A CONTRIBUTION TO THE EXPERIMENTAL STUDY OF ANALOGY

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INTRODUCTION

The researches of Thumb and Marbe[1] on the psychological basis of analogy[2] in language were an attempt to determine what characteristics a word-association must possess in order to become linguistically effective. Their investigation established the following characteristics:

1. The effectiveness of an association in producing analogical changes increases with its *frequency*, *i. e.*, with the number of members of a speech-community in whom it is present. This may be represented algebraically by $E = F/n$ when E represents the effectiveness in producing analogical changes, F the frequency or number of occurrences of the association and n the number of persons under investigation.

2. The effectiveness of an association increases with a decrease in the average *time* required for the association to take place. This may be represented algebraically by $E = 1/(T + 1)$ when T represents the average association-time; with a decrease in the association-time the value of E approaches 1.[3]

Strictly speaking the results of Thumb and Marbe's in-

[1] A. Thumb und K. Marbe, 'Experimentelle Untersuchungen über die psychologischen Grundlagen der sprachlichen Analogiebildung,' Leipzig, Engelmann, 1901.

[2] By 'analogy' and 'analogical changes' we mean those changes in the form or meaning of words or groups of words which are brought about through association with other words or groups of words.

[3] In a further investigation, published in *Indogermanische Forschungen*, 22, 1–55, Thumb established an additional characteristic for linguistically effective associations, namely their 'spontaneous' nature. In this type of association the associated word follows immediately after the stimulus-word without any intervening mental process. In my experiments the association-types were not investigated, for reasons set forth below.

vestigation are applicable only to the German Language; or still more strictly only to the dialect of his observers.

The Problem.—Briefly stated my problem was (1) to make a beginning in the establishing of the associational basis of the English language and (2) to make a comparative study of the English and German results.

EXPERIMENTAL INVESTIGATION

In the first experiments of Thumb and Marbe, a list of 60 words was chosen from different categories as follows: 10 names expressive of family relations, *e. g.*, father, mother, etc., 10 adjectives, 10 numerals from 1 to 10, 10 pronouns, 10 adverbs of place, 10 adverbs of time. All sixty of these words were presented to each observer at one sitting. They were arranged in such an order than in no case would a word immediately follow another of the same category; miscellaneous words not belonging to the list selected for the experiment were frequently interposed. The observers were eight in number, all students, teachers, or doctors of philosophy. In a later experiment 80 verbs (infinitives) were used as stimulus words. Eight observers were again used, three of whom (students) had not served in the first experiment. A stop-watch was used to measure the reaction-time in the first experiment and a Hipp chronoscope and voice key in the later investigation. The results of the two investigations do not differ materially from each other. In very few cases do the favored associations of the one investigation differ from those of the other.

In my experiments, conducted in the psychological laboratory of the Ohio State University in the spring and summer of 1917, 126 observers were used. These fall into three groups. The members of Group A (100 students) are classified in the following table according to their standing as represented in the table. The four vertical columns, numbered 1, 2, 3, 4, refer to the four undergraduate classes; the remaining columns, designated by Roman numerals, refer to the following classes: I, graduate students; II, professors; III, a group of high school teachers who attended the Uni-

versity Summer School of 1917; IV, a group of elementary school teachers who attended the same summer school.

	1	2	3	4	I	II	III	IV	Total
Men..........	14	3	5	3	5	2	21	2	55
Women......	6	10	6	3	3		9	8	45

Group B consisted of 11 children, aged 9 to 13 years. Group C consisted of 15 university janitors. By means of Group A, I desired to test out the results of Thumb and Marbe with a large group of observers, as compared with the very small group used by the German investigators. This large group was supplemented by the other two groups in order that the results gained from educated adults might be compared with those from uneducated adults and children.

The stimulus-words used were made to correspond as nearly as possible to those used by Thumb and Marbe in their earlier experiments. They fall into six categories, as follows: 10 names of personal relations, 10 adjectives, 10 numerals (1 to 10), 10 verbs (present participles), 10 pronouns, 10 adverbs of time and place. The participles of verbs were used to prevent verbs such as *walk*, used in the infinitive, from being understood as nouns. Only one- and two-syllable words were used, to avoid the possibility of the reaction time being increased by the length of the stimulus-word. Hence no translation of German *Schwager*, etc., was used. A preliminary experiment had been undertaken to discover whether there were any marked difference in length between the reaction-times when one-syllable stimulus words were used and when two-syllable words were used. The results showed the time for the two-syllable words practically the same as for the one-syllable words; the difference may therefore be regarded as negligible for our purposes.

The method employed was as follows: a Hipp chronoscope was set up in a room adjoining that in which the observer and experimenter sat. This was to prevent the sound of the chronoscope from disturbing the observer. The experimenter controlled the chronoscope by means of a key

which was connected by wiring with the instrument. The chronoscope readings were taken by an assistant.[1]

The following instructions were read to each observer:

Please keep your eyes closed during the experiment. I will read you a list of words. To each word respond as quickly as possible with another word. The first five words will be for practice.

I then gave the following words: *house, jumping, fast, red, who.* The words chosen for the experiment then followed. These were arranged in ten different haphazard orders, so that in each ten observers no one was given the stimulus-words in the same order. As the experimenter began the articulation of each word, he pressed the key which started the chronoscope; when the observer began to respond the experimenter released the key, thus stopping the chronoscope. (The experimenter did not look at the observer during the experiment, but released the key upon receiving the auditory stimulus of the observer's response.)

No attempt was made to classify the associations according to the occurrence or non-occurrence of mental processes intervening between the stimulus and reaction words, because this would have required introspection on the part of the observers, whereas it was my desire to make the conditions of the experiment as simple as possible, thus approaching more nearly the conditions in everyday speech. Moreover, as Thumb himself notes,[2] the 'spontaneous' character of an association may be inferred from the rapidity with which it occurs; the associations having the shortest reaction-times are the 'spontaneous' ones.

In the following tables, the results for Group A are presented. The figures in parentheses, placed after the stimulus-words, indicate the total number of successful reactions. The columns under *n, A* and *M* give the number of occurrences, the average reaction-time and the median[3] of the re-

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[1] Miss Ethel M. Cooke, a student in the university, to whom I am greatly indebted for her careful and patient work.

[2] *Indogerman. Forsch.,* 22, 18, 24.

[3] The median is to be regarded as more significant than the average because it is not affected by the extremely long or short reaction-times. We are concerned, not so much with the *average* times as with the *most frequent* times.

TABLE I

Stimulus	Most Frequent Reaction				Next Most Frequent Reaction				All Remaining Reactions		
		n	A	M		n	A	M	n	A	M
1. *father ......(95)	*mother......	69	1.265	1.160	son..........	4	1.266	1.248	22	2.229	1.904
2. *mother......(96)	*father........	55	1.310	1.219	sister..........	7	1.300	1.289	34	2.321	1.976
3. *son[1] ....(44)	daughter......	27	1.443	1.223	father..........	7	2.129	2.124	10	2.155	2.044
4. *daughter.....(94)	son..........	35	1.603	1.347	sister	15	1.404	1.212	44	2.181	1.765
5. *brother......(94)	*sister.......	72	1.165	1.060	relative[2]	3	2.087	1.437	19	2.479	2.313
6. *sister........(98)	*brother......	72	1.208	1.146	girl..........	4	2.364	2.214	22	1.989	1.908
7. cousin......(97)	uncle........	20	1.623	1.314	aunt..........	19	2.308	1.843	58	2.038	1.960
8. aunt ....(89)	uncle........	67	1.327	1.290	Mary..........	4	2.038	1.700	18	2.060	1.894
9. uncle........(99)	aunt........	66	1.335	1.228	relative[3].......	4	1.648	1.596	29	2.021	1.870
10. nephew......(96)	niece........	58	1.600	1.472	cousin........	10	1.680	1.698	27	2.330	1.931
1. Vater.........(8)	Mutter......	5	1.24		——	–	—		3	2.13	
2. Mutter..........	Vater......	3	1.67		meine M.......	2	3.00		3	1.93	
3. Sohn............	Vater..... ...	5	1.36		Tochter.......	2	2.10		1	3.80	
4. Tochter.........	Mutter	4	1.50		——	–	—		4	1.70	
5. Bruder..........	Schwester.....	6	1.33		——	–	—		2	4.30	
6. Schwester........	Bruder......	4	1.90		——	–	—		4	1.60	
7. Vetter.........:..	Base........	3	1.40		Schwester......	2	1.60		3	2.67	
8. Base.............	Vetter........	5	1.88		——	–	—		3	3.27	
9. Schwager........	Bruder.......	2	1.60		——	–	—		6	2.70	
10. Schwägerin......	——	–	—		——	–	—		8	2.25	

[1] The small number of successful reactions to the stimulus 'son' is due to the fact that many observers understood it as 'sun.'

[2] Including 1 case of 'relation.'

[3] Including 2 cases of 'relation.'

TABLE II

Stimulus	Most Frequent Reaction				Next Most Frequent Reaction				All Remaining Reactions		
		n	A	M		n	A	M	n	A	M
1. *big.........(93)	*little.........	52	1.150	1.079	small.......	18	1.208	1.132	23	1.922	1.599
2. *little........(93)	*big........	52	1.280	1.224	small.......	17	1.458	1.309	24	2.073	1.811
3. *light¹											
4. *heavy.......(96)	*light.........	73	1.356	1.272	load........	6	1.450	1.455	17	2.479	1.839
5. *old.........(93)	*young........	69	1.382	1.223	new........	7	1.105	1.124	17	2.200	2.201
6. *young ......(97)	*old.....	80	1.179	1.102	man.........	4	1.348	1.301	13	2.872	2.186
7. *thick...... (99)	*thin....	72	1.346	1.214	heavy......	4	1.538	1.589	23	2.620	2.030
8. *thin........(93)	*thick..	50	1.351	1.217	fat..........	17	1.499	1.427	26	2.089	1.688
9. *white ......(96)	*black.........	74	1.181	1.128	{ dark........ { light.........	3 3	1.216 1.632	1.078 } 1.772 }	16	1.969	1.694
10. *black........(98)	*white.........	79	1.173	1.097	color.......	3	2.314	1.693	16	2.059	2.054
1. gross.........(8)	klein........	7	1.29						1	2.40	
2. klein...	gross.........	6	1.37						2	2.00	
3. leicht............	schwer......	7	1.46						1	2.00	
4. schwer...........	leicht.......	6	1.23						2	1.90	
5. alt............	jung........	6	1.30						2	2.40	
6. jung..........	alt...........	7	1.17						1	2.20	
7. dick.............	dünn........	7	1.26						1	2.00	
8. dünn............	dick........	7	1.29						1	2.00	
9. weiss............	schwarz.....	7	1.63						1	1.60	
10. schwarz	weiss...	6	1.43						2	2.50	

¹ Out of a total of 97 observers who responded to the stimulus 'light,' only 4 understood it in the sense intended, *i.e.*, German 'leicht,' 'not heavy.' The results are as follows:

		Most Frequent Reaction	Av. Time	Av. Time of Other Reactions
1. Understood as 'not heavy'	(4)	heavy (4)	1.299	——
2. Understood as 'not dark'	(58)	dark (54)	1.281	1.802
3. Understood as a noun	(35)	darkness (6)	1.251	2.038

TABLE III

Stimulus	Most Frequent Reaction				Next Most Frequent Reaction				All Remaining Reactions		
		n	A	M		n	A	M	n	A	M
1. *one.........(97)	*two..........	78	1.160	1.102	——	-	—	—	19	2.316	2.030
2. *two.........(92)	*three........	56	1.250	1.127	four.........	13	1.440	1.377	23	1.783	1.546
3. *three.......(98)	*four.........	68	1.163	1.084	number.....	9	1.599	1.515	21	1.749	1.515
4. *four[1].......(83)	*five.........	53	1.168	1.096	three	5	1.486	1.385	15	2.116	2.021
					six	5	1.304	1.308			
					number	5	2.893	2.214			
5. *five[1].......(87)	*six..........	55	1.296	1.254	ten	8	1.577	1.398	24	1.817	1.653
6. *six.........(94)	*seven........	65	1.102	1.044	number	5	3.104	2.154	24	1.954	1.828
7. *seven.......(99)	*eight........	68	1.220	1.114	number	6	1.580	1.410	25	2.122	1.747
8. *eight.......(91)	*nine.........	66	1.183	1.090	ten	5	1.023	1.179	20	1.814	1.626
9. *nine........(97)	*ten..........	73	1.352	1.186	number	5	1.831	1.544	19	2.198	2.157
10. *ten.........(97)	eleven.......	51	1.219	1.131	twenty	8	1.599	1.562	38	1.946	1.549
1. eins.........(8)	zwei..........	5	1.20		——	-	—		3	2.13	
2. zwei.............	drei..........	4	1.15		——	-	—		4	1.75	
3. drei..............	vier..........	5	1.32		——	-	—		3	2.00	
4. vier..............	fünf..........	6	1.13		——	-	—		2	2.20	
5. fünf.............	sechs........	6	1.17		——	-	—		2	6.70	
6. sechs............	sieben.......	5	1.16		——	-	—		3	2.00	
7. sieben...........	acht	6	1.33		——	-	—		2	2.20	
8. acht.............	neun........	6	1.43		——	-	—		2	6.00	
9. neun............	zehn........	5	1.52		——	-	—		3	1.87	
10. zehn.............	zwanzig......	3	1.60		elf	2	1.20		3	2.33	

[1] The relatively small number of successful reactions to the stimulus words 'four' and 'five' is due to many observers understanding these as 'for' and 'fife' respectively.

TABLE IV

Stimulus	Most Frequent Reaction				Next Most Frequent Reaction				All Remaining Reactions		
		n	A	M			n	A	M	n	A	M
1. *giving......(98)	*taking........	39	1.396	1.306	receiving....		7	1.473	1.489	45	2.052	1.727
					money........		7	1.925	1.861			
2. *taking......(93)	*giving	16	1.626	1.400	receiving.....		8	2.090	1.895	69	2.150	2.009
3. *eating......(94)	*drinking	42	1.446	1.332	food.........		11	1.933	1.724	41	2.056	1.642
4. *drinking.....(95)	eating........	30	1.863	1.815	water........		25	1.632	1.453	40	2.069	1.593
5. *losing[1]......(81)	finding......	29	1.459	1.422	gaining......		9	1.368	1.288	34	1.990	1.499
					lost.........		9	1.627	1.478			
6. *walking.....(97)	*running........	29	1.547	1.376	riding		17	1.486	1.464	51	1.826	1.665
7. *reading.....(96)	*writing......	55	1.298	1.200	book.		18	2.108	1.810	23	2.358	1.743
8. *writing......(97)	*reading.	43	1.729	1.674	letter(s).....		8	1.722	1.692	46	1.831	1.722
9. seeking[1].....(83)	finding.......	28	1.490	1.399	looking[2].....		8	1.712	1.634	47	2.013	1.838
10. *finding......(92)	losing........	20	1.915	1.699	lost........		10	1.566	1.574	62	2.174	1.883
1. geben........(8)	nehmen.......	4	1.75		——		–	——		4	2.30	
2. nehmen..........	geben........	6	1.33		——		–	——		2	1.80	
3 essen.............	trinken......	6	1.13		——		–	——		2	1.90	
4. trinken.........	winken......	2	1.40		——		–	——		6	1.37	
5. verlieren.........	Geld........	6	1.90		——		–	——		2	1.90	
6. gehen...	laufen........	2	1.30		——		–	——		6	1.93	
7. lesen	schreiben.....	5	1.16		Buch........		2	1.70		1	2.00	
8. schreiben	lesen.........	4	1.15		——		–	——		4	3.50	
9. ——[3]												
10. finden...........	suchen......	4	1.40		——		–	——		4	1.50	

[1] The stimulus words 'losing' and 'seeking' were not used for the first 14 observers; hence the smaller number of responses.

[2] 'hunting' occurs 7 times (A, 1.486 M, 1.416); 'hunt' occurs 3 times (A, 2.192 M, 2.034). Taking these two responses together, the results are: n, 10 A, 1.698 M, 1.568. The association seeking-hunt(ing) thus appears stronger than seeking-looking.

[3] 'suchen' does not occur as a stimulus word in the German investigation. Out of a total of 80 verbs which T&M used as stimulus words, I have taken only those which correspond to those used by me; whereas in the case of the other categories, where T&M use only 10 words, I have given them all.

TABLE V

Stimulus	Most Frequent Reaction				Next Most Frequent Reaction				All Remaining Reactions		
		n	A	M		n	A	M	n	A	M
1. *I¹ . . . . (46)	*you	27	1.358	1.265	me	6	1.666	1.653	13	1.678	1.381
2. *you . . . . (92)	me	26	1.357	1.274	they	10	1.733	1.519	56	2.009	1.709
3. *we . . . . (91)	they	28	1.404	1.403	us	20	1.540	1.414	43	1.794	1.450
4. *he . . . . (89)	*she	48	1.273	1.226	man	7	2.264	1.855	34	1.681	1.440
5. her . . . . (87)	she	27	1.357	1.267	him	23	1.765	1.558	37	1.935	1.771
6. it . . . . (90)	they	20	2.240	1.856	that	9	1.826	1.842	61	2.096	1.938
7. they . . . . . . (94)	them	29	1.743	1.592	we	16	1.608	1.418	49	2.073	1.653
8. *this . . . . . . (95)	*that	68	1.165	1.097	what	3	1.619	1.696	24	2.030	2.106
9. *that . . . . . . (97)	*this	47	1.307	1.211	{ which	6	1.346	1.324	38	2.113	1.904
					{ what	6	1.998	1.820			
10. *what . . . . . . (94)	when	20	1.445	1.336	that	14	1.953	1.584	60	2.043	1.724
1. ich . . . . (8)	du	4	1.25		er	3	1.53		1	3.00	
2. du	er	5	1.28		———	—	—		3	2.07	
3. wir	{ uns	3	1.47		———	—	—		2	2.30	
	{ ihr	3									
4. er	sie	4	1.30		———	—	—		4	2.75	
5. sie	er	3	0.93		———	—	—		5	1.76	
6. ihr	wir	3	1.60		{ sie	2	{ 1.60		1	5.00	
					{ seid	2					
7. wer	er	3	1.60		ist	2	3.80		3	2.13	
8. dieser	jener	6	1.33		Mann	2	2.50		—	—	
9. jener	dieser	4	1.30		———	—	—		4	1.75	
10. was	das	4	1.60		———	—	—		4	1.80	

¹ The stimulus word 'I' was understood by many observers as 'eye.'

TABLE VI

Stimulus	Most Frequent Reaction			Next Most Frequent Reaction			All Remaining Reactions		
	n	A	M	n	A	M	n	A	M
1. *where........(98)	when........ 33	1.478	1.339	there........ 23	1.464	1.401	42	1.798	1.626
2. *here¹........(64)	*there........ 37	1.420	1.159	now........ 10	1.391	1.222	17	1.820	1.935
3. *there²........(70)	*here........ 23	1.396	1.256	where........ 20	1.813	1.635	27	2.198	1.978
4. *now........(94)	then........ 55	1.426	1.330	when........ 10	1.809	1.327	29	1.979	1.824
5. *then³........(68)	now........ 34	1.870	1.480	when........ 12	1.916	1.504	22	1.952	1.652
6. *when........(96)	now........ 21	1.737	1.559	where........ 20	1.453	1.333	55	1.776	1.485
7. *never........(89)	now 17	1.506	1.368	always........ 15	1.649	1.444	57	2.249	1.733
8. *always........(93)	*never........ 37	1.774	1.489	now........ 20	2.030	1.731	36	2.238	1.976
9. seldom........(94)	often........ 42	1.815	1.548	never........ 14	1.818	1.768	38	2.261	1.950
10. often........(90)	seldom........ 20	1.573	1.496	soon........ 14	1.620	1.377	56	2.297	1.884
1. wo.........(8)	da......... 4	1.45		——— -	—		4	2.40	
2. hier........	dort........ 6	1.37		——— -	—		2	2.30	
3. dort........	hier........ 5	1.32		——— -	—		3	2.47	
4. jetzt........	nie........ 2	7.30		——— -	—		6	1.87	
5. dann........	wann........ 6	1.70		——— -	—		2	1.90	
6. wann........	dann 5	1.68		wo........ 2	1.50		1	8.00	
7. niemals........	jemals........ 5	1.72		——— -	—		3	2.87	
8. immer........	nimmer........ 2	1.60		——— -	—		6	1.93	
9. ——⁴									
10. ——⁴									

¹ frequently understood as *hear*.

² frequently understood as *their*.

³ frequently misunderstood as *them*.

⁴ *selten* and *oft* do not occur as stimulus-words in the German investigation. T&M used 10 adverbs of place and 10 adverbs of time. Of these I have given above only those which correspond to my stimulus-words.

action-times, respectively, of the most frequent response, the next most frequent response and of all remaining responses. A star before a stimulus-word indicates that it occurs as a stimulus word in the experiments of Thumb and Marbe; a star before a most frequent response indicates that it was also the favored response in the German investigation. Below each table is given the corresponding German table.

Of the 60 stimulus-words used in my investigation, 50 correspond to stimulus-words used by Thumb and Marbe. Of the most frequent responses to these 50 words, 35, or 70%, agree with the favored German reactions. It should be noted, moreover, that in some cases where the favored English response is not the same as the favored German response, the next most frequent response of the one investigation agrees with the most frequent of the other. Thus the responses to *son* (*Sohn*) are *daughter* (*Vater*); *Tochter* however occurs as the next most frequent German response and *father* as the next most frequent English response. It is quite possible that had Thumb and Marbe used a larger group of observers, the agreement between the German and English results would have been still greater.

In both the English and German experiments, stimulus-words of a given category were responded to predominantly with words of the same category, as the following figures show. (German percentages are given in parentheses.)

1. Names of personal relations responded to names of presonal relations: 77.4% (80%).

2. Adjective responses to adjectives: 85.3% (87.5%).

3. Numeral responses to numerals: 83.9% (87.5%).

4. Pronoun responses to pronouns: 72.9% (71.3%).

5. Adverbs of place responded to adverbs of place: 51.7% (68.8%).

Adverbs of time responded to adverbs of place: 26.3% (1.2%).

6. Adverbs of time responded to adverbs of time: 72.4% (76.3%).

Adverbs of place responded to adverbs of time: 6.9% (6.2%).

7. *Verb responses to verbs:* 70.2% (42.0%).
   Noun responses to verbs: 23.3% (51.7%).

The English and German results are seen to agree closely in this respect except in the case of the responses to adverbs of place and to verbs. The English observers show a marked tendency to respond to adverbs of place with adverbs of time, whereas in the case of the German observers this tendency is hardly present. A decided difference is seen between the English and German responses to verbs. The results for the English observers are here similar to the results in the other categories, whereas only 42.0% of the German responses to verbs are again verbs. To what this difference is due may be inferred from a comparison of the results of Schmidt.[1] In this investigation, 8 boys, aged about 10 years, acted as observers. The stimulus-words were the forms of the present and imperfect indicative, the present infinitive and the past participle of 30 verbs. Of the responses to these words, 89.65% were verbs, 4.82% substantives and 5.53% scattering. Although Schmidt does not himself give us the necessary data, we may infer from a comparison of the results of Thumb and Marbe that most of the substantive and scattering responses were given as reactions to the 30 infinitives. "Das Resultat ist sprachpsychologisch nicht uninteressant; wir betrachten den Infinitiv als Träger der Verbalbedeutung, als die abstrakte Verbalform, und können daher a priori verstehen dass der Infinitiv mit sonstigen Wortklassen durch die Wortbedeutung assoziativ enger verknüpft ist als eine finitive Verbalform, deren assoziative Beziehungen mehr durch die formale Seite bestimmt sind."[2] Since the English observers were given participles as stimulus-words and the German observers infinitives, the difference in the results is probably due to the difference in the stimulus-words. If this is so, we see between the infinitive and finite forms, besides the linguistic difference, also a decided psychological difference.

It is to be noted also that of the responses to adjectives,

[1] *Ztschr. f. Pscyhol. u. Physiol. d. Sinnesorgane,* **28**, p. 65 ff.
[2] Thumb, *Indoger. Forsch.,* **22**, 35.

76.5% were adjectives of meanings *opposed* to those of the
stimulus-words. For the German responses the percentage
was 82.5%. In the case of the numerals, the most frequent
response to each stimulus-word was the *next higher numerals*
in the German results the response *zwanzig* to the stimulus
zehn offers an apparent exception to this rule;[1] the next most
frequent response is however *elf*.

There are 17 cases of reciprocal associations, as follows:
father ⇄ mother, son ⇄ daughter, brother ⇄ sister, uncle ⇄
aunt, big ⇄ little, light ⇄ heavy, old ⇄ young, thick ⇄ thin,
white ⇄ black, giving ⇄ taking, eating ⇄ drinking, losing
⇄ finding, reading ⇄ writing, this ⇄ that, here ⇄ there,
now ⇄ then, seldom ⇄ often.

It remains for us to consider the relations between the
reaction-times for the most frequent, next most frequent and
remaining responses. Thumb and Marbe found in their ex-
periments that the more frequent a response was, the shorter
was its reaction time. The following table will show that
the same rule applies to the English results. In the lines
marked *a*, *b* and *c* are given the average reaction-times of
the most frequent, next most frequent and remaining re-
sponses, respectively, to the stimulus-words of each of the
six categories. At the right are given the medians of all six
categories.

	Family Names	Adjectives	Numerals	Verbs	Pronouns	Adverbs	Total
(a)	1.387	1.258	1.211	1.577	1.465	1.600	1.416
(b)	1.822	1.477	1.767	1.720	1.756	1.696	1.706
(c)	2.180	2.254	1.982	2.052	1.945	2.057	2.078

Results of Groups B and C

In the following tables are given the results for Group B
(children) and Group C (uneducated adults). 'The figures
in parentheses after the stimulus-words indicate the total
number of successful reactions; the columns under *n* and *M*
give the number of occurrences and median time of the most

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[1] I say 'apparent' because in the very common 'counting by tens' *twenty* may be
regarded as the next higher numeral after *ten*. The English table also shows the in-
fluence of counting by twos and by fives.

GROUP B

Stimulus	Most Frequent Reaction		Next Most Frequent Reaction		All Remaining Reactions	
	n	M	n	M	n	M
Table Ib... 1. father....(10)	*mother.... 10	1.439	——	–	——	–	——
2. mother...(11)	*father..... 10	1.456	son.... 1	1.924	–	——
3. son.......(6)	*daughter... 4	1.417	——	–	——	2	1.834
4. daughter..(11)	*son........ 9	1.921	——	–	——	2	1.556
5. brother...(11)	*sister...... 11	1.330	——	–	——	–	——
6. sister.....(11)	*brother.... 9	1.412	——	–	——	2	1.310
7. cousin....(11)	*uncle...... 3	1.485	niece... 2	1.928	1	1.590
	sister...... 3	2.087	aunt... 2	4.734		
8. aunt.....(11)	*uncle...... 9	1.707	——	–	——	2	3.338
9. uncle.....(10)	*aunt...... 5	1.553	cousin.. 3	1.559	2	2.120
10. nephew...(11)	*niece...... 7	1.593	cousin.. 2	2.082	2	2.522
Table IIb.. 1. big......(11)	*little...... 10	1.422	——	–	——	1	1.286
2. little....(11)	*big........ 10	1.460	——	–	——	1	2.333
3. light[1]						
4. heavy....(11)	*light 8	1.654	——	–	——	3	1.774
5. old.......(11)	*young..... 11	1.447	——	–	——	–	——
6. young....(11)	*old........ 11	1.398	——	–	——	–	——
7. thick.....(10)	*thin....... 6	1.924	——	–	——	4	2.291
8. thin.......(9)	*thick...... 4	1.550	——	–	——	1	1.653
	fat........ 4	2.518				
9. white....(11)	*black...... 9	1.164	blue.... 2	2.012	–	——
10. black.....(11)	*white...... 9	1.296	——	–	——	2	1.714
Table IIIb.. 1. one.......(9)	*two....... 8	1.437	——	–	——	1	1.586
2. two......(11)	*three...... 4	1.285	——	–	——	3	1.645
	four....... 4	1.986				
3. three.....(11)	*four....... 8	1.397	——	–	——	3	1.893
4. four.......(9)	*five....... 3	1.298	three... 2	1.890	4	3.542
5. five.......(7)	*six........ 4	1.433	——	–	——	3	1.333
6. six.......(11)	*seven...... 7	1.266	twelve.. 2	3.586	2	1.417
7. seven.....(11)	*eight...... 4	1.261	six..... 3	1.469	4	1.716
8. eight......(8)	*nine....... 3	1.403	ten..... 2	2.745	3	2.286
9. nine......(10)	*ten........ 8	1.604	——	–	——	2	1.426
10. ten.......(10)	*eleven.... 4	1.549	——	–	——	6	1.790
Table IVb.. 1. giving....(10)	gave...... 2	1.314	——	–	——	6	2.375
	keeping.... 2	2.145				
2. taking....(9)	keeping.... 2	3.308	——	–	——	7	2.321
3. eating....(10)	*drinking... 3	1.971	ate...... 2	1.424	5	2.097
4. drinking..(11)	*eating..... 3	2.221	drank.. 2	1.644	4	4.072
			cup.... 2	1.914		
5. losing....(11)	*finding.... 4	2.654	found... 3	2.227	4	1.522
6. walking...(9)	*running.... 3	2.241	slow.... 2	2.838	4	1.789
7. reading...(10)	*writing.... 5	1.427	read.... 2	1.204	3	3.053
8. writing...(11)	*reading.... 3	1.749	wrote... 2	1.428	4	3.366
			playing. 2	6.942		
9. seeking....(9)	——	–	——	——	–	——	9	2.196
10. finding...(10)	*losing..... 4	2.284	keeping 2	5.590	4	1.742

[1] Understood only once as 'not heavy'; response *heavy*, time 1.679. Understood 10 times as 'not dark'; response *dark* occurs 8 times, median time 1.365; time of other two responses 1.588.

GROUP B—*Continued*

	Stimulus	Most Frequent Reaction		Next Most Frequent Reaction		All Remaining Reactions	
		n	M	n	M	n	M
Table Vb...	1. I ....(6)	*you...... 3	1.532	—— -	——	3	2.249
	2. you......(10)	*me........ 4	1.350	—— -	——	6	2.418
	3. we........(9)	*they...... 2	1.469	—— -	——	5	2.834
		you...... 2	2.169	—			
	4. he.......(10)	*she........ 7	1.555	her..... 2	1.449	1	.953
	5. her......(11)	him....... 4	1.841	he..... 2	2.046	3	2.097
				his..... 2	1.547		
	6. it.........(8)	is......... 2	3.298	—— -	——	6	1.876
	7. they.....(10)	*them...... 4	2.179	—— -	——	6	1.942
	8. this......(11)	*that....... 7	1.267	—— -	——	4	2.300
	9. that......(11)	*this....... 4	2.002	there... 2	2.238	5	1.894
	10. what......(9)	who....... 2	1.514	—— -	——	5	2.446
		that....... 2	2.097				
Table VIb..	1. where....(11)	there...... 6	1.538	when .. 2	1.876	3	3.237
	2. here......(8)	*there...... 5	1.851	where.. 2	1.590	1	2.088
	3. there.....(10)	*here...... 4	1.618	then.... 2	1.550	4	3.758
	4. now......(11)	*then...... 7	1.607	—— -	——	4	2.212
	5. then......(8)	*now........ 4	1.646	—— -	——	4	1.752
	6. when.....(10)	*now........ 4	1.935	—— -	——	6	1.836
	7. never....(10)	*now........ 2	2.047	—— -	——	6	2.388
		always..... 2	2.928				
	8. always....(10)	*never...... 4	2.024	now.... 2	1.568	4	2.322
	9. seldom... (7)	*often...... 5	2.267	—— -	——	2	4.738
	10. often.....(10)	slow....... 2	2.814	—— -	——	6	7.378
		soon....... 2	3.464				

GROUP C

	Stimulus	Most Frequent Reaction		Next Most Frequent Reaction		All Remaining Reactions	
Table Ic....	1. father....(15)	*mother.... 10	1.463	—— -	——	5	4.525
	2. mother...(15)	*father..... 8	1.916	sister... 3	1.967	4	2.040
	3. son.......(5)	*daughter... 3	2.873	—— -	——	2	2.232
	4. daughter..(15)	brother.... 5	2.749	father.. 3	1.726	7	1.814
	5. brother...(15)	*sister...... 8	1.424	—— -	——	7	2.390
	6. sister.....(15)	*brother.... 11	1.669	—— -	——	4	1.982
	7. cousin....(15)	*uncle...... 5	2.848	aunt... 4	1.653	6	2.516
	8. aunt.....(13)	*uncle...... 6	1.482	no..... 2	1.758	5	1.748
	9. uncle ....(14)	*aunt...... 4	2.132	sister... 2	1.298	4	2.278
		cousin...... 4	2.624				
	10. nephew...(14)	*niece...... 4	1.952	—— -	——	6	1.923
		uncle...... 4	2.156				
Table IIc ..	1. big ......(12)	*little 5	1.847	small .. 3	1.467	4	1.814
	2. little.....(14)	large...... 6	2.285	big..... 3	1.651	5	1.501
	3. light[1]						
	4. heavy....(15)	*light...... 8	1.675	load.... 2	1.942	5	2.063
	5. old.......(14)	*young..... 10	1.386	—— -	——	4	2.277
	6. young... (14)	*old........ 12	1.492	—— -	——	2	1.279
	7. thick.....(14)	*thin....... 10	2.170	—— -	——	4	1.496
	8. thin......(12)	*thick...... 7	1.405	—— -	——	5	3.415
	9. white....(15)	*black...... 8	1.780	red..... 2	1.775	3	2.504
				blue.... 2	2.966		
	10. black.....(14)	*white...... 7	1.534	yellow.. 2	1.987	5	1.721

[1] Understood 3 *times as* 'not heavy'; *responses and reaction-times as follows:* *heavy*, 2.719; food, 2.524; clothes, 3.704. Understood 4 times as 'not dark'; *response* *dark*, median time 1.468. Understood as noun 8 times; *response darkness occurs* twice, time 1.808; median time of other responses 1.598.

GROUP C—*Continued*

Stimulus	Most Frequent Reaction	n	M	Next Most Frequent Reaction	n	M	n	M
Table IIIc.. 1. one......(15)	*two.......	8	1.506	four ..	2	1.842	5	1.818
2. two......(15)	*three.....	5	1.116	——	–	——	5	2.115
	four......	5	1.828					
3. three.....(15)	*four.......	7	1.374	five....	2	2.134	4	3.104
				six.....	2	1.767		
4. four..... .(9)	six........	4	2.256	——	–	——	5	2.464
5. five.... .(12)	*six........	5	1.932	eight...	2	2.790	5	1.957
6. six......(15)	*seven......	4	1.352	ten.....	3	2.175	8	1.985
7. seven....(15)	*eight.. ...	10	1.688	——	–	——	5	1.398
8. eight...(13)	*nine.	3	1.536	ten.....	2	1.268	8	2.410
9. nine.....(15)	*ten........	5	1.459	——	–	——	10	1.994
10. ten......(15)	*eleven.....	4	1.427	nine....	2	1.226	7	2.553
				twelve. .	2	2.955		
Table IVc.. 1. giving... (15)	*taking.....	6	1.394	——	–	——	9	1.990
2. taking....(14)	something..	3	1.934	giving..	2	2.362	9	1.563
3. eating....(15)	*drinking...	8	2.065	——	–	——	7	1.863
4. drinking..(14)	*eating.....	2	2.164	——	–	——	10	2.160
	whiskey...	2	2.591					
5. losing....(15)	*finding....	4	1.652	found...	3	2.040	5	1.634
				lost....	3	1.876		
6. walking...(14)	*running....	5	1.421	talking.	3	1.457	6	1.845
7. reading...(15)	*writing....	5	1.432	——	–	——	5	2.222
	spelling....	5	2.400					
8. writing...(14)	*reading....	5	1.627	spelling.	3	1.800	6	2.639
9. seeking...(15)	*finding....	3	1.770	——	–	——	9	1.729
	looking....	3	3.046					
10. finding...(15)	lost......	4	1.478	losing...	3	1.840	8	1.672
Table Vc... 1. I.........(8)	*you......	2	2.265	——	–	——	6	1.567
2. you......(14)	*me........	4	1.692	——	–	——	10	2.340
3. we.......(14)	those......	2	1.438	——	–	——	10	1.589
	she......	2	1.567					
4. he.......(13)	*she........	6	1.238	——	–	——	7	1.689
5. her......(10)	*she........	4	1.372	him....	2	2.890	4	2.934
6. it........(15)	that......	2	1.662	——	–	——	11	2.421
	now......	2	2.821					
7. they.....(13)	*them......	3	2.180	——	–	——	10	1.553
8. this .....(14)	*that... ..	8	1.750	——	–	——	6	2.457
9. that......(15)	*this.... .	4	1.450	they....	2	1.196	9	2.296
10. what.....(15)	now......	2	2.325	——	–	——	9	1.555
	who......	2	4.922					
	is.........	2	2.044					
Table VIc.. 1. where....(15)	there......	4	1.494	here....	3	3.264	8	1.762
2. here. .....(7)	*there......	3	1.656	——	–	——	4	1.796
3. there.....(12)	*here.......	3	2.342	where..	2	2.664	7	2.075
4. now.....(13)	*then.......	8	1.701	——	–	——	5	2.102
5. then.....(11)	*now.......	3	1.745	——	–	——	8	2.243
6. when.....(13)	*now.......	5	2.071	where..	2	3.847	4	1.512
				anytime	2	3.041		
7. never....(15)	*now.......	3	1.335	——	–	——	12	2.046
8. always...(15)	forever....	2	2.376	——	–	——	11	2.033
	now......	2	3.831					
9. seldom...(12)	*often......	3	2.280	never...	2	1.739	7	2.661
10. often.....(14)	*seldom....	3	1.702	now....	2	2.278	7	3.912
				quick...	2	3.876		

frequent, next most frequent and remaining responses. A star before a most frequent response indicates that it was also the favored response for Group A.

Except in the length of the reaction-times, the results of Groups B and C present comparatively small differences from those of Group A. Of the most frequent responses of Group B, 86.4% are the same as the most frequent responses of Group A. Of the most frequent responses of Group C, 83.1% are the same as those of Group A. The responses of Groups B and C, as was the case in Group A, are predominantly of the same category as their stimulus-words. In the category of numerals, the influence of counting by twos is to be noted; in Group B *four* occurs 4 times as a response to *two*, while in Group C *four* occurs 5 times as a response to *two*, and *six* occurs 4 times as a response to *four*. In both of these groups, *there* occurs as the most frequent response to *where;* the most frequent response of Group A was *when*. The supplementary groups are not large enough, however, to permit us to make comparisons between the results for single words. They do however show us clearly that the associative processes of children and uneducated adults do not differ widely from those of educated adults, except that they are slower. The following tables give the medians of the reaction-times, (a) of the most frequent, (b) next most frequent, and (c) remaining responses to the stimulus words of each of the six categories; at the right of each table are given the medians of the most frequent, next most frequent and remaining reactions of all the categories taken together.

GROUP B

	Family Names	Adjectives	Numerals	Verbs	Pronouns	Adverbs	Median
(a)	1.485	1.454	1.403	2.183	1.698	1.980	1.598
(b)	1.924	2.012	2.318	1.914	1.796	1.579	1.914
(c)	1.834	1.744	1.681	2.258	2.173	2.355	2.097

GROUP C

	Family Names	Adjectives	Numerals	Verbs	Pronouns	Adverbs	Median
(a)	2.042	1.675	1.506	1.770	1.721	1.745	1.702
(b)	1.726	1.858	1.988	1.858	2.048	3.041	1.954
(c)	2.136	1.814	2.054	1.854	1.992	2.061	2.033

It will be seen from these figures that the reaction-times for children and uneducated adults are longer than those for educated adults. That the times for the next most frequent responses are in many cases longer than those for the infrequent (remaining) responses and in a few cases shorter than the corresponding times for the most frequent responses, is due to the very small number of next most frequent responses (cf. the tables). The number of these being small, the medians represent, not the frequent values of a large group of observers, but the individual peculiarities of two or three observers. In Group A, where many observers were used, the relations of time between most frequent, next most frequent and infrequent reactions are clearly seen.

In discussing the associations of children, Thumb[1] calls attention to the investigation of Ziehen[2] and those of Watt.[3] Of the former investigation, Thumb says, "Wie schon Ziehen an Kindern zwischen 8 und 14 Jahren beobachtet hat, sind Verbal-, d. h. reine Wortassoziationen überhaupt selten; am haüfigsten sind Wörterergänzungen (Post-karte); geläufige Wortverbindungen und Reimassoziationen sind sehr viel seltener als bei Erwachsenen; wir sehen also schon hieraus, dass bei Kindern die Bedingungen viel seltener erfüllt sind, die wir für das Zustandekommen von Analogiebildungen voraussetzen müssen: Geläüfigkeit, Schnelligkeit und Spontaneität der Assoziationen." The investigation of Watt had for its object a direct comparison of the results from children and adults. The stimulus-words used were the same as those which Thumb and Marbe had employed. Of the 8 observers, 5 were children in the second to fifth years of school. The results of this experiment show that the responses of the children are much more scattering than those of the adults; of the responses of the latter, 74% belonged to the class of 'most frequent' reactions; of the responses of the children, only 29% belonged to this class.

A study of Table B will show that the differences between

[1] *Indogerman. Forsch.*, 22, 43 f.

[2] *Ideenassoziation des Kindes*, I, II, Berlin, 1898, 1900.

[3] *Ztschr. f. Psychol.*, 36, 417 ff.

the associations of adults and children, found by Ziehen and Watt, do not appear in the results from the English observers —with one exception, namely, the length of the reaction-times. The tables given on pp. 484, 480, show that the association-times for children are longer than those for adults. But in the *character* of the associations, a comparison of the tables of Groups A and B shows a remarkable similarity; thus, 86.4% of the most frequent responses of Group B are the same as the most frequent responses of Group A. The greater *scattering* of the responses which Watt found in children our results do not show at all. Indeed, the scattering is less in the case of the children than in that of the adults. The following table will show what percent of all responses in Group A (educated adults), Group B (children) and Group C (uneducated adults) belong (*a*) to the class of 'most frequent' responses and (*b*) to the classes of 'most frequent' and 'next most frequent' taken together.

	A	B	C
(*a*)	51.7	58.0	42.8
(*b*)	63.8	67.6	52.9

These figures show that the scattering is greatest in the uneducated adults and least in the children. Of course, it must be borne in mind that Groups B and C are much smaller than Group A; nevertheless, until further and more extended investigations are made, we cannot regard the results of Ziehen and Watt as being of general significance. The significance of the conclusions reached from experiments of this sort is proportional to the number of observers. Until more reliable results are at hand, we are justified in believing that the associations of children are quite similar to those of adults, except in the length of the reaction-time. That there are *more* associations present in the adult than in the child we cannot doubt; but the associations which the child already has are similar to those of the adult.

GENERAL CONCLUSIONS

1. The rule established by Thumb and Marbe, namely, that the more frequent an association is, the more rapidly

does it take place, is confirmed by the results from the English-speaking observers.

2. In both languages, words of a given category are associated predominantly with words of the same category.

(*a*) In all categories investigated, with the exception of the numerals, reciprocal associations were found. In these cases a word *a* which calls up a word *b* is in turn called up by *b*.

(*b*) Numerals are associated predominantly with higher numerals; the numerals 1–10 are associated predominantly with the *next* higher numeral.

(*c*) Adjectives are associated predominantly with adjectives of opposed meaning.

3. A comparison of the English and German results tends to show that the associations of English- and German-speaking communities correspond in the case of most words which are of familiar meaning and in universal use in both languages.

4. The reaction-times of the associations of children and uneducated adults are longer than those of educated adults, but the favored associations are in most cases the same, and the essential character of the associations is similar.