

Selection of High-Imagery Words for the Study of Episodic Memory
from Middle Childhood to Old Age

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Abstract

The goal of the present study was to select a set of highly imaginable and concrete words that can be used in age-comparable memory research. The selection process included two steps. First, 10 children aged 7-9 years rated 400 high-imagery, concrete, and meaningful words selected from an existing corpus of 1082 spoken words (Singer et al., 2003) on a three-point scale of comprehensibility. Second, two independent raters further selected words to reduce the likelihood of lexical error during recall. As a result, 413 words were retained as stimulus materials for age-comparative investigations of episodic memory performance.

Introduction

Intellectual development across the lifespan is characterized by gains and losses. Different functions have been found to sharply increase during childhood and decrease monotonically during adulthood, with accelerated decline in old age (Baltes & Lindenberger, 1997; Lindenberger & Baltes, 1997, Li, Lindenberger, Hommel, Aschersleben, Prinz, & Baltes, 2004). One problem of cognitive developmental research is that age differences in performance can be related not only to age differences in specific age-based functions but also to age gradients in pre-experimental task-relevant knowledge or cohort effects. Therefore, whenever the focus of interest is on specific aspects of cognitive performance such as episodic memory, the materials employed must be equivalent across age groups (at some level of analysis at least).

The motivation for the present study was to identify words that are suitable for examining age differences in learning and plasticity in episodic memory from middle childhood into old age. The planned studies used instruction and training in a mnemonic technique (method of loci) that required the generation of interactive images connecting location cues with to-be-learned words by pair-wise associations. To enhance comparability of results across age groups, the location cues and the to-be-learned words had to be comprehensible for both children and adults. Given that children have a smaller vocabulary than adults, the goal of this study was to select words from a larger pool that attain high comprehensibility ratings on children. Note that no attempt was made to check whether children actually knew the “correct” meaning of the word. Instead, we examined whether children claimed to know the meaning of the given word.

Original Word Pool

A pool of 1082 nouns served as the basis for selection. The pool emanated from work at the Max Planck Institute for Human Development in Berlin and has been applied in various studies on adult age differences in episodic memory performance (e.g. Baltes & Kliegl, 1992; Kliegl et al., 1989, 1990; Singer et al. 2003). In this earlier work, nouns were selected from a German dictionary, and retained in the pool if they obtained ratings of 6 or 7 on the seven-point concreteness and imagery scales introduced by Paivio and his colleagues (Paivio et al. 1968, Baschek et al. 1977). The 1082 words were spoken by a professional male speaker and audiotaped (see Singer et al., 2003).

Participants

Eleven children aged 7-9 years were recruited from different elementary schools neighboring Saarland University. One child was excluded from data analysis because of apparent lack of motivation. The final sample consisted of five girls and five boys with a mean age of 8.5 years ($SD = 0.39$).

Procedure

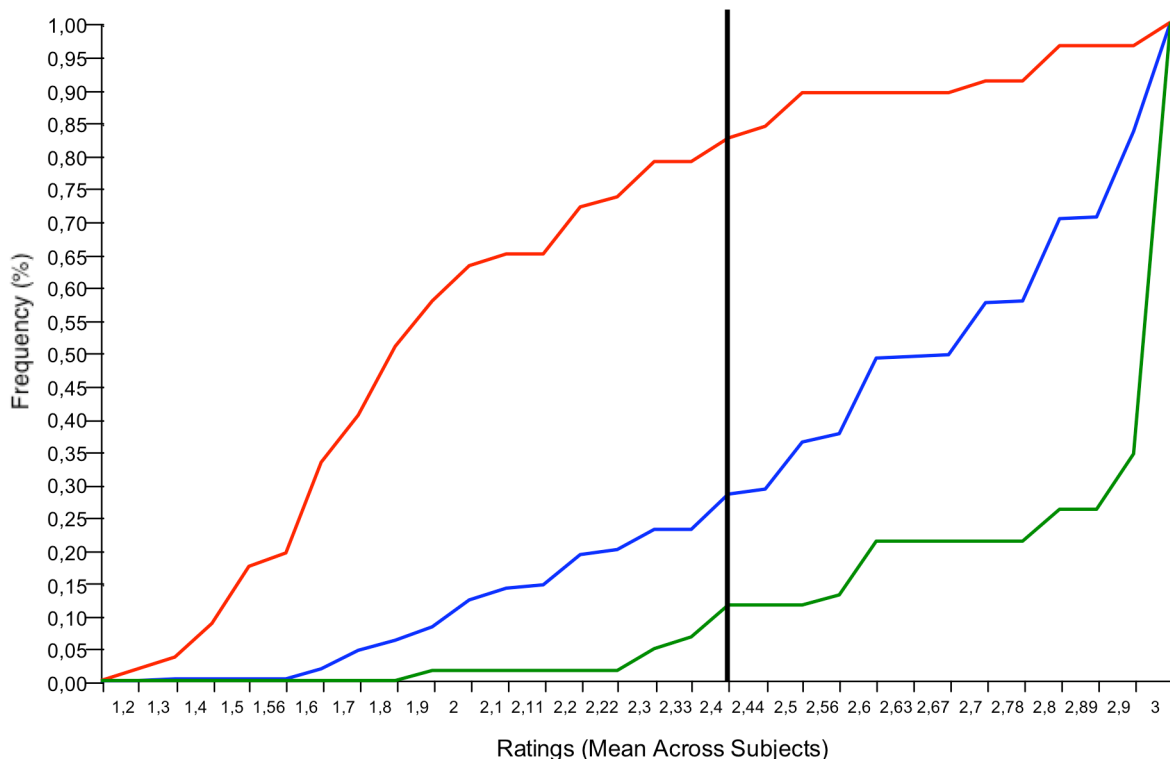
Prior to the experiment, two independent raters divided the initial database (1082 words) into three categories: (a) words that children should know for sure (easy words); (b) words that children may or may not know (intermediate difficulty words); (c) words that children should not know the meaning of. This resulted in 240, 282 and 560 words in category a, b and c respectively. To examine which of the words in the intermediate category were actually known to children and to validate our initial categorization, all 282 words from the intermediate category were mixed with 61 randomly selected words of the easy and 57 randomly selected words of the difficult category. The selected 400 words (61 easy, 282 intermediate, 57 difficult) were sequentially presented to the children through loudspeakers. Children were set in front of the loudspeaker and were asked to rate if they (a) “know the exact meaning of the word”, (b) “do not know the exact meaning of the word but have a vague idea about what the word may mean” and (c) “do not know the meaning of the word” (see Appendix A for precise wording of instructions in German). Children marked their answers to each word in a booklet (see Appendix A). To check whether children were actually following the instructions, they were asked for explanations of individual words on three occasions (i.e., word 150, 300, and 400). Children were tested in small groups of 2-4 participants.

Results

For each word, ratings were averaged across subjects. The range of the rating scale was between 1 and 3 (i.e., 1 denotes no idea about the meaning of the word, 2 denotes sort of knowing the word, 3 denotes knowing the exact meaning of the word). The response distribution to the 61 words in the easy category served as a reference point. The exclusion limit was 10% of the lowest rating within this easy word category. Specifically, all words with a rating score below 2.4 were excluded. This corresponds to discarding 4 out of the 61 words of the easy category, 65 out of the 282 words from the intermediate category, and 45 out of the 57 words from the difficult category. Thus, 286 of the original set of 400 words were selected for further consideration. Adding the 499 easy words not included in the experiment to this set, 785 words were retained.

Figure 1.

Frequency Distribution of Comprehension Ratings as a Function of Word Category (Easy, Medium, Difficult)



Note. Green, blue, and red lines refer to easy (N = 61), intermediate-difficulty (N = 282), and difficult (N = 57) words respectively. The black line marks the 10% rating limit in the easy word category.

Subsequent Selection Based on Within-Category Ratings

To reduce the likelihood of lexical recall errors that originate from ambiguous image-word mappings, two trained raters arranged the remaining 785 words according to categories (e.g. fruits, clothes, furniture...). After that, they checked whether two or more words of a given category may evoke the same visual image. If such instances were observed, only one of the words was retained in the pool (e.g., king was retained, emperor deleted; orange was retained, and tangerine deleted). Selection favored words located at the basic level of a given category (e.g., Rosch, 1975). For instance, dog (basic level) was retained, whereas pet (high level) and poodle (low level) were deleted. This selection process resulted in a final pool of 413 words. The 413 German words and their English translations are listed in Appendix B.

Appendix A

Child instruction in the word-comprehension rating

Ich möchte Euch jetzt erklären, worum es bei unserer Untersuchung geht und was Eure Aufgabe sein wird.

Wie Ihr wisst, gibt es Wörter, die Ihr gut kennt, während Ihr andere nicht so gut kennt. Hört Ihr etwa das Wort „Banane“, so wisst Ihr genau, worum es sich handelt: eine gelbe Frucht, die man essen kann.

Es gibt aber auch Wörter, die nur von Erwachsenen benutzt werden und die Ihr deswegen nicht so gut kennt. Zum Beispiel das Wort „Advokat“.

Wir Erwachsenen wissen häufig nicht so genau, ob Ihr ein Wort kennt oder nicht. Ihr selbst wisst das natürlich am besten. Deswegen haben wir Euch als Experten eingeladen.

Ihr werdet jetzt gleich über diese Lautsprecher von einer männlichen Stimme Wörter vorgelesen bekommen. (Beispiel)

Von jedem Wort möchten wir gerne erfahren, wie genau Ihr wisst, was es bedeutet. Damit Euch die Antworten leichter fallen, müsst Ihr nicht jedes Mal erklären, was Ihr Euch unter dem Wort vorstellt. Stattdessen bitten wir Euch, Eure Antworten auf den Euch vorliegenden Bögen zu notieren. (Bögen)

Wie Ihr seht, gibt es auf jeder Seite zehn Reihen. In jeder Reihe befindet sich auf der linken Seite ein trauriges Gesicht, auf der rechten Seite ein frohes Gesicht. In der Mitte ist jeweils ein Gesicht zu sehen, das nicht genau weiß, wie es ihm geht. Unter jedem Gesicht befindet sich ein Kästchen.

Wenn Ihr nun gleich das erste Wort hört, sollt Ihr in der ersten Reihe ein Kästchen ankreuzen: Wisst Ihr genau, was das Wort bedeutet, so macht das Kreuz unter dem frohen Gesicht. Wisst Ihr nicht genau, was das Wort bedeutet, so markiert das Kästchen unter dem mittleren Gesicht. Und wenn Ihr überhaupt nicht wisst, was das Wort bedeutet, so kreuzt bitte das Kästchen unter dem traurigen Gesicht an. (3 Beispiele)

Ihr werdet gleich viele Wörter mit kurzen Pausen nacheinander hören. Macht bitte zügig nach jedem Wort das Kreuz, um uns zu sagen, ob Ihr das Wort kennt. Jedes Wort kriegt seine eigene Reihe. Nach dem 10. Wort wartet Ihr bitte, bis ich Euch Bescheid sage. Wenn die Seite voll ist, blättern wir alle auf mein Kommando gemeinsam um.

Es ist wichtig, dass jeder für sich alleine arbeitet. Es geht nicht darum möglichst viele Wörter gut zu kennen. Es kann gut sein, dass Ihr manche Wörter überhaupt nicht kennt.

Habt Ihr noch Fragen?

High-Imagery Word Selection

Table 1. One side of the text book in the word-comprehension rating.

	Ich weiß überhaupt nicht , was das Wort bedeutet:	Ich weiß nicht genau , was das Wort bedeutet:	Ich weiß genau , was das Wort bedeutet
1	☹ <input type="checkbox"/>	☺ <input type="checkbox"/>	☺ <input type="checkbox"/>
2	☹ <input type="checkbox"/>	☺ <input type="checkbox"/>	☺ <input type="checkbox"/>
3	☹ <input type="checkbox"/>	☺ <input type="checkbox"/>	☺ <input type="checkbox"/>
4	☹ <input type="checkbox"/>	☺ <input type="checkbox"/>	☺ <input type="checkbox"/>
5	☹ <input type="checkbox"/>	☺ <input type="checkbox"/>	☺ <input type="checkbox"/>
6	☹ <input type="checkbox"/>	☺ <input type="checkbox"/>	☺ <input type="checkbox"/>
7	☹ <input type="checkbox"/>	☺ <input type="checkbox"/>	☺ <input type="checkbox"/>
8	☹ <input type="checkbox"/>	☺ <input type="checkbox"/>	☺ <input type="checkbox"/>
9	☹ <input type="checkbox"/>	☺ <input type="checkbox"/>	☺ <input type="checkbox"/>
10	☹ <input type="checkbox"/>	☺ <input type="checkbox"/>	☺ <input type="checkbox"/>
			STOP

Appendix B

1. Final List of Words (in German)

Affe	Computer	Geld	Kamm	Lehm
Akkordeon	Confetti	Gerüst	Känguru	Lehne
Akrobat	Cowboy	Gesicht	Kanu	Lehrer
Altar	Daumen	Geweih	Kapsel	Leiche
Ameise	Denkmal	Girlande	Karotte	Leiter
Ananas	Diamant	Gitarre	Karren	Libelle
Anker	Dichter	Gitter	Karte	Limonade
Antenne	Dose	Glas	Käse	Lineal
Apfel	Efeu	Gleis	Kassette	Löffel
Arzt	Eisbeutel	Globus	Kaspar	Löwenzahn
Asche	Eisenbahn	Glocke	Kastanie	Luftpumpe
Atlas	Elefant	Gondel	Katze	Lunge
Auge	Elfe	Gras	Keks	Lupe
Auto	Eltern	Grill	Kellner	Mädchen
Baby	Engel	Grille	Kerker	Magnet
Ballon	Erde	Gummi	Kirsche	Maler
Bambus	Eule	Gurke	Kissen	Malkasten
Bauch	Euter	Gürtel	Klammer	Mann
Bauer	Fackel	Haar	Klavier	Mantel
Becken	Fahne	Hagel	Klee	Mappe
Beil	Falter	Hahn	Kleid	Marzipan
Benzin	Faust	Haken	Kleister	Marmelade
Besen	Feder	Hals	Knochen	Matratze
Bett	Feile	Handschuh	Knopf	Maurer
Bettler	Fels	Hase	Koffer	Mehl
Biber	Fenster	Häuptling	Kokosnuss	Messer
Bikini	Fernrohr	Heft	Kommissar	Metzger
Bleistift	Fernseher	Hemd	Kompass	Mikado
Blinder	Feuerzeug	Henker	König	Mikrophon
Blut	Film	Herd	Kontrabass	Mikroskop
Bohne	Fisch	Herz	Korb	Mixer
Bombe	Fischer	Hexe	Kotelett	Motor
Bonbon	Flasche	Himbeere	Kran	Mücke
Boxer	Floh	Hose	Kranz	Mumie
Braten	Flöte	Hufeisen	Krawatte	Musiker
Bräutigam	Flügel	Hummel	Krebs	Mütze
Brei	Flugzeug	Hund	Kreide	Nachthemd
Brennholz	Foto	Igel	Kreisel	Nackedei
Brett	Frau	Iglu	Krokodil	Nadel
Brief	Frosch	Jäger	Krone	Nagel
Brille	Fuchs	Junge	Krümel	Nase
Brot	Fußball	Kabel	Kuchen	Nest
Buch	Futter	Kaffee	Kugel	Netz
Bügel	Gabel	Kakao	Kutsche	Nikolaus
Busch	Gardine	Kaktus	Lampe	Omnibus
Butter	Gärtner	Kalender	Laub	Orange
Chinese	Geier	Kamel	Leder	Paket

1. Final List of Words (in German) continued

Palme	Puppe	Scherben	Spritze	Trichter
Pantoffel	Puzzle	Schere	Spüle	Trommel
Panzer	Qualle	Schilf	Staub	Trompete
Papagei	Quelle	Schild	Steckdose	Truhe
Papier	Rahmen	Schirm	Stern	Tube
Paprika	Räuber	Schlange	Stock	Vase
Papst	Rauch	Schleier	Stoff	Ventil
Pedal	Reifen	Schleim	Storch	Waffel
Peitsche	Reis	Schleuder	Strauß	Wanne
Perle	Richter	Schlitten	Strick	Watte
Pfanne	Riegel	Schnabel	Stroh	Wecker
Pfarrer	Riese	Schnecke	Strumpf	Wein
Pfeffer	Ring	Schneider	Student	Weizen
Pfeil	Ritter	Schrank	Stuhl	Windel
Pferd	Robbe	Schuh	Suppe	Wippe
Pfote	Roller	Schürze	Tablett	Wolf
Pille	Rollstuhl	Schlüssel	Tafel	Wurm
Pilot	Rose	Schwamm	Tanne	Wurzel
Pilz	Rucksack	Schwanz	Tapete	Zahn
Pinguin	Ruder	Schweif	Tarzan	Zauberer
Pinsel	Rüstung	Schwein	Taste	Zebra
Pinzette	Saft	Schwimmer	Taube	Zehe
Pirat	Säge	Seepferd	Taxi	Zeitung
Pistole	Sahne	Seife	Teddy	Zelt
Plakat	Salami	Senf	Telefon	Zepter
Plane	Salat	Serviette	Teller	Zeugnis
Pokal	Salz	Sieb	Teufel	Zimt
Praline	Sarg	Sofa	Tiger	Zirkel
Präsident	Satellit	Spargel	Tinte	Zitrone
Priester	Saurier	Spaghetti	Tisch	Zunge
Prinz	Schach	Spange	Tomate	Zwerg
Professor	Schaf	Speck	Tonne	Zwiebel
Pudding	Schal	Speer	Topf	Zylinder
Pullover	Schale	Spiegel	Trage	
Puma	Schaufel	Spinat	Traktor	
Pumpe	Schaum	Spinne	Tresor	

2. Final List of Words (translated into English)

The words in bold are ones where the translation from German is ambiguous.

Accordeon	Booklet	Clover	Earth	Head
Acrobat	Bottle	Coach	Elephant	Heart
Aerial	Bowl	Coat	Elf	Hedgehog
Airplane	Boxer	Coat hanger	Engine	Hook
Alarm clock	Boy	Cockerel	Executioner	Horse
Altar	Bread	Cocoa	Eye	Horseshoe
Anchor	Bricklayer	Coconut	Eyeglasses	Hunter
Angel	Bridegroom	Coffee	Face	Ice pack
Ant	Broom	Comb	Farmer	Igloo
antler	Brush	Compass	Feather	Ink
Apple	Bumblebee	Compasses	File	Ivy
Apron	Bus	Computer	Film	Jackstraws
Armor	Bush	Confetti	Fir tree	Jam
Arrow	Butcher	Canker	Firewood	Jellyfish
Ash	Butter	Cooker	Fish	Jigsaw
Asparagus	Butterfly	Cookie	Fisherman	puzzle
Atlas	Button/key	Cord	Fist	Juice
Ax	Cable	Corpse	Flag	Kangaroo
Baby	Cactus	Cotton	Flea	Key
(Chair)	Cake	batting	Flour	King
back	Calendar	Cowboy	Flute	Knife
Bacon	Camel	Crab	Foam	Knight
Balloon	Can	Crane	Folder	Ladder
Bamboo	Candy	Cream	Food	Lamp
(Lock) bar	Canoe	Cricketer	Football	Leather
Barbecue	Capsule	Crocodile	Fork	Leaves
Barrel	Car	Crown	Fox	Lemon
Barrow	Carrot	Crumb	Frame	Lemonade
Basin	Cart	Cucumber	Frog	Letter
Basket	Casket	Curtain	Frying pan	Lighter
Beak	Cassette	Cushion	Funnel	Lung
Bean	Cat	Custard	Gardner	Magician
Beaver	Certificate	Cylinder	Garland	Magistrate
Bed	Chair	Dandelion	Gas	Magnet
Beggar	Chalk	Devil	Giant	Magnifying
Bell	Cheese	Diamond	Girl	glass
Belt	Cherry	Diaper	Glass	Man
Bicycle	Chess	Doctor	Globe	Map
pump	Chest	Dog	Glove	Marzipan
Bikini	Chief	Doll	Goblet	Mash
Blackboard	Chinese	Double bass	Gondola	Material
Blender	Chocolate	Dove	Grass	Mattress
Blind person	candy	Dragonfly	Grid	Memorial
Blood	Chop	Dress	Guitar	Microphone
Board	Cinnamon	Drum	Hail	Microscope
Bomb	Clay	Dungeon	Hair	Minister
Bone	Clip	Dust	Hare/rabbit	Mirror
Book	Closet	Dwarf	Hat	Money

2. Final List of Words (translated into English) continued

The words in bold are ones where the translation from German is ambiguous.

Monkey	Pepper	Ruler	Spaghetti	Tire
Mosquito	Pepperoni	Safe	Spear	Toe
Mucus	Photo	Salad	Sphere	Tomato
Mummy	Piano	Salt	Spider	Tongue
Mushroom	Pig	Santa Claus	Spinach	Tooth
Musician	Pill	Satellite	Spinning top	Torch
Mustard	Pilot	Saurian	Sponge	Tractor
Nail	Pineapple	Saw	Spoon	Trail
Naked	Pirate	Scaffolding	Star	Train
Napkin	Pistol	Scarf	Stick	Tray
Neck	Plate	Scepter	Stomach	Trousers
Needle	Poet	Scissors	Stork	Trumpet
Nest	Pope	Scoop	Straw	Tub
Net	Poster	Scooter	Student	Tube
Newspaper	Pot	Seahorse	Suitcase	Tweezers
Nightgown	Power	Seal	Superintend	Udder
Nose	socket	Seesaw	ent	Umbrella
Oar	President	Shards	Sweater	Valve
Onion	Priest	Sheep	Swimmer	Vase
Orange	Prince	Shirt	Table	Veil
Ostrich	Professor	Shoe	Tail	Vulture
Owl	Puma	Shot	Tailor	Waffle
Paint-box	Pump	Sieve	Tank	Waiter
Painter	Punch and	Signpost	Tarpaulin	Wallpaper
Palm tree	Judy	Sink	Tarzan	Wheat
Paper	Rail	Sled	Taxi	Wheelchair
Parcel	Raspberry	Slingshot	Teacher	Whip
Parents	Reed	Slipper	Teddy	Window
Parrot	Rice	Smoke	Telephone	Wine
Paste	Ring	Snail	Telescope	Wing
Paw	Roast	Snake	Television	Witch
Pearl	Rock	Soap	Tent	Wolf
Pedal	Root	Sock	Thief	Woman
Peg	Rose	Sofa	Thumb	Worm
Pencil	Rubber	Soup	Tie	Wreath
Penguin	Rucksack	Source	Tiger	Zebra
Pepper				

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