



LUND UNIVERSITY

Design: category formation, prototypicality and (aesthetic) preference

Ranta, Michael

Published in:

WONDERGROUND: Design Research Society International Conference Lisbon

2006

[Link to publication](#)

Citation for published version (APA):

Ranta, M. (2006). Design: category formation, prototypicality and (aesthetic) preference. In K. Friedman, T. Love, C.-R. Eduardo, & R. Chris (Eds.), *WONDERGROUND: Design Research Society International Conference Lisbon* Design Research Society.

http://www.iade.pt/drs2006/wonderground/proceedings/fullpapers/DRS2006_0280.pdf

Total number of authors:

1

General rights

Unless other specific re-use rights are stated the following general rights apply:

Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

- Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
- You may not further distribute the material or use it for any profit-making activity or commercial gain
- You may freely distribute the URL identifying the publication in the public portal

Read more about Creative commons licenses: <https://creativecommons.org/licenses/>

Take down policy

If you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.

LUND UNIVERSITY

PO Box 117
221 00 Lund
+46 46-222 00 00



0280

DESIGN:

Category Formation, Prototypicality and (Aesthetic) Preference

M R Ranta

Stockholm University, Stockholm, Sweden

m.ranta@chello.se

Cognitive psychology has, to a considerable extent, investigated the capacity of humans and other living creatures to categorize objects and events. The formation of categories enables us to apply previous experiences to new ones, to make inferences, to make predictions about the future, and they provide efficiency in communication - just to mention a few examples. Important questions, however, are how categories arise at all (i.e. whether, or to what extent, they are the result of environmental features or constructive processes on the part of the categorizer), and how they are represented in consciousness. Numerous cognitive psychologists have, following the psychologist Eleanor Rosch's initial work (1975; 1978; 1994), attempted to investigate the nature and acquirement of categories in general, most notably that of taxonomic categories. In this paper, I intend to give an outline as to how psychological categorization research might have implications for understanding some significant aspects of our preferences for instances of "design". More specifically, I shall argue that matches and moderate mismatches between instances (and/or types) of design and beholders' mental representations and schemata may lead to hedonic effects and thus may have a bearing on their (aesthetic) preferences.

*

A major tenet in cognitive psychology is the assumption that the mind should be regarded as a symbol-processing system, and that one important goal is to identify and explain the representations and symbolic processes involved in cognitive activities. A significant characteristic of cognitive psychology, which clearly distinguishes it from traditional behaviourism, is thus the supposition that intelligent organisms are capable of constructing and manipulating mental representations. Such mental representations may provide us with information that enables us to distinguish members of a category from non-members. A number of cognitive psychologists have proposed that perception and cognitive activities are hierarchically structured. New information is compared with and assimilated into broader schemata or categories which are necessary for object recognition, explanations, predictions, and communicative activities. In other words, humans seem to



be able to store mental representations which have something like a *type-character*. These representations are thus some kind of abstractions stored in long-term memory with which external objects are compared. Common taxonomic categories are acquired after encountering several particular instances of the category in question, after which relevant characteristics are extracted and integrated into category knowledge.

Eleanor Rosch developed a number of experimental procedures in her research on categorization. In most of these experiments various groups of subjects, usually students of psychology, encountered different kinds of stimuli, such as words (nouns), sentences, outline drawings, or photographs. In other cases subjects had to "produce" examples of category members. Some, though not all, of the methodological strategies used in her (as well as other researchers') investigations were designed as follows (Rosch 1994; cf. Lakoff 1987):

- (i) Direct rating: Subjects have to rate the typicality of an item (referred to by a word or a picture), or how good an example of a category it is. In early studies on categorization carried out by Rosch subjects were asked to rate the typicality of category members (on a 1 to 7 scale, where 1 is very typical and 7 very atypical). It turned out that the subjects quite consistently considered some members to be more typical than others. In the category *bird*, for example, a robin is judged to be very typical (with an average rating of 1.1), while a chicken (3.8) is not.
- (ii) Reaction time: Subjects have to press a button to indicate the experienced truth-value of statements (such as "An apple is a fruit"). Clear-cut and typical examples lead to shorter reaction times.
- (iii) Production of examples: Subjects have to list or draw category members, which often prove to be members considered to be more typical.

The results obtained from these experiments support, according to Rosch, the assumption that categories, psychologically speaking, usually do not have clear-cut boundaries, but rather possess a *graded* structure. This means that there are certain category members which are experienced as cognitive reference points (or the clearest cases of category membership), while other members gradually deviate from them, although they still belong to the category in question. In other words, categories are formed around their most representative instances, which have something like a prototypical character. Moreover, Wittgenstein's notion of *family resemblance* may be treated as a general psychological principle of category formation (Rosch & Mervis 1975, p. 575):

"...[M]embers of a category come to be viewed as prototypical of the category as a whole in proportion to the extent to which they bear a family resemblance to (have attributes which overlap those of) other members of the category. Conversely, items viewed as most prototypical of one category will be those with least family resemblance to or membership in other categories."

This hypothesis seems to have been empirically confirmed by various experiments where, for example, subjects were asked to list attributes for members which previously had been rated as very typical for the category in question. It was shown that the items with most attributes in common - which had to be specified by the subjects - and which had the least overlap with other categories were also considered to be the most representative category members. Likewise, studies with children have shown comparable results.



In all these cases the underlying assumption is obviously that there exists some kind of (experienced) similarity relation, based on family resemblance, between category members and prototypes, or matches to a standard. The more attributes an item shares with other members in a category, and the fewer attributes it shares with members of contrast categories, the higher is its degree of family resemblance and thus typicality supposed to be. Cognitive psychologists have, however, also been interested in other possible determinants of typicality. For example, it has been suggested that familiarity and frequency of exposure to an item determine typicality. While familiarity may be defined as someone's perceived knowledge of an item, frequency of exposure or instantiation may be defined as someone's subjective estimate of how often an item has been experienced, either as a member of a specific category or across all contexts in which it might occur. An apple, for instance, may be regarded as an often-experienced object in general, but as an unusual instance of a pizza topping.

Now, numerous studies within cognitive psychology indicate that category formation in general, whether we think of categories such as *furniture, fruit, birds, animals*, and so on, may generally be explained as outlined here. Psychologically seen, then, taxonomic categories are established after encountering several instances of a category, or of a preliminary category, where after characteristics experienced as relevant (or prototypical examples) are extracted and incorporated into category knowledge. It should further be emphasized that these psychological studies are empirically based, making use of sophisticated and rigorous experimental and statistical methods, thus giving the hypotheses put forward, as I believe, additional strength compared to pure philosophical and rather speculative reflections (cf. Ranta 2000). Here I will only refer to two of these studies.

Example 1: Pseudo-memory

In an experiment by Robert Solso and Judith McCarthy more realistic pictures of faces were used, created with Identikit, a face identification device used in police work.¹ Some characteristics of the faces composed using this device, such as hair, eyes, nose plus chin, and mouth were varied systematically. At first three faces were composed and given status as prototypes, from which four levels of modified exemplars were derived. These exemplars embodied different degrees of similarity to the originals, that is, three, two, or one out of four features were common to the prototypes (see figure 1).² Subjects were shown the derived faces for a few seconds. Then they participated in a recognition test which, in addition to the previously shown faces, also included new ones and a prototype face. Afterwards the subjects had to decide which of the faces they had seen before and to estimate (on a five-point scale) their confidence in that decision. Most of the subjects not only - falsely - identified the prototype faces as previously seen, but also gave those faces the highest confidence rating. Solso & McCarthy called this phenomenon "pseudo-memory", i.e. cases where "visual memories for complex stimuli formed from a synthesis of previous experiences...serve as a more salient representation of reality than do representations formed on the basis of previously experienced visual stimuli."³

¹ Solso & McCarthy (1981).

² Illustration from Solso (1995), p. 114.

³ Solso & McCarthy (1981), p. 502. According to Solso (1994, p. 251), "[s]ince the original experiment the results have been replicated using differently composed faces, with young children, with a six-week delay between the presentation of original faces and test faces, and with students from Stanford University, the University of Nevada, and Moscow State University (Russia), all with very similar results." For a similar experiment with comparable results, see also Young & Bruce (1991).



According to Solso et al., the formation and storage of prototypes is actually an essential component of human long-term memory.

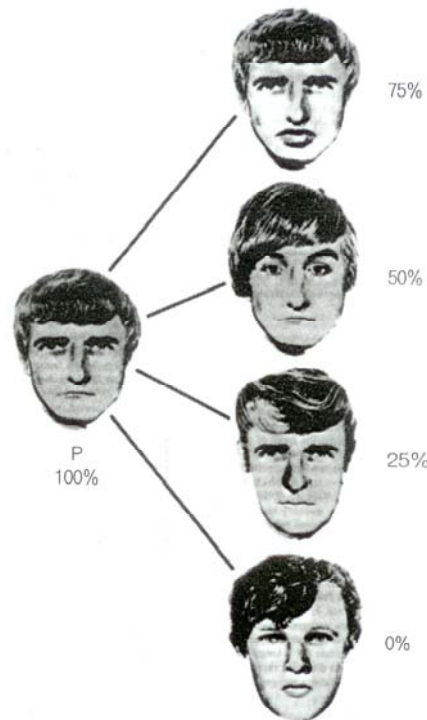


FIGURE 1: Prototype face and derived faces used in a study by Solso & McCarthy.

Example 2: Representational view

Prototypical representations may also include the most representational view of objects. A series of experiments carried out by Stephen Palmer, Eleanor Rosch, and Paul Chase support the assumption that there is a privileged or canonical perspective for recognizing and imagining objects.⁴ Various common objects (such as a horse, a shoe, a car, a clock, and so on) were photographed from different angles and shown to subjects who had to rate the perspectives for typicality and familiarity (for an example, see figure 12).⁵ In a subsequent stage of the experiments the subjects had to identify the previously shown objects as fast as possible. The results achieved showed that objects photographed from the most typical perspectives were identified most rapidly, and the less typical the perspectives, the greater were the reaction times. Thus it seems that canonical perspectives are more intimately related to human's internal conceptions about objects. There are several possible explanations for the different reaction times: (i) some perspectives provide more relevant information about the object, (ii) they reflect underlying mental representations in memory, abstracted from previous encounters with the same class of objects, and (iii) they are the most commonly experienced perspectives.⁶ Be

⁴ Palmer, Rosch & Chase (1981).

⁵ Illustration from *ibid.*, p. 139.

⁶ See Solso (1995), p. 96.



this as it may, it was concluded that "people's concepts of objects contain at least implicit aspects of perspective."⁷

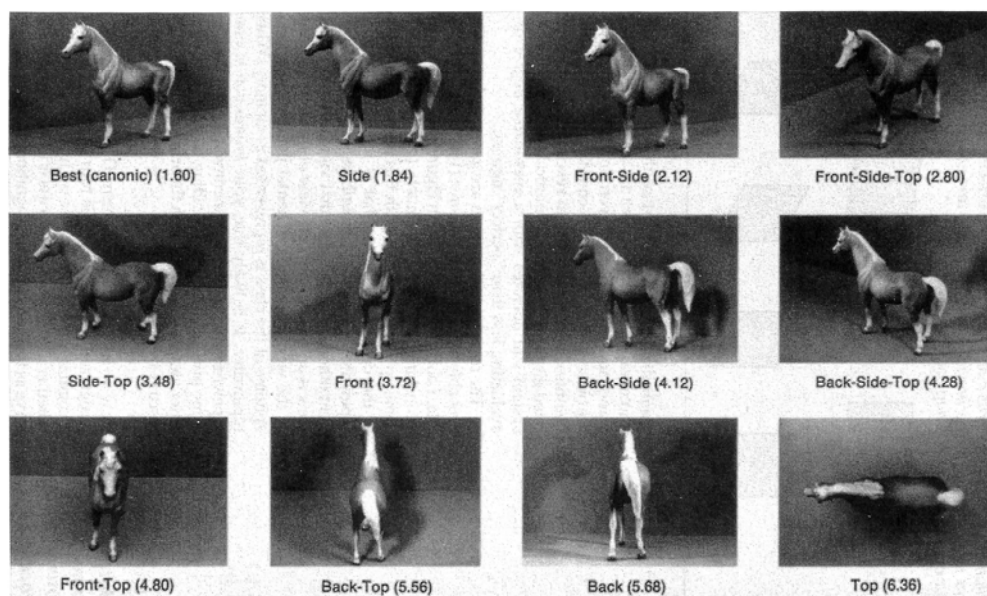


FIGURE 2: Examples from a picture set showing 12 perspective views of a horse together with perspective descriptions and mean goodness rating.

*

Now, in which way may categorization research as outlined here have some bearing on understanding the concept of "design"? First, we may note that this concept has a quite broad area of application. Thus we may think of an artifact's visual, or otherwise perceptual, appearance, such as its colour, sound, and tactile features, its pattern, composition, ornamentation, and the like. Moreover, may also conceive of its functional features (with regard to various goals) in terms of efficiency, durability, economic value, ease of usage, and so forth. Further, we might ask, then, which members of the category "design" would qualify as best or prototypical examples, as cognitive reference points. Generally speaking, this depends of course on the prevailing socio-historical circumstances (as probably is the case with numerous further or even most category structures). Impressionist paintings, for example, were judged to be highly atypical in the 1870s and 1880s and for some beholders hardly categorizable as art at all. They seemed to have no drawing, no composition, no convincing space or serious subject matter. Nowadays Impressionist works are highly admired and seem to belong to the core of the category "art". Indeed, as we might assume, this category (or strictly speaking the category "the visual arts") could probably be conceived as centring around exemplary members such as figurative landscape paintings, Greek sculpture, Michelangelo's frescoes, Picasso's cubist paintings, and so on. From these best

⁷ Palmer, Rosch & Chase (1981), p. 151.



examples other category members are more or less deviating, such as those relatively atypical works mentioned earlier.

However, apart from such socio-historical presuppositions, it seems also, from an evolutionary point of view, reasonable to assume that there are cross-culturally valid constraints concerning people's category structures (and beliefs in causal relations), having to do with basic needs for e.g. food, protection/health and sexual reproduction. Moreover, numerous findings suggest that "some categories are salient to all observers", and that "[s]trong clusters of features exist in the world, and the human categorizer need only apply basic perceptual processes to extract these feature clusters and form categories".⁸ Apart from a possible "substantial contribution of a structured environment", these constraints may possibly be explained by the fact that human beings share some general capacities, such as ease of perception, motor movement, memory, learning, and so on.

Now, when it comes to the design of (instances and types of) everyday utility objects, it seems certainly plausible to suspect that the emergence of best or prototypical category examples is also dependent on the physiological and neurological functions and construction on part of the possible users. Thus the features of an organism (which does not necessarily have to be human) in combination with structural features of the environment might be assumed to have a constraining effect on the establishment of subcategories (for example, *furniture*, *vehicle*, *cutlery*), held "together" by certain cognitive reference examples, within the more general category "design".

It might perhaps be argued that this line of reasoning necessitates the existence of prior-established, prototypical instances of "design" in order to clarify the nature of the category "design" as a whole. Thus it seems that we somehow are presupposing what we are trying to explain, and, moreover, that we will end up in an infinite regress into the past. How did the (historically) very first instances of "design" come into being? Well, how did the very first members of categories such as *furniture* or *fruit* come into being? Genealogically speaking, we might assume that at earlier stages of human development quite broad and more-inclusive categories have existed from which increasingly specialized subcategories have emerged. For example, broad categories such as *eatable objects* may subsequently have been differentiated as *fruit*, *vegetables*, or *meat*. A category such as the Greek notion *technê* (which perhaps could be translated as "organized knowledge and procedure applied for the purpose of producing a specific preconceived result") could then be conceived of as having evolved into specialized categories such as *science*, *art*, *handicraft* - and *design*.

In which way, though, may these considerations help us to understand the emergence of (aesthetic) preferences when it comes to instances of "design"? Within recent emotion theory, it has frequently been argued that emotions usually involve or are directed toward objects. Numerous scholars have adhered to a view which may be called "conflict theory of emotion" (see e.g. Mandler 1984; Frijda 1986; Oatley 1992). According to this position, emotions arise in situations where progress toward or away from some goal is hindered, when there is a conflict among goals, when a plan of action is interrupted, when the probability of achieving a goal has changed, and the like. An underlying assumption consists of the idea that humans constantly monitor the status of goals and preferences which are supposed to lead to states of well-being. Generally speaking, people are assumed to have preferences to be in certain states (e.g. pleasure) or to avoid other states (e.g. pain), and when they are in unpleasant states, they attempt to change them. Emotions are

⁸ Malt 1995, p. 129.



assumed to occur when expectations regarding ability or probability in attaining or preserving valuable states, objects, or activities (or avoiding or escaping from things that are regarded as undesirable) are violated. For example, fear may arise when goals of self-protection or of avoiding pain are violated (e.g. when encountering a predator in a forest, or an armed robber), disgust when deviations from gustatory goals occur, sadness in situations of loss (e.g. the death of a relative or losing one's wife after a divorce), and so on. In all these cases, ongoing plans may be interrupted, a re-evaluation of the situation has to be made, and appropriate measures taken. Emotions are processes which arise as a part of the solution necessary to straighten out discrepancies between one's expectations (or goals) and an event.

However, how are conflicts or disruptions involved in positive emotions, such as happiness? Well, it may be argued that the experience of happiness also depends on the recognition of discrepant information, though in terms of progress toward (or an unexpected maintenance of) goal states. Several conditions seem to be crucial with regard to happiness, as suggested by Nancy Stein, Tom Trabasso, & Maria Liwag (1993). First, some aspect of an event has to be experienced as novel (i.e. as violating one's expectations) in relation to the ability to achieve or maintain (or avoid aversive) states. Second, one has to believe that the possibility of achieving, maintaining, or avoiding a state has changed. Third, inferences have to be made about the certainty of state achievement, maintenance, or avoidance. Last, the outcome of the goal state has to be considered enjoyable. This account of happiness is, of course, to some extent superficial. For example, it may be claimed that happiness may arise "where there is no pressing overall goal, in states where the mind is full as in listening to music, in creative activities, in play, or when social participation is more important than any end result".⁹ Moreover, the achievement of enjoyment can be a goal in itself, not a by-product. Much more could, not surprisingly, be said about happiness and the nature of emotions in general, but not all of the topics and intricacies in the current discussion of the subject concern us here.

Still, as already indicated, there is one tenet which is quite prevalent in recent theories of emotion which deserves our attention, namely that emotions usually involve expectations. Put in another way, we employ mental models or schemes when we perceive our environment, make inferences and predictions, and evaluate the conditions for attaining, maintaining, or avoiding certain states. Accordingly, the object of an emotion may be conceived of as being mediated via (partial and sometimes erroneous) mental models of external subjects, objects, or events. Numerous scholars, such as Stein, Trabasso, & Liwag, have adhered to a conflict (or match-mismatch) theory of emotion, according to which

"...a distinguishing characteristic of emotional experience is an effort to assimilate some type of new information into current knowledge schemes...We contend that people constantly monitor their environment in an effort to maintain preferred states. In order to succeed at this task, procedures analogous to pattern-matching and assimilation are used to analyze and compare incoming data to what is already known. When new information is detected in the input, a mismatch occurs, causing an interruption in current thinking processes. Attention then shifts to the novel or discrepant information. Along with the attentional shift comes

⁹ Oatley (1992), p. 48. Cf. the objections against a conflict theoretical account of emotions, and particularly with regard to happiness, put forward by Averill (1994), pp. 85 - 88. According to Averill, we should further consider impulsive and transcendental emotions, the latter resulting from meditation, neurological damage, sensory deprivation, and the like. The former, though, is reminiscent of Oatley & Johnson-Laird's notion of control signals (which Averill himself points out).



arousal of the ANS and a focus on the implications that the new information has for the maintenance of valued goals. Thus, emotional experience is almost always associated with attending to and making sense out of new information." ¹⁰

Now, let us return to the main issue of this paper, that is, the relationship between experienced typicality and affect or preference. As we may recall, a common view within cognitive psychology consists of the idea that we acquire mental representations (mental images, schemata, scripts, frames, and so on) due to repeated exposure to regularities in the environment. While some schemata are more concrete (such as the schemata for my living room, my cat, and my car), others are generic (such as schemata for living rooms, cats, and cars in general), centring around prototypical examples. According to George Mandler, another influential proponent of a conflict theory of emotion, encounters with external objects, situations, or environments may more or less match pre-existent schemata, and, depending on the degree of discrepancy, result in different emotional states and changes in arousal.

"Schemas organise and interpret our world. Their activation proceeds automatically from the most concrete to the most abstract schemas relevant (a process referred to as bottom-up processing). At the same time, and also automatically, activated high-level schemas pass activation to lower schemas (top-down processing) which constrain further perception. Expectations are those elements of schemas activated by top-down processing which are not directly supported by input evidence. Expectations influence what will be attended to by influencing the ease with which particular new evidence may be interpreted...When a discrepancy between expectations and available evidence is found, autonomic (sympathetic) arousal results, which will potentiate emotional experiences, in addition to alerting the organism and providing resources for coping with the unexpected." ¹¹

Schemata create expectations, and if deviations occur, active cognitive processes become necessary. Referring to Jean Piaget's notions of *accommodation* and *assimilation*, Mandler claims that encounters with events that do not fit in with one's schematic representations necessitate modifications of (or adaptations to) the latter. Accommodation is defined as "the case in which a new experience is such that existing structures (schemas) cannot accept the new information; structures must be changed in order to take account of it...In the case of assimilation, on the other hand, existing structures remain unchanged, but the interpretation of the world is changed in order to deal adequately with a slightly changed situation - for example, when meeting somebody at a party and finding the initial conversation about a painting puzzling because the other person talks about shadings when we see brilliant color. We might accommodate these new opinions to a new structure, but simply assimilate when we discover that the other person is colorblind - no change in our existing mental organization is needed". ¹²

Such adaptations are said to give rise to affective experiences, or, to be more exact, to arousal changes in the autonomic nervous system (ANS). Events or stimuli which are extremely congruous with prior

¹⁰ Stein, Trabasso & Liwag (1993), p. 281.

¹¹ Gaver & Mandler (1987), pp. 265 - 266, where emotional responses to music in particular are discussed from this perspective.



of instances of “design” to evoke hedonic effects, nor has it anything (explicit) to say about the value of such instances. Rather, it has been an attempt to sketch underlying *principles* concerning the enjoyment we frequently gain from encounters with some of them. However, it may still be argued that a strict demarcation of preference judgements from value judgements is difficult to uphold (perhaps we should rather think about them in terms of differences in degree than differences in kind). Moreover, value judgements might be given further strength and plausibility by considering investigations concerning people's preferences, instead of primarily relying on intuitive and philosophical reflections.

REFERENCES:

- AVERILL, James R.: "Aristotle Meets the Computer and Becomes Conflicted (A Review of *Best Laid Schemes: The Psychology of Emotions* by Keith Oatley)", *Cognition and Emotion*, vol. 8, pp. 73 - 91, 1994
- CLARK, Margaret S. & FISKE, Susan T. (eds.): "Affect and Cognition - The Seventeenth Annual Carnegie Symposium on Cognition", London/Hillsdale, N.J.: Lawrence Erlbaum Associates, Publishers, 1982
- FRIJDA, Nico: "The Emotions", Cambridge/Paris: Cambridge University Press/Editions de la Maison des Sciences de l'Homme, 1986
- GAVER, William W. & MANDLER, George (1987): "Play it again, Sam: On Liking Music", *Cognition and Emotion*, vol. 1, pp. 259 - 282
- LAKOFF, George (1987): "Women, Fire, and Dangerous Things - What Categories Reveal about the Mind", Chicago/London: The University of Chicago Press
- LEWIS, Michael & HAVILAND, Jeanette M. (eds.) (1993): "Handbook of Emotions", New York/London: The Guilford Press, 1993
- LONG, John & BADDELEY, Alan (eds.): "Attention and Performance IX", Hillsdale, N.J.: Lawrence Erlbaum Associates, Publishers, 1981
- MALT, Barbara C. (1995): "Category Coherence in Cross-cultural Perspective", *Cognitive Psychology*, vol. 29, pp. 85 - 148
- MANDLER, George: "The Structure of Value: Accounting for Taste", in Clark & Fiske (1982), pp. 3 - 36
- MANDLER, George (1984): "Mind and Body - Psychology of Emotion and Stress", New York/London: W. W. Norton & Company
- MEYERS-LEVY, Joan & TYBOUT, Alice M.: "Schema Congruity as a Basis for Product Evaluation", *Journal of Consumer Research*, vol. 16, pp. 39 - 54, 1989
- OATLEY, Keith: "Best Laid Schemes - The Psychology of Emotions", Cambridge/Paris: Cambridge University Press/Editions de la Maison des Sciences de l'Homme, 1992
- PALMER, Stephen E., ROSCH, Eleanor & CHASE, Paul: "Canonical Perspective and the Perception of Objects", in Long and Baddeley (1981), pp. 135 - 151
- RANTA, Michael (2000): "Mimesis as the Representation of Types - The Historical and Psychological Basis of an Aesthetic Idea", Stockholm: Stockholm University
- ROSCH, Eleanor (1975): "Cognitive Representations of Semantic Categories", *Journal of Experimental Psychology: General*, vol. 104, pp. 192 - 233
- ROSCH, Eleanor (1994): "Categorization", *Encyclopedia of Human Behavior*, vol. 1, Academic Press, Inc., pp. 513 - 523
- ROSCH, Eleanor & MERVIS, Carolyn B. (1975): "Family Resemblances: Studies in the Internal Structure of Categories", *Cognitive Psychology*, vol. 7, pp. 573 - 605
- ROSCH, Eleanor & LLOYD, Barbara B. (eds.) (1978): "Cognition and Categorization", Hillsdale, New Jersey: Lawrence Erlbaum Associates, Publishers
- SOLSO, Robert L. & MCCARTHY, Judith E.: "Prototype Formation of Faces: A Case of Pseudo-Memory", *British Journal of Psychology*, vol. 72, pp. 499 - 503, 1981
- SOLSO, Robert L.: "Cognitive Psychology", Boston et al.: Allyn & Bacon, (1979) 1995
- STEIN, Nancy L, TRABASSO, Tom, & LIWAG, Maria (1993): "The Representation and Organization of Emotional Experience: Unfolding the Emotion Episode, in Lewis & Haviland (1993), pp. 279 - 300
- YOUNG, Andrew W. & BRUCE, Vicki: "Perceptual Categories and the Computation of 'Grandmother'", *European Journal of Cognitive Psychology*, vol. 3, pp. 5 - 49, 1991

¹⁴ Mandler (1984), p. 207.