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CATEGORIZATION AND AGING AS MEASURED BY AN ADAPTED VERSION OF WECHSLER'S SIMILARITIES TEST

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Résumé

L'objectif de cette recherche est d'étudier l'évolution avec le vieillissement du processus taxonomique impliqué dans une version adaptée du test des Similitudes de Wechsler, qui distingue la catégorisation des mots concrets versus abstraits. Deux groupes ont été constitués : 20 adultes jeunes (M =20ans, SD=1.36) et 20 adultes âgés (M =70ans, SD=4.66). Les résultats montrent un déclin de la catégorisation taxonomique avec l'âge, notamment pour les mots abstraits. L'effet de concrétude est donc observé mais seulement chez les âgés du fait d'un effet « plafond » des performances chez les jeunes adultes. De plus, il s'avère que la moyenne des réponses taxonomiques des âgés est à peu près équivalente à celle d'enfants de 9 ans d'une étude antérieure. La courbe curvilinéaire du développement de la catégorisation taxonomique observée par de nombreux auteurs est donc retrouvée. Néanmoins, une analyse plus précise des items et des réponses montre que les âgés ont davantage de difficultés avec des mots faciles qu'avec des mots difficiles. Ce résultat suggère que le processus de catégorisation serait préservé mais que des variables affectives viendraient moduler l'activation du processus taxonomique.

Abstract

We used an adapted version of the Wechsler Similarities subtest to study taxonomic processing, the superordinate categorization of concrete and abstract words, in 20 young adult (M =20 years, SD=1.36) and 20 elderly (M =70 years, SD=4.66) subjects. Young adults performed near ceiling on both categorization tasks. Elderly subjects performed less well, especially with abstract words. Our results are consistent with the curvilinear function reported by many authors, which describes an increase in taxonomic processing from childhood to adulthood and then a decline as aging progresses. The mean performances of the elderly adults studied here were about similar to the mean taxonomic scores in a group of 9 year-olds (Rozencwajg & Corroyer, 2007). An item analysis of the child and elderly data suggests that taxonomic processing is preserved in the elderly but that affective variables modulate response strategies.

Key Words : Cognitive processes – Aging - Categorization – WAIS-III – Concreteness

INTRODUCTION

This research falls within the general framework of cognitive psychology's contribution to the understanding of how performance on intelligence tests evolves with age. By identifying the processes that underlie a subject's performance on intelligence tests, the researcher can better understand a subject's cognitive function with information that is not necessarily reflected in an intelligence test's total score (Grégoire, 2004; Huteau & Lautrey, 1999; Rozencwajg & Corroyer, 2002; Rozencwajg, 2005, Rozencwajg, Cherfi, Ferrandez, Lautrey, Lemoine & Loarer, 2005a; Rozencwajg, Lemoine, Rolland-Grot & Bompard, 2005b; Rozencwajg, 2006a; Rozencwajg, 2007).

In particular, we focused on the Similarities Subtest of the Wechsler Scales, which originated in the work of Binet and Simon (1908). Needless to say, this test was not developed within the context of cognitive psychology. Therefore, the Similarities Test used in this study was adapted so that we could identify the processes underlying performance. We define categorization as follows: "Categorization corresponds to a cognitive activity that leads the individual to treat different objects in the same way, in order to move beyond specificities toward generality" (Bonthoux, Berger, & Blaye, 2004, p. 4, our translation).

SIMILARITIES TEST

In the Wechsler Similarities Test for adults (2000), the subject is asked in what way two words (objects or concepts) are alike; for instance, "How are a poem and a statue alike?" (Item 12 of the WAIS-III). Scoring depends on whether the subject mentions a similarity, even a concrete one, and not a difference. An answer based on a difference shows the subject's inability to create a link between these two elements. Scoring is then based on the abstractness of the answer. The more capable a subject is of abstraction, the higher he or she will score on the Similarities Test. Following this scoring principle, an answer such as "they are both artworks" receives the most points (2 points); an answer like "a representation of something" is worth 1 point, and an answer like "the poem describes the statue" results in 0 points.

SIMILARITIES TEST AND AGING

Comparing the performance on the Similarities and Vocabulary Subtests of the WAIS-III (cf. Figure 1) across age leads to a paradox. The Similarities Test of the WAIS-III is one of the best measures of the verbal comprehension factor index, which loads heavily on crystallised intelligence. In terms of aging, the dissociation phenomena[1] (Li et al., 2004 ; Schroeder & Salthouse, 2004; Verhaeghen, 2003) predicts the same level of performance on the Similarities Test as on the Vocabulary Test, which involves crystallised intelligence. However, when analyzing the change in performances across age (cf. Figure 1), the mean performance level on the Vocabulary Test after 70 years of age comes close to a teenage level (16 years), whereas performance

[1] The dissociation phenomena is the fact that the fluid abilities decline earlier during aging than the crystallized abilities do.

drops well below this level on the Similarities Test. Analyses of age effects on the Wechsler Adult Intelligence Scale-III subtests in American subjects shows the same phenomena (Ardila, 2007; Ryan, Sattler & Lopez, 2000).

The main objective of our research was to analyse the age-related differences in cognitive processes involved in categorization as measured by the Similarities Test, and also to resolve the paradox in the elderly subjects' performance on the Wechsler Similarities Test and Vocabulary Test.

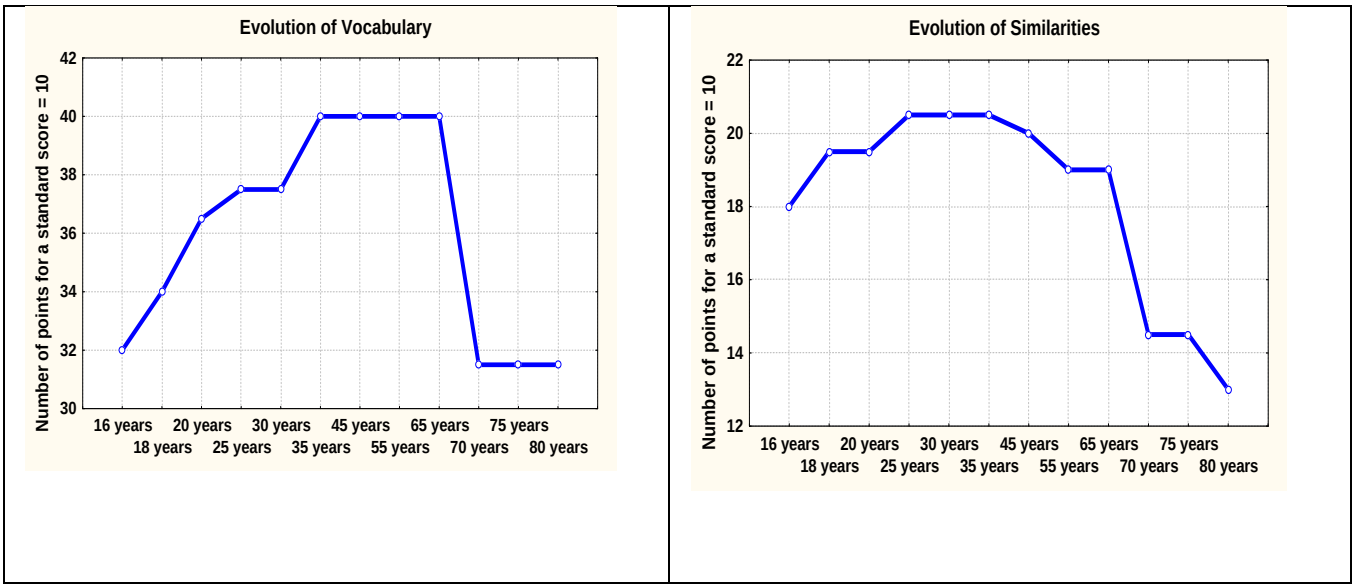

FIGURE 1. AGE-RELATED CHANGES IN VOCABULARY AND SIMILARITIES

Source: Data reproduced from the WAIS III handbook

COGNITIVE PROCESSES INVOLVED IN CATEGORIZATION

A review of the literature on categorization (Blaye, Bernard-Peyron, & Bonthoux, 2000; Bonthoux et al., 2004; Lautrey, 1998; Nelson, 1985) suggests that the answer "they are both artworks" is the result of superordinate taxonomic categorization, which consists of grouping objects or words according to their common features at a high level of generality. Taxonomic processing requires one to separate the category from the context in which the elements were found. A subject who answers "representation of something" is able to find a common feature, but only a perceptual or visual one. The answer, "the poem describes the statue", results from a thematic categorization process where, "elements are associated on the basis of spatial or temporal contiguity […]. Most often, the thematic relation places two entities in a causal relationship, in temporal or spatial succession, in a relation of a part to the whole" (Blaye et al., 2000, p. 59, our translation). Thematic categorization refers to the notion of a schema in which the organization of knowledge relates to familiar events or scenes from daily life. According to Lautrey (1998), thematic categorization reflects "knowledge organization in episodic memory, which is more context-related than knowledge organization in semantic memory" (p. 93, our translation). Taxonomic categorization allows more inferences about new objects than does thematic categorization because the object inherits the properties of the category. Hamon and Parmentier (2005) recently showed that the performance of 10-year-olds on the Wechsler Similarities subtest (WISC-III) can be analyzed using taxonomic categorization.

CATEGORIZATION IN CHILDREN AND ELDERLY ADULTS.

Development of the Categorization Process: Nelson (1985) describes the development of categorization as taking place in three stages. First is categorization by a script—the representation of actions organized according to a goal—which is the primary form of knowledge organization in long-term memory. For example, in a breakfast script the child drinks hot chocolate and eats a slice of bread. In the second stage, the script changes into a slot-filler category, as contextualized taxonomic categories are formed by element substitution in the script itself. For instance, beverages consumed at breakfast include hot chocolate, but also tea and coffee. Finally, de-contextualized taxonomic categories emerge as, for example, a breakfast script element is seen in another script: the child drinks hot chocolate at a party too. In this way, the category of beverage is formed; it eventually includes hot chocolate, coffee, and tea, as well as soda and water.

The quantification of inclusion underlies the superordinate taxonomic response (Piaget & Inhelder, 1967). In principle, this developmental strategy starts during the concrete operational stage, which begins at 7 or 8 years and lasts until age 11, but is most active between 9 - 11 years of age (Mpofu, 1994). In order to give a taxonomic response, one must overcome the perceptual aspects of a word (or object), or "de-contextualize" it. Otherwise, there is a chance that a concrete response may be evoked. Mpofu (1994) analyzed responses of 7-, 9- and 11-year-olds, given in a Wechsler-related Similarities Test, depending on whether they were instrumental (functional) or analytic (abstract). These two types of answers correspond to thematic (using an object) and taxonomic (superordinate category) answers, respectively. His results showed an age-related increase in frequency for the analytical strategy: 7- to 9-year-olds used instrumental strategies whereas 9- to 11-year-olds used analytical strategies. This finding confirms that the quantification of inclusion is most typical of children at the most advanced concrete operational stage. Likewise, Cicirelli (1976) showed an increase in superordinate taxonomic categorization between 6 and 7 years of age, as well as for young adults (42%, 68% and 75%, respectively) and a parallel decrease in thematic categorization (25%, 19% and 7%, respectively).

However, not all authors are convinced by the hypothesis of an age-related increase in taxonomic categorization. "The traditional literature on the thematic-to-taxonomic shift has argued that it represents a radical change in children's cognitive abilities. From the Piagetian or Vygotskyan perspective, young children are unable to form logical classes, and so they rely on thematic relationship as a more primitive approximation to real categories. More contemporary approaches do not take such a global view, recognizing that children may for many years make a mixture of taxonomic and thematic responses. Furthermore, it is now widely recognized that even young children are able to make taxonomic classes at the basic level" (Lin & Murphy, 2001, page 4).

For Bonthoux et al. (2004), the child's choice of the type of categorization is more task- related than age-related: the changing of instructions, the salience of relationships or the number of objects to be categorized all have an impact. Individual differences prevail over age-related differences. Yet, in the WISC-IV Similarities Test (Wechsler, 2005), mean performance significantly increases between 6 and 9 years, then increases less sharply thereafter. For Wechsler, the taxonomic response required to score the most points (2 points) increases with age during the concrete operational stage.

Categorisation Processes and Aging: Denney and Lennon (1972) showed an important age-related effect on the classification of geometrical figures with varying colour, size and form. Aged persons categorise like young children, forming classes by construction and not like young adults, who create classes by considering common features. Their interpretation of these results is not based on decline but, rather, on

environmental constraints: “Since neither the young child nor the elderly adult has any occupational or educational reason for categorizing in any particular way, they are free to categorize in the most natural and salient way” (Denney & Lennon, 1972, page 213).

Kogan’s (1974) study of aged persons with low levels of education obtained similar results: they used a thematic classification system more often than classification by common features. He explained this finding with the curvilinear function hypothesis (young children and aged subjects are highly similar and less likely to use classification by common features than young and middle-aged adults). However, he interprets the performance of the elderly to mean that they are more creative and less conformist, and that both thematic classification and classification by common features can apply to their performance.

The study of Cicirelli (1976) replicated and extended Kogan’s findings. He studied, 5-, 6- and 7-year old children, young adults of 19-21 years, and elderly subjects 60-69, 70-79 and 80-89 years of age. The study confirmed the quadratic tendency of categorization. However, the question remains as to whether there is a decline in performance or if the daily life of the elderly no longer requires logical categorisation. Cicirelli noted, “Certainly the environment of many elderly persons is not one which requires the use of logical classification, and thus such responses would not tend to appear unless there was some clear demand for their use” (page 680).

Smiley & Brown (1979) investigated the evolution of taxonomic and thematic processes during life span from this perspective. They observed an increase in taxonomic responses between 6 and 10 years and a clear return of the thematic process in aged persons (*average age of* 72 years; 66-85 years). Moreover, they found that this pattern reflects a preference for thematic categorization: young and elderly people were both able to produce a taxonomic categorization on a second try, even though they spontaneously responded with a thematic response on their initial try. According to the authors, this preference is due to the fact that neither the young child nor the elderly adult has any professional or educational constraints to use taxonomic categorization, so, thematic categorization appears to be more natural and salient. “Preference for a conceptual organization based on thematic relations is related to age, with young and elderly individuals preferring to rely on the more immediate functional relationship based on active perceptual experience. Middle-school students as well as college adults prefer taxonomic systems of organization. These data are consistent with previous work which suggests that schooling and cultural status influence modes of categorization” (Smiley and Brown, 1979, page 256). In addition, Lin & Murphy (2001), report that the type of categorization used by young adults is related to the salience of thematic and taxonomic relationships. Indeed, they state that the saliency effect is more important than the age effect. Pennequin, Fontaine, Bonthoux, Scheuner and Blaye (2006) reported the similar results with older persons (*average age* =71.5 years).

How then, does one explain the sharp age-related decline of performance on the WAIS-III Similarities Test (cf. Figure 1)? Consideration of three points may help resolve the issue.

First, the instructions used by Wechsler clearly demand a super-ordinate taxonomic category: the experimenter corrects the subject once if he or she does not use one. In other words, these are not open instructions such as “Choose the objects that match the best,” but rather “How are these concepts alike?” The thematic response is no longer appropriate for Wechsler’s instructions (it scores 0 points), while taxonomic and thematic responses remain appropriate for the “match best” instruction.

Secondly, recent studies generally use concrete concepts that can be represented by pictures. Like classical intelligence tests (Binet-Simon Test, Differential scale of intellectual efficiency – EDEI; NEMI-2; Wechsler Scales), the Similarities Categorization Task uses abstract words as well. For instance, Binet and Simon had already distinguished between these two levels of difficulty. As they pointed out, 6-year-old children

are usually able to define concrete words related to their purpose alone, which nowadays might be defined as thematic processing, while 9-year-olds are able to define concrete words "beyond their purpose" (Binet & Simon, 1917; Rozencwajg, 2006b). It is only around age 12 that children become able to define abstract words or to find the similarity between two abstract words. In fact, finding the super-ordinate category for two concrete words requires abstracting them from their features. Analogously, finding the superordinate category for two abstract words requires reasoning about the words non-material content. Although the abstract words chosen for this experiment are all very familiar, the reasoning behind their superordinate classification remains more difficult.

The EDEI Intelligence Scale also has both concrete and abstract items on its Conceptualization Test (Perron-Borelli, 2000). Because the EDEI is administered to children as young as 4 years old, the need for operational reasoning about abstract taxonomic categories does not apply to the first 22 of the 26 items of the Conceptualization Test. For these items, a common perceptual feature or visual semantic trait is required. For instance, "a ball and an orange are similar because both are … round" (item 4, p. 70). The last four of the 26 items are abstract and, thus, require operational reasoning about abstract taxonomic categories. For Perron-Borelli's sample of 4- to 9-year-olds (n = 609), the mean conceptualization score increased with age (5.34 for 4-year-olds and 19.8 for 9-year-olds, p. 177). More specifically, the concrete items were solved by 13% to 96.6% of the sample, whereas the abstract items were solved by 1.8% to 8.5% of the sample (p. 173).

Similarly, Winnykamen and Dhenin (1974) studied word recall with 8-, 9- and 10-year-old children. They built four lists of 20 words each by comparing two factors: words were concrete or abstract and they were easily categorizable or independent. The results showed that concrete words are easier to categorize than abstract words. In fact, beginning at the age of 8, recall of easily categorizable concrete words was better than recall of independent concrete words, i.e., as early as 8 years of age, children improve recall by categorizing concrete words. However, recall of independent abstract words and categorizable abstract words did not differ for 8- and 9-year-olds. Only 10-year-olds recalled categorizable abstract words more precisely. According to the authors, "…it seems that only at the age of 10 does the categorizable nature of the material start to compensate for the difficulty of retention" (p. 52, our translation). Before this age, children do not spontaneously categorize in order to improve their recall of abstract words. Another hypothesis might be that children younger than 10 are unable to find an appropriate category.

Furthermore, the context availability model "predicts that with adequate contextual support (that is, where contextual information has been made available), persons will be able to make the cognitive contributions necessary for understanding abstract materials as readily as for concrete materials" (Schwanenflugel & Shoben, 1983, page 83). Out of context, abstract materials are more difficult than concrete materials. Moreover, according to the dual coding theory of Paivio (1971), concrete words are better memorized than abstract words.

Although concreteness effect was highlighted in lexical decision tasks and memory tasks, we expect that it applies in categorization tasks too which requires deep semantic processing (Craik & Tulving, 1975, Rozencwajg, 2007). We expect that concrete words will be more easily categorized than abstract words.

Another argument for the difference between concrete and abstract comes from studies that have measured cortical activity during recognition of concrete and abstract words. Day's (1977) results show a hemispheric asymmetry: concrete words activate by both hemispheres, while abstract words activate only the left hemisphere. The results are identical in a recognition task of super-ordinate categories. One can conclude that the processing of abstract words depends on strictly verbal performance, whereas processing of concrete words benefits from double coding (Paivio, 1971). The work of Villardita, Grioli, and Quattropani (1988) shows the same kind of hemispheric asymmetry in a categorization task of concrete versus abstract words. Fifteen

adults with right-hemispheric brain damage and 15 adult controls were tested with two- or three-syllable words. The first list contained 12 common concrete words belonging to three categories and the second list contained 12 common abstract words also belonging to three categories. Subjects had five trials to memorize the list. The dependent variable was a clustering score and evaluated categorization abilities. Right-brain-damaged adults had problems only in categorizing concrete words, not abstract words. The authors concluded that the right hemisphere is involved in the processing of pictorial and concrete words.

Finally, according to Elkind (1981), the items used in the Similarities Test do not all depend on the operative level. Some items, like "the similarity between a wheel and a ball," depend on a preoperational level because one only needs to respond on the basis of common perceptual features such as "they are both round," whereas items such as "the similarity between a piano and a guitar" require concrete operational reasoning. The preoperative item does not require a superordinate taxonomic category. The child may simply use a visual feature common to both elements. Thus, responses based on a concrete perceptual similarity are less elaborate than responses based on a superordinate similarity. Unless a subject is asked to justify his or her choice, one cannot know whether it is based on functional, perceptual, or superordinate similarities.

In our study, the classification of all the items in our adapted version of the Similarities Subtest of the Wechsler Scales depend on the operational level and thus, require a superordinate taxonomic response related to concrete operating reasoning. Nevertheless, both concrete and abstract words could be problematic because the thematic or visual links, between words could trigger a perceptual response at the preoperational level. Words could also be problematic because of a seeming difference. Finally, for all the items of the experiment, concrete or abstract, taxonomic response is not immediate. For example, in the item 'anger-joy', the immediate link is a difference and not a similitude. In norms established by Ferrand (2001), 'anger' is never associated with 'joy', and 'beauty' is never associated with 'kindness'. Therefore, the subjects have to create the link.

The likelihood that a subject would give a superordinate taxonomic response was facilitated by giving specific instructions, correcting the first response it was incorrect and by using verbal materials, which makes taxonomic categorization easier than matching figures (Bonthoux et al., 2004).

AIMS

We expect subjects to find the superordinate taxonomic category for concrete words more readily than for abstract words.

We already know that concrete words are easier than abstract words in lexical decision tasks (Schwanenflugel et al. 1983), memory tasks (Paivio, 1971) and categorization tasks (Villardita et al. 1988). We expect that this concreteness effect will also be shown in our categorization task. In fact we observed that this concreteness effect was even more important in our categorization task than in a memory task what we already observed with children (Rozencwajg, 2007).

The second aim of our study is to find out whether young and elderly adults can identify the superordinate taxonomic category of concrete and abstract items. We expect that concrete words will be more easily categorized than abstract ones, in particular with the elderly adults.

We already know that abstract words are later categorized with the children (Binet-Simon, 1908 ; Cognet, 2006 ; Perron-Borelli, 2000 ; Wechsler, 2005 ; Winnykamen et al., 1974). They are more relevant to study their development (Rozencwajg, 2007). As far as we know, this phenomena has not been studied with the elderly. Nevertheless, we expect that abstract words, which are more difficult, will be visible earlier than concrete words, which are easier.

Finally, the results will be discussed to also resolve the paradox in the elderly subjects' performance on the Wechsler Similarities Test and Vocabulary Test (cf. Figure 1). We will propose an explanation to understand this phenomena.

METHOD

CHARACTERISTICS OF THE SAMPLE

Two age-groups were compared: 20 young adults (11 males and 9 females, 18 to 22 years of age, average = 20 years, *SD* = 1.36) and 20 aged adults (8 males and 12 females, 62 to 79 years of age, average = 70 years, *SD* = 4.66). Their participation was voluntary.

Our older subjects showed no signs of dementia; their mean score on the Mattis Dementia Rating Scale (DRS) (Mattis, 1976) was 41; range =136- 144 (See Lucas and al., 1998; Schmidt and al. 1994), or major signs of depression; their mean score on the GDS (Yesavage and al., 1983) was 5.20; range = 3-11. Their mean standardized score on the Vocabulary Test (Wechsler, 2000) was 12.55; range = 9- 18. Women do not neither differ from men about taxonomic score of concrete words (F [1,18]=0.35, NS, CE[2]=0.19) nor about abstract words (F [1,18]=0.03, NS, CE=0.05).

Table 1 shows the education level of our samples. Their mean educational levels were not statistically different (F [1,38] = 0.78, NS, CE=0.20).

[2] To measure the magnitude of the effects from a descriptive standpoint, we calculated the calibrated effects (Corroyer and Rouanet, 1994; Rouanet, 1996). Basically, this index is the ratio of the between variance to the within variance. The higher this ratio is, the greater the difference in the means between the groups will be in comparison the inter-individual differences within each group. A calibrated effect is taken to be small when the ratio is below 1/3 and large when it is above 2/3.

Table 1. Education level of young and elderly subjects.

Education (Years)	<8	[8-11]	[12]	[13-14]	>15
Young	0	4	10	4	2
Elderly	6	2	5	3	4

MATERIALS AND PROCEDURES: A MODIFIED VERSION OF WECHSLER'S SIMILARITIES TEST

The materials were comprised of two lists, one list of 10 pairs of concrete words and one list of 10 pairs of abstract words (Table 2). Concrete words have an imaging value of 4 points out of 5 on the Bonin scale (Bonin et al., 2003) or 6 points out of 7 on the Flieller scale (Flieller & Tournois, 1994). Abstract words have an imaging value of 4 points out of 7 on the Flieller scale. "The imaging value of a word is defined by the ease with which it evokes a mental image. Words with a high imaging value generate richer semantic representations than words with a low value." (Bonin et al., 2003, p. 658, our translation). A mental image is created when the concept's visual traits in long-term memory are activated. Furthermore, according to the standards applied by Bonin et al. (2003) and Flieller and Tournois (1994), all words used in this study are frequent: They all have a subjective frequency value of 4 points out of 5 on the Bonin scale or 6 points out of 7 on the Flieller scale.

Table 2. Abstract and concrete items of the categorization tasks

Concrete items	Cat / Mouse	Rose / Daisy	Football / Basket-ball	Fir / Apple tree	Hammer / Axe	Dress / Trousers	Milk / Coffee	Train / Bus	Grand-mother / Boy	Knee / Elbow
Abstract items	Winter / Summer	Vision / Smell	Anger / Joy	Sweet / Salty	July / August	Beauty / Kindness	Meter / Kilo-gram	Sunday / Saturday	Storm / Wind	Singing / Drawing

Subjects were tested individually. The following instructions were given: "I will say two words to you and ask you how they are alike. For example, if I ask you, "How are red and blue alike?" you might say, "They are both colours. Now we are going to start".

If for the first item, "How are an apple and a banana alike?" the subject answers something different from "They are both fruits," such as "We eat them," the experimenter would reply, "That's true, we eat them both but they are also both fruits." This clue was given only once. The experimenter made sure that the subject understood that the superordinate category was required.

The order of words in each list as well as the order of lists (concrete vs. abstract) was the same for all subjects.

The dependent variable is the number of taxonomic responses on each list (one point per correct response).

RESULTS

First of all, for older subjects, the correlation between educational level and Vocabulary Test scores is high (r=. 77). In contrast, the correlations between educational level and scores for taxonomic categorization of concrete words is low (r= 0.17) and moderate for abstract words (r=0.37). These correlations support the

argument that the Vocabulary subtest is tightly bound to crystallized intelligence, whereas the Similarities subtest is not only bound to crystallized intelligence.

AGE AND LIST EFFECTS.

The Age effect was statistically significant, younger subjects obtained a higher mean taxonomic score than the older subjects, (F [1; 38] = 11.19, p=.002). The List effect was statistically significant, concrete words were better categorized than abstract words (F [1; 38] = 15.74, p=.001). More important, the Age x List interaction was also statistically significant, (F[1;38]= 6.30, p=.02): Young adults categorize concrete and abstract words near ceiling levels (t[19]= 1.09, NS), whereas old adults, who do less well in general, clearly have more difficulties with abstract words than with concrete words (t[19] = 4.36, p<.001) (Table 3).

Table 3. Number of correct taxonomic responses, mean (*s.d.*), obtained for concrete and abstract words by younger and older adults

	Taxonomic categories	
	Concrete words	Abstract words
Younger (n=20)	9.10 *(0.70)*	8.65 *(1.80)*
Older (n=20)	8.25 *(1.48)*	6.25 *(2.59)*
CE	0.51	0.74

The range of ages in the older group goes from 62 to 79. So, the correlation between taxonomic score and age is relevant. Concerning concrete words, the correlation is low (r=-.28 ; t [18]=1.22, NS) ; concerning abstract words, the correlation is more important (r=-.48 ; t [18]=2.30, p=.03) (cf. Figure. 2). This negative correlation confirms the decline of taxonomic categorization with aging.

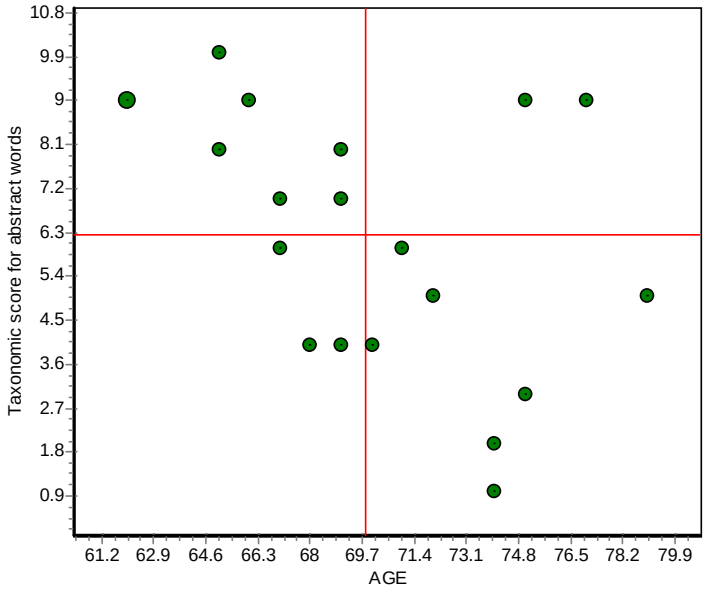

Figure 2. Correlation between age and taxonomic score of abstract words among the older

DIFFERENTIAL EFFECT OF ITEMS

The mean taxonomic scores of our older subjects is roughly equivalent to the means of 72, 9- year-old children on the same test (Rozencwajg & Corroyer, 2007); for concrete words- 8.2 vs. 7.6, respectively

(t[90]=1.45, p=.15, CE=.21), and for abstract words- 6.2 vs. 4.8, respectively (t[90]=2.75, p<.05, CE=.41)[3]. This comparison confirms the curvilinear function observed by many authors (Cicirelli, 1976; Denney & Lennon, 1972; Kogan, 1974; Smiley & Brown, 1979).

However, Table 4 shows that correct responses and errors in taxonomic categorisation by our older subjects and the 9-year-olds was not the same. Older subjects had a higher success rate for the items which children found more difficult, like the similarity between 'a kilogram and a meter' (measure units), 'a knee and an elbow' (joints), 'vision and smell' (senses), 'anger and joy' (feelings) and 'drawing and music' (arts). In contrast to children, older subjects did not do as well in seemingly easy items like the similarity between 'a grandmother and a boy' (persons), 'August and July' (months) and 'Sunday and Saturday' (days). These simpler items tend to confuse older subjects. If so, this result implies that crystallised intelligence as measured by the ability of finding logical, abstract, taxonomic categories, is well preserved for sophisticated categories but fails for over-significant categories: “the grand-mother looks after the boy”, or “it is summer time and heat” or “It’s week end”. Furthermore, some emotionally charged answers are given only by elderly, e.g., (Anger – Joy) “that’s life”, (Beauty – Kindness) “both are wonderful” or (Singing – Drawing) “passions”.

Table 4. Mean correct percent taxonomic scores for 9-year-olds (Rozencwajg & Corroyer, 2007) earlier) and our aged subjects, as a function of items.

		Elderly	Children
Concrete items	Animals	95%	86%
	Flowers	100%	96%
	Sports	100%	74%
	Trees	95%	90%
	Tools	85%	86%
	Clothes	95%	93%
	Liquids	70%	76%
	Transports	80%	65%
	Persons	40%	85%
	Joints	60%	10%
Abstract items	Seasons	100%	89%
	Senses	75%	38%
	Sentiments	60%	31%
	Tastes	70%	46%
	Months	50%	89%
	Qualities	20%	19%
	Measures	70%	28%
	Days	60%	82%
	Times	65%	51%
	Artistic Activities	45%	10%

[3] We know that a significant test (t or F) only means that there is a difference in the population but it doesn’t say anything about the size of the difference. We also know that the higher the number of subjects in a sample is, the easier the test becomes significant (Rouanet, 1996). The value of the calibrated effect suggests that the effect is, in fact, relatively small.

DISCUSSION

This experiment studied taxonomic processing of concrete and abstract items by young and elderly adults, as measured by an adapted version of the Wechsler Similarities subtest. Our selection of items, procedures, instructions and the use of verbal materials insured that the task measured the subjects' ability to identify the taxonomic category of the items. We found that older subjects made more taxonomic categorization errors than young adults, especially with abstract words, which indicates that this ability declines first for abstract words as a consequence of age. The concreteness effect usually observed in decision lexical tasks and memory tasks (Paivio, 1971; Schwanenflugel et al. 1983) is confirmed to be also observed in our categorization task. The hypothesis, according to which abstract words are later categorized with children will be the first visible in aging, is confirmed.

In addition, the performance of our older subjects is consistent with curvilinear function reported by many authors (Cicirelli, 1976; Denney & Lennon, 1972; Kogan, 1974; Smiley & Brown, 1979). That is, our older subjects' performance with concrete and abstract words was comparable to the performance of 9-year-olds tested with concrete and abstract words (Rozencwajg & Corroyer, 2007) on the same test. However, the items on which these children and our older adults succeeded or failed were different. Our elderly subjects succeeded on more sophisticated items that were difficult for children, but had more difficulty than children on seemingly easy, but emotionally charged items. Older adults are more likely ensnared by these easy and very familiar items. That is, the taxonomic ability itself is preserved in the aged, as is crystallized intelligence, but the emotional context seems to distract elderly people more than young adults or 9 year-old children. This differential effect of items is consistent with the works of Lin & Murphy (2001) and Pennequin et al. (2006) that show that the reports of age-related decline of taxonomic processes may be due to methodological factors and the idea that young as well as old adults choose a category as a function of saliency of the relation words.

It remains unclear why some elderly people age faster than others, considering that educational level does not seem to reliably slow down the aging process. In order to explain individual differences in performance of the elderly, one might hypothesize that executive functions, sensitive to aging, might be necessary to activate taxonomic categories in the face of the entrapping nature of thematic relations between words (Pennequin, Lauverjat & Fontaine, 2004). Somehow, crystallized intelligence, resulting in semantic knowledge of categories in long term memory, is not sufficient. Executive functions are needed to activate this knowledge at the right moment. This could explain paradoxical evolution with aging presented in Figure 1 in which Similarities remain less stable than Vocabulary with aging.

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