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Complexity and prototypicality as determinants of the appraisal of cubist paintings

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In this experiment inexperienced observers ($N = 22$) scored 40 black-and-white slides of cubist paintings on a number of seven-point rating scales. On the basis of the time it took subjects to identify the depicted human figure, these slides were divided into three subgroups of Low Categorizability (LC), Intermediate Categorizability (IC) and High Categorizability (HC), respectively. For the LC slides 'beauty' scores revealed an inverted U-shaped relation with 'complexity'. No significant relation between these two variables could be demonstrated, however, for the HC slides. 'Beauty' ratings of the latter stimuli increased linearly with the degree of prototypicality. For the IC slides 'beauty' showed a (nearly significant) inverted U-shaped relation to 'complexity', as well as a significant linear relation to 'prototypicality'. The results of this study suggest that, whereas 'complexity' determines aesthetic preference for abstract paintings, 'prototypicality' determines preference for representational works.

According to Berlyne's (1971, 1974) influential psychological theory of aesthetics, hedonic effects of stimulus patterns are due to their arousal potential. From the three types of variables contributing to this potential – psychophysical, ecological and collative stimulus properties – the latter, and in particular, stimulus complexity, received most attention in experimental aesthetics. Reviews of work in this field by Berlyne (1971), Bortz (1978) and Hochberg (1978) point out that evaluative ratings of stimuli in terms of pleasingness, liking, beauty or preference tend to follow an inverted U-shaped curve when plotted against complexity, a relation which is in line with Berlyne's collative motivation model.

The research in question, however, was primarily concerned with judgements of artificial, simple, visual patterns such as polygons, random dot and black-and-white patterns, or, in the case of acoustic stimuli, with randomly generated tone sequences. With particular respect to visual stimuli, this restriction militated against a generalization of the demonstrated relationship between preference and complexity to everyday aesthetic objects, embodying associative ecological factors, a weakness which has been criticized by several authors (e.g. Kaplan, 1987; Kreitler & Kreitler, 1972; Martindale, 1984), and which had already been admitted earlier by Berlyne (1971, p. 220) himself.

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When the latter author expanded his work to the judgement of real art objects like paintings, his results indicated that the simple–complex scale failed to show its usual relations with other variables (Berlyne, 1975). Subsequent research with paintings (Cupchik & Heinrichs, 1981; Heinrichs, 1984*a*, *b*; Martindale, 1984; O'Hare, 1976; O'Hare & Gordon, 1977) continued to testify to the fact that complexity is often a very poor predictor of the appreciation of these less artificial stimuli, a conclusion which was corroborated by Kaplan (1987) with respect to the appreciation of simulated real-life environments. The hypothesis of another variable affecting preference for such stimuli may be derived from the work of Whitfield & Slatter (1979). These authors developed a 'preference-for-prototypes' model based on studies on categorization by Rosch (1975*a*, *b*; Rosch & Mervis, 1975) and Tversky (1977), who postulated the existence of mental schematic representations or prototypes for categories of things. Such prototypes reflect the features occurring most frequently in category members, or, stated in other words, bear most family resemblances to them. According to the preference-for-prototypes model, aesthetic appraisal of objects which are instances of natural everyday categories is a function of their degree of prototypicality; the closer they match the category prototype, the more they will be preferred. Experimental evidence for their model is presented by Whitfield & Slatter (1979) and Whitfield (1983) in demonstrating that furniture is preferred to the degree that it is considered more prototypical (representative) for the categories (chair, table) involved. Similar results have been published with respect to evaluation of faces (Light, Hollander & Kayra-Stuart, 1981; Tversky & Baratz, 1985), houses (Purcell, 1984) and interior designs (Pedersen, 1986).

Whitfield (1983) also suggests that the preference-for-prototypes model can deal with the phenomenon of increased evaluative ratings as a function of 'mere exposure' (Zajonc, 1968), such exposure leading to enhanced prototypicality. The high preference ratings for simple geometric patterns like triangles, squares and rectangles which have sometimes been observed (see Berlyne, 1971), are explained by their similarity to well-established prototypes. Recently the same line of reasoning was followed by Gaver & Mandler (1987) with regard to musical preferences, and by Martindale & Moore (1988) with regard to colour preferences. According to the theory put forward by the latter authors, cognitive units coding more prototypical stimuli are stronger, or capable of greater activation, than less prototypical ones, leading the stimuli that they code to induce more pleasure.

While Whitfield's preference-for-prototypes model is, by definition, restricted to observables for which prototypes do indeed exist, it is compatible with the possibility that aesthetic preference for non-categorizable stimulus patterns is indeed determined by complexity in the way predicted by Berlyne's (1971) collative motivation model.

The present experiment was designed to investigate the validity of these notions with respect to the appraisal of paintings. The first hypothesis tested is that the appreciation of abstract paintings, with low- or non-categorizable content, will be determined by the complexity of the stimulus patterns. The second one is that representational works, depicting recognizable instances of a familiar category, will be evaluated according to stimulus prototypicality instead of complexity.

Both hypotheses were tested on the same kind of stimulus material, namely, black-and-white slides of cubist paintings of human figures depicted with different degrees

of realism. The choice of these stimuli guaranteed that the role of differences of colour, content or style was minimized. Categorizability of the stimuli was operationalized by the time it took subjects to identify the depicted figure. Complexity, aesthetic appraisal and prototypicality were measured by means of three rating scales. For aesthetic appraisal the use of a 'beauty' scale was favoured over a 'preference' scale, because preference may in principle be based on other than aesthetic criteria. This possibility may have played some role in Whitfield's experiments on preference for furniture, where utility may have influenced preference ratings. 'Photographic likeness' was deemed to be the most clear-cut scale to operationalize prototypicality of the depicted model. Where the aforementioned three scales are the most important ones in the light of the hypotheses, subjects were also required to rate the paintings on interestingness and orderliness.

Method

Subjects

Subjects were 22 students (mean age 23.9 years, range 17 to 31 years) enrolled in different faculties, who received Dfl. 15 (about $7.00) for participation. None of them had any special education, knowledge or interest in art.

Stimulus material

Stimuli consisted of 40 black-and-white slides of cubist paintings depicting human figures (see Table 1). The reproductions were selected from three sources, viz. Cooper (1971), Cooper & Tinterow (1983) and Gamwell (1980). Selection was not random, but systematic in the sense that a relatively wide range of degrees of realism was covered.

Dependent variables

The following dependent variables were measured:

Categorizability. Categorizability of the content of the painting was defined as the time it took the subjects to identify the human figure depicted. It was measured by means of a simple reaction-time (RT) task. The remaining dependent variables were all operationalized by scores obtained on the following seven-point scales:

Prototypicality. Scale poor photographic likeness to a human being – good photographic likeness to a human being.

Complexity: Scale simple–complex.

Beauty: Scale ugly–beautiful.

Interestingness: Scale uninteresting–interesting.

Orderliness: Scale disorderly–orderly.

Procedure

All subjects were tested singly. They were seated at a table in front of a film screen on which the slides were projected. The carousel projector was steered by an Apple IIe computer. The distance between subject and screen was approximately 3.5 m, the projections measured 0.8 by 1.2 m.

The experimental session consisted of two parts. At the beginning of the session, subjects were informed that all paintings depicted human or human-like figures, and they were shown five such paintings covering a broad range of prototypicality. These five slides were only used to familiarize the subjects with the stimulus material. Then slides of the 40 paintings listed in Table 1 were presented

Table 1. List of paintings presented to subjects

No.	Painter	Painting	RT (ms)	Cat.
1.	Braque	Standing female nude (1907–08)	931	HC
2.	Braque	Woman playing a mandolin (1910)	6481	IC
3.	Braque	Female figure (1910–11)	4196	IC
4.	Braque	Seated man with a guitar (1911)	9160	LC
5.	Braque	Man smoking a pipe (1912)	9770	LC
6.	Braque	La musicienne (1913)	6705	IC
7.	Braque	The musician (1917–18)	5564	IC
8.	Capek	Cubist figure (1913)	2098	HC
9.	Duchamp	Nude descending a staircase (1911–12)	7656	LC
10.	Gleizes	Portrait of Jacques Nayral (1910–11)	1838	HC
11.	Gleizes	Man on a balcony (1912)	988	HC
12.	Gleizes	Dancer (1917)	6012	IC
13.	Gris	Portrait of Picasso (1912)	829	HC
14.	Gris	Portrait of Josette (1916)	2089	HC
15.	Gris	Portrait of madame Leonce Rosenberg (1917)	822	HC
16.	Gris	Harlequin with guitar (1917)	1959	HC
17.	Gris	Harlequin seated beside a table (1919)	1588	HC
18.	Larionov	Woman walking on the boulevard (1912)	1895	HC
19.	Léger	Woman sewing (1909)	893	HC
20.	Léger	Seated woman (1913)	4209	IC
21.	Léger	Soldier smoking (1916)	4066	IC
22.	Léger	The typographer (1919)	9976	LC
23.	McDonald-Wright	Synchrony in purple (1917)	3985	IC
24.	Mondrian	Female figure (1912)	7879	LC
25.	Picasso	Nude with draperies (1907)	4085	IC
26.	Picasso	Clovis Sagot (1909)	774	HC
27.	Picasso	Nude woman in an armchair (1909)	1660	HC
28.	Picasso	Wilhelm Uhde (1910)	1096	HC
29.	Picasso	Portrait of D. H. Kahnweiler (1910)	5303	IC
30.	Picasso	Nude (1910)	5937	IC
31.	Picasso	Seated female nude (1910)	2468	HC
32.	Picasso	Female nude (1910–11)	8063	LC
33.	Picasso	Clarinet player (1911)	8247	LC
34.	Picasso	Man with a mandolin (1911)	9484	LC
35.	Picasso	Ma jolie (1911–12)	9531	LC
36.	Picasso	Man with a violin (1912)	7947	LC
37.	Picasso	Man leaning on a table (1916)	9103	LC
38.	Picasso	Harlequin (1918)	1586	HC
39.	Udaltsova	At the piano (1914)	7888	LC
40.	Villon	Portrait of madame Y.D. (1913)	6429	IC

Note. Mean RT indicates identification of depicted human figure.
Categorizability of paintings: HC = High Categorizability; IC = Intermediate Categorizability; LC = Low Categorizability.

for 10 s each with an inter-slide interval of 3 s. Subjects were required to indicate the moment of recognition of the depicted human figure by releasing a response button which they held depressed. This button was mounted on a panel, placed at the tabletop in front of the subject. Reaction times were registered in ms and stored on disk. If no identification had occurred, a default time of 10.000 ms was noted. After this part of the session there was a break of about 5 min, after which the second part started. The slides were presented for a second time in the same order as during the first presentation. The subjects now rated each slide on the five rating scales, at a self-paced tempo. In total five randomized sequences of the 40 slides were used, which, in turn, were randomly assigned to the subjects.

One week after the experimental session the subjects returned to the laboratory and rerated the same slides, presented in another order than the week before. The results of this second session allowed an assessment of the stability of the ratings over time.

Results

Reliability

For two subjects the correlations between the ratings of the paintings given on the first and on the second day were very low, the median value of the Pearson product moment correlations for the five scales being less than .50. Although this lack of stability might be due to real fluctuations in the judgements of these subjects, observations by the experimenter had already singled out these subjects as lacking interest and seriousness in fulfilling their task. For this reason, it was decided to exclude the data of these subjects from further analysis.

The test–retest reliability of each scale for the remaining group of 20 subjects was computed over the 800 pairs of subject-by-painting combinations. The resulting Pearson product moment correlations for the complexity, beauty, prototypicality, interestingness and orderliness scales were .73, .69, .83, .62 and .63, respectively, indicating a moderate to fair stability of the ratings. As mentioned before, the results reported below will be based on 20 subjects. Only the data of their first testing day have been entered into the further analyses.

Categorizability

RTs for each slide, averaged over subjects, are presented in Table 1 next to the titles of the paintings. Based on these mean RTs, the paintings were divided into three about equally sized groups, viz. Low Categorizability (LC), with mean RT > 7000 ms, Intermediate Categorizability (IC), with mean RT between 3000 and 7000 ms, and High Categorizability (HC), with mean RT < 3000 ms. This resulted in groups of 12 LC, 12 IC, and 16 HC slides, a division chosen to prevent slides for which the RTs were very close together from being assigned to different groups.

Beauty as a function of prototypicality and complexity

Low Categorizability. For the LC slides beauty scores showed a significant second-order relation ($R^2 = .56$, $F(2, 9) = 5.77$, $p < .05$) to complexity, with the top of the parabola at complexity rating 5.3, whereas no significant linear trend ($R^2 = .04$, $F(1,10) = .46$, $p > .50$) was detected (see Fig. 1). Because, by definition, the role of prototypicality is limited to stimuli which are categorizable by observers, it is not surprising that, due to restriction of range of the prototypicality scores, neither the linear regression ($R^2 = .18$, $F(1, 10) = 2.25$, $p > .15$), nor the second-order regression

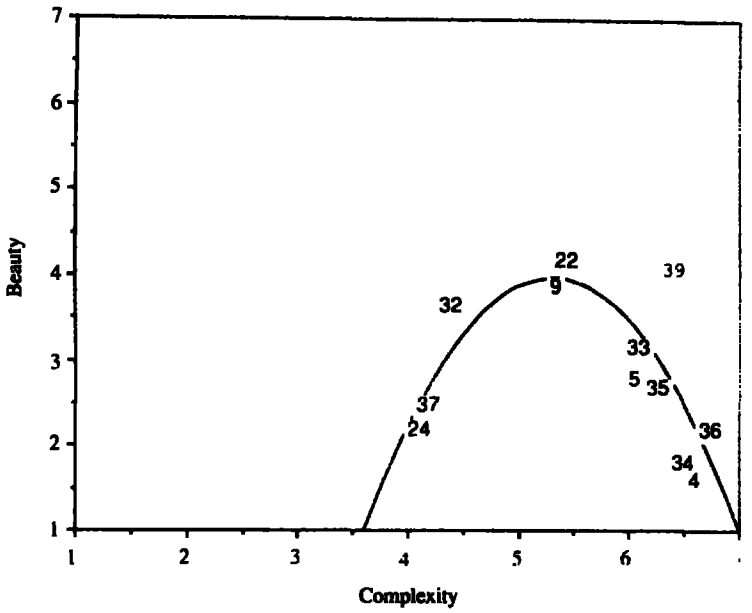

Figure 1. Beauty of LC slides as a function of complexity. Numbers refer to paintings listed in Table 1

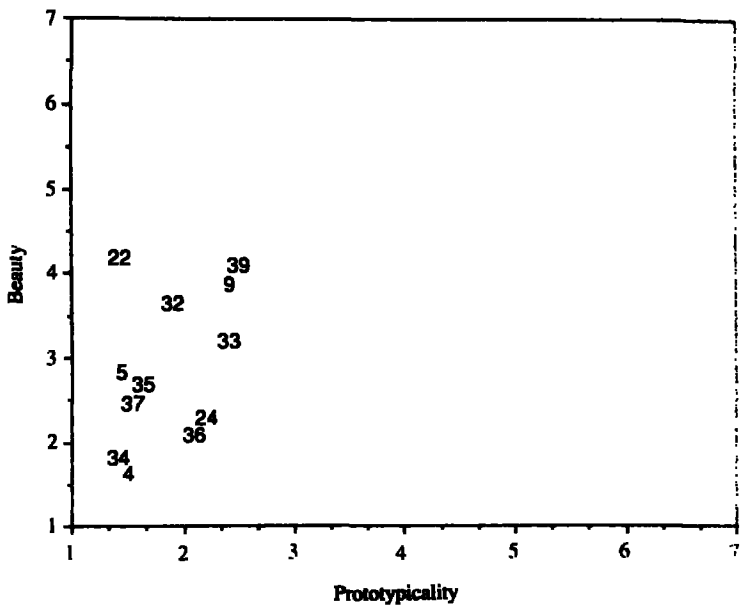

Figure 2. Beauty of LC slides as a function of prototypicality. Numbers refer to paintings listed in Table 1.

($R^2 = .25$, $F(2, 9) = 1.51$. $p > .20$) from the beauty scores on prototypicality approached significance (see Fig. 2). It is worth mentioning, in this context, that the prototypicality ratings and RTs operationalizing categorizability showed a strong linear relationship ($r = -.86$ for the total group of 40 stimuli).

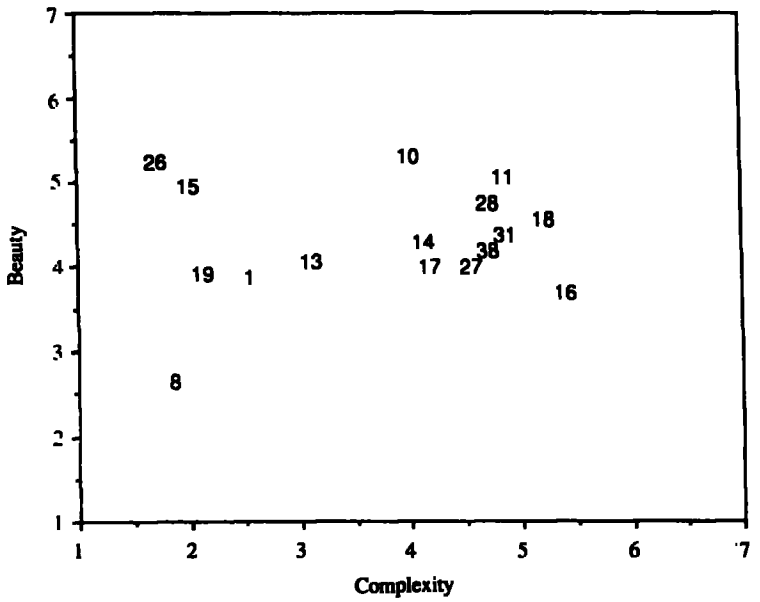

Figure 3. Beauty of HC slides as a function of complexity. Numbers refer to paintings listed in Table 1.

High Categorizability. Figure 3 shows that for the HC slides there was no significant relation between beauty and complexity; both a linear fit ($R^2 = .02$, $F(1, 14) = .25$, $p > 60$) and a second-order fit ($R^2 = .03$, $F(2, 13) = .17$, $p > .80$) were far from being significant.

For these slides, however, a significant linear relation ($R^2 = .53$, $F(1, 14) = 15.60$, $p < .005$) between beauty and prototypicality was revealed, while a second-order regression ($R^2 = .53$, $F(2, 13) = 7.27$, $p < .01$), did not result in a better fit (see Fig. 4).

Intermediate Categorizability. While for the IC slides no significant linear relation ($R^2 = .17$, $F(1, 10) = 1.99$, $p > .15$) between beauty and complexity showed up, a second-order model ($R^2 = .43$, $F(2, 9) = 3.22$, $p < .10$), with the top of the parabola at complexity rating 4.7, approached significance (see Fig. 5). The linear relation between beauty and prototypicality ($R^2 = .42$, $F(1, 10) = 7.25$, $p < .05$), was significant; a second-order regression ($R^2 = .60$, $F(2, 9) = 6.72$, $p < .05$) did not result in a significantly better fit of the data (see Fig. 6).

Interestingness and orderliness

While the aforementioned results are the crucial ones with respect to the hypotheses put forward, two more relations are worth mentioning. Firstly, orderliness showed a strong linear relationship to complexity, both when computed over the total group of stimuli ($r = -.91$) and when computed over the subgroups of LC slides ($r = -.90$), IC slides ($r = -.86$) and HC slides ($r = -.87$) separately.

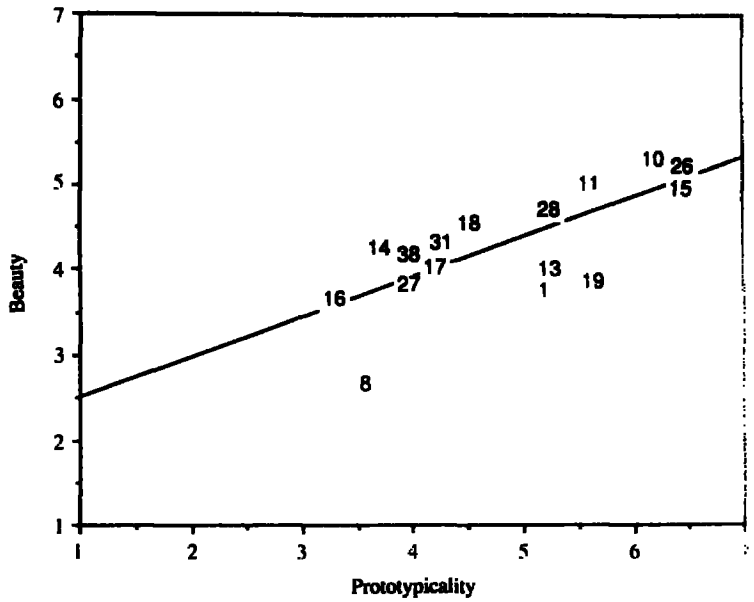

Figure 4. Beauty of HC slides as a function of prototypicality. Numbers refer to paintings listed in Table 1.

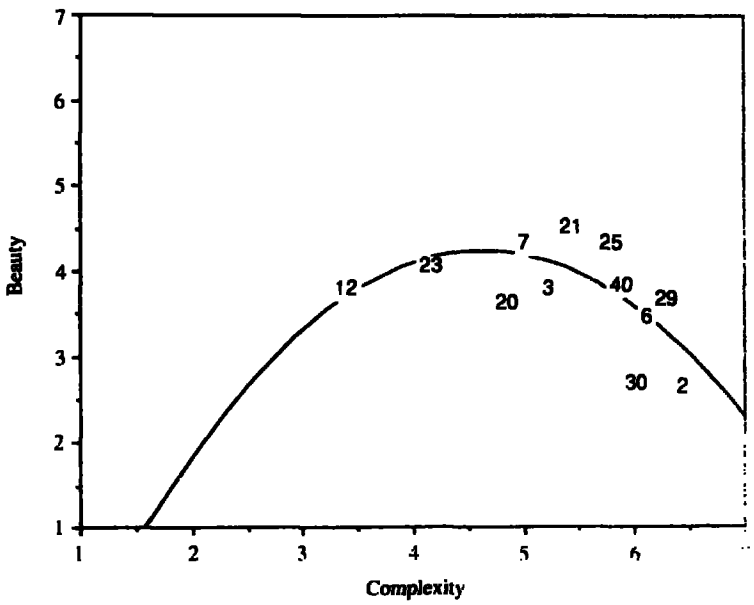

Figure 5. Beauty of IC slides as a function of complexity. Numbers refer to paintings listed in Table 1.

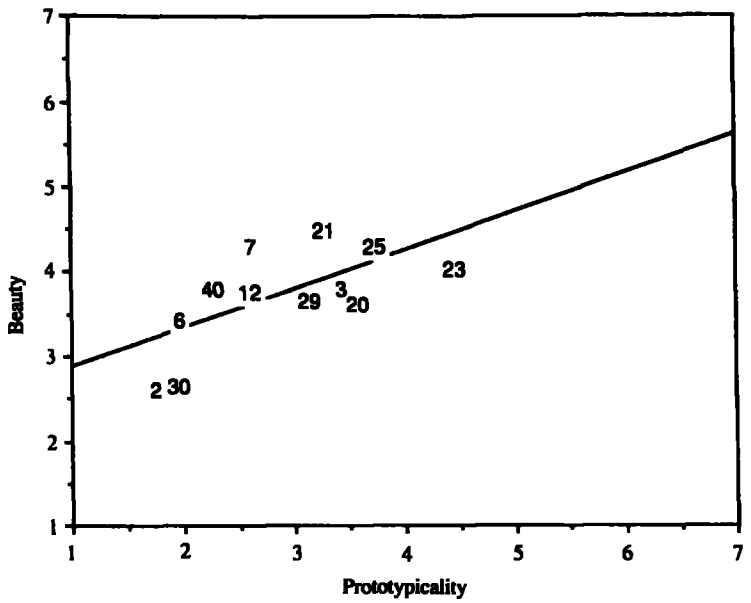

Figure 6. Beauty of IC slides as a function of prototypicality. Numbers refer to paintings listed in Table 1.

Secondly, the linear relation between the interestingness and beauty scores was very high, the correlation coefficient being .92, .92, .85 and .87 for the total, the LC, the IC, and the HC group of paintings, respectively.

Discussion

The results of the experiment reported above clearly support the hypotheses put forward in the introduction. As predicted, the attributes determining aesthetic appraisal of stimuli do vary as a function of their categorizability. For the High Categorizability (HC) stimuli, beauty ratings increased linearly with prototypicality. Moreover, the former ratings were unrelated to complexity. These results are in agreement with Whitfield's suggestion that aesthetic evaluation of familiar real-world objects is determined primarily by stimulus prototypicality, and operates independently of stimulus complexity, a suggestion he himself backed up with empirical data on furniture selection tasks (Whitfield, 1983).

For the slides of low categorizability (LC) the prediction of an inverted U-shaped relation between beauty and complexity was confirmed. Although, in principle, very orderly paintings might be judged as complex because of their association value – paintings by Mondrian being an obvious example – the high negative correlation between complexity and orderliness demonstrates that such a process did not occur to any significant degree. Therefore, complexity as measured in this experiment may indeed be considered as a collative variable in Berlyne's (1971) sense, and it may be safely concluded that the inverted U-shaped relation between beauty and complexity

for the LC slides is indeed an instance of the 'classic' relation between these variables, postulated on the basis of Berlyne's collative motivation model and earlier confirmed in experiments on appraisal of artificial stimuli.

Recently Arnheim (1985), in an essay on Fechner, has suggested that the latter's 'principle of the aesthetic middle', which is in accordance with a preference for medium complexity, is valid for everyday behaviour, but that in the arts 'it would reflect at most a classical taste for moderation (p. 862)'. Although the latter phrase clearly has a depreciatory ring, the present results indicate that at least the preference of our non-expert subjects regarding abstract works, does reveal such a taste.

Interestingly, for the stimuli with Intermediate Categorizability (IC) the results were 'in between' those for the HC and LC slides, beauty showing a linear relation to prototypicality, as well as a second-order relation to complexity (the latter relation only being significant at the 10 per cent level). These findings (although less clear-cut than those for the other two subgroups of stimuli) further corroborate the conclusion that complexity indeed exerts a strong influence on aesthetic appraisal when lack of categorizability prevents prototypicality of playing a role, but that with increasing categorizability this influence gives way to the effects of the latter variable.

Where, according to Berlyne (1971), interestingness ratings and aesthetic appraisal reflect different processes, the high correlation found between interestingness and beauty in the present experiment confirms Purcell's (1984) conclusion that these variables are less independent than Berlyne's model would require.

With respect to this topic, it is interesting to notice that our demonstration of a very high linear correlation coefficient between beauty and interestingness ratings is in good agreement with Sargent-Pollock & Konečni's (1977) report of a correlation of .78 between pleasingness and interestingness for 60 20th century paintings, including cubist works. While the latter authors found a much lower correlation ($r = .33$) between these two variables for 60 Renaissance paintings, they suggest that even within the same artistic medium the drawing of a sharp distinction between pleasingness and interestingness may be more justified for some than for other aesthetic materials (Sargent-Pollock & Konečni, 1977, p. 292), a suggestion still awaiting further empirical scrutiny. The possibility that the degree of realism might play a crucial role in modifying the relation between aesthetic appraisal and interestingness is at least rendered improbable by the fact that the beauty and interestingness scores were as closely related within each subgroup of LC, IC and HC slides as they were for the total group of stimuli.

A comparison between Figs. 1 or 2 and 3 or 4 reveals an overall tendency to prefer High Categorizability slides to Low Categorizability ones, a tendency which is backed up by a significant difference between the respective beauty scores ($t = 4.77$, $p < .001$). This difference is in agreement with the finding of Nicki, Lee & Moss (1981) that cubist paintings of low ambiguity are judged more pleasing than highly ambiguous ones, and may be interpreted as an example of the well-known preference for representational and realist art to abstract art by inexperienced observers (see e.g. Konečni, 1984; McWhinnie, 1987; Tobacyk, Bailey & Myers, 1979).

Recently, Zusne (1986) proposed that the reinforcing experience of cognitive consonance between an aesthetic specimen and the 'model of perfection currently held by the individual' is the core of aesthetic experience. This view is compatible

with the preference-for-prototypes model if one assumes that the 'model of perfection' is the prototype of the shown or depicted object, a prototype which, for non-sophisticated observers, will coincide with photographic likeness. As Rosch (e.g. 1975*b*) and, more recently, Gaver & Mandler (1987) have stipulated, however, learning and practice in specific domains may lead to more differentiated categories with new prototypes emerging at different levels of organization.

Therefore, expert audiences may be hypothesized to differ from non-expert audiences in two respects. Firstly, because of exposure, experts will have developed specific prototypes for abstract art works, prototypes which will function as aesthetic references for such works. Where no such prototypes exist, as will likely be the case for people having very limited experience with abstract art, the reinforcing experience described by Zusne as basic to aesthetic appraisal is, by definition, impossible.

Secondly, experts' criteria for representative art works will no longer coincide with the everyday prototypes of the depicted scenes, because categorizations in aesthetically more relevant and art specific terms have come to the fore. The latter hypothesis received some support from the work of Purcell (1984), who demonstrated that attractiveness of houses was significantly related to 'goodness-of-example' for his general sample of subjects, but not so for a group of architecture students. It is, therefore, improbable that the results of the present experiment, demonstrating the importance of prototypicality (in the sense of photographic likeness) and complexity for the aesthetic judgement of, respectively, representational and abstract paintings, can be generalized to more sophisticated audiences.

Moreover, although the results of this study clearly indicate the relevance of both prototypicality and complexity for the judgement of at least a limited domain of art products, it is an open empirical question if, even for non-expert audiences, further generalizations to other art forms or even other styles of painting, will be justified. The choice of our stimuli allowed for relatively broad ranges of both prototypicality and complexity without having to deal with possible interactions of these variables with colour, subject matter or style. Such interactions may very well be complex, and a firm theoretical basis for predicting their effects is lacking.

Before drawing this paper to a close, we would like to address two possible criticisms of this experiment. A first objection might be that there is no independent evidence that the operationalization of categorizability by reaction times indicating recognition of the human figures was indeed a valid one, because there was no check on whether or not the subjects had actually identified such a figure when releasing the response-button. The force of this argument is, however, considerably weakened in the light of the aforementioned strong linear relation ($r = -.86$) between the reaction times and subsequent prototypicality ratings. Evidently, more prototypical (realistic) depictions resulted in faster reaction times, which seems to warrant the use of this measure as an index of the ease of identification.

Further, it might be objected that the implicit requirement to look for a human figure in the reaction time task resulted in another way of inspecting the slides than would have occurred without such an instruction. Although this possibility may indeed exist, we do not believe that it diminishes the validity of the study. Firstly, all but one (No. 23) of the titles of the paintings referred to the human figure being

depicted. Where, both on expositions, and in books, titles are displayed together with the art works to which they refer, 'looking for the human figure' will probably not be confined to viewing these paintings in the laboratory condition of the present experiment. Secondly, the judgements of the paintings were made during a later part of the session than the reaction time task, which will at least have prevented immediate effects of the latter task from influencing the ratings of the works. It is for these reasons that we think the criticisms formulated above do not militate against the appropriateness of the methodology used in testing our hypotheses.

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