna, 2010a, b; Pinna & Albertazzi, 2011). It is worth to remember that the configural orientation effect represents the reference frame that preserves symmetry within the configuration, according to which the perception of local spatial orientation is determined by the global spatial orientational structure, therefore the elements of Fig. 2a should all appear as diamonds.

The role of the reference frame preserving symmetry is further weakened in Fig. 2b, where the accentuation imparted by the bars and the circles, clearly, not only does it influence the direction and the pointing of the triangles but also it affects their shape (see also Pinna, 2012a). This phenomenon occurs in spite of the configural orientation effect which is intrinsic in the shape of the figure given and against other geometrical/phenomenal principles that preserve symmetry. In details, the triangles are geometrically isosceles, therefore they should point more clearly in the symmetrical direction imparted by their configural orientation dictated by their two equal and longer sides. Nevertheless due to the pointing induced by the two kinds of accentuation (rectangles and circles), they are perceived like scalene triangles, thus breaking the possible symmetries. Briefly, the shape distortion (from isosceles to scalene triangles) is likely due to the fact that the perceived pointing is not in the direction of the angle created by the two longer and equal sides. As a consequence, this induces an asymmetrical effect making each triangle to appear as scalene. These outcomes can be perceived also when only one isosceles triangle is accentuated, so the accentuation propagates to all the triangles.

A third condition in favor of the necessary and unique role imparted by the accentuation is shown in Fig. 2c. Here the accentuation plays against Kopfermann's effect (Kopfermann, 1930; see also Antonucci, Fanzon, Spinelli, & Zoccolotti, 1995; Gibson, 1937; Witkin & Asch, 1948), according to which a square and a diamond (upper row), when included within a rectangle obliquely oriented, are perceived respectively as a diamond and as a rotated square. However, due to the accentuation imparted by the black dot, the geometrical shapes are now restored in the lower row of Fig. 2c. (see also Pinna, 2012a). Under

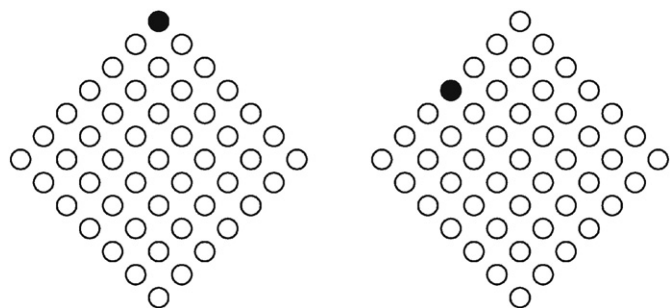


Fig. 1. Due to the accentuation principle, the two figures are respectively perceived as a diamond (left) and as a square rotated by 45° (right).

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