

IMPROVEMENT IN MEMORY SPAN

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Memory span has usually been regarded as a congenital ability. For this reason it has been considered highly valuable as a diagnostic test of mental ability. Humpstone has shown that memory span improves rapidly and markedly with increasing age up to the college level.¹ The implication is that the limits for adult memory span are fixed at birth and beyond this fixed limit, improvement is not to be expected. In Humpstone's own words: "We may assume that there is present a definite congenital capacity. This can never be increased." But then he goes on to say that "one's capacity can be used more and more so that its effectiveness is increased."²

It seemed worth while to ascertain the validity of these statements. For this purpose, two highly intelligent undergraduates at the University of Pennsylvania—Mr. W. F. Kennedy (K) and Mr. R. S. Rubinow (R)—volunteered to go through a lengthy and systematic series of memory span training.

The auditory-vocal memory span for digits was used under standard conditions. The digits were read at a rate slightly faster than one per second. Every day the *Ss* were given a complete series—from five digits until they broke down. Two series were given for each number of digits and the 'score' for each day was the highest single series reproduced absolutely correctly. New series were compiled and given each day.

K had 52 learning periods extending over a period of 4 months and R had 57 learning periods extending over the same period. Daily introspective reports were obtained every day from both *Ss*, especially regarding the methods employed during stimulation and during recall.

The daily scores will be found in Table I for K and in Table II for R. The scores for each 10 successive days will be found in a row. The right hand columns contain the averages for these 10 trials. The improvement in the case of K is very marked—the average for the first 10 series being 8.9 and for the fifth series of 10 being 13.1—an improvement of 47%. For R the improvement was not so great; his increase being from 10.9 for the first 10 series to 14.8 for the last 10 series—an improvement of 36%. It will be noted that R started with a higher memory span than K.

These values have been plotted as curves in the accompanying Fig. Both are of the form of typical learning curves. On the other hand, the curves for

* Accepted for publication July, 12, 1928.

¹H. J. Humpstone, Some aspects of the memory span: A study in associability, *Univ. of Penna. Studies in Psych. and Ped.*, 8, 1917, 1-31.

²*Op. cit.*, 14.

the *Ss* show certain marked differences in form. The curve for K begins to improve markedly after the fourteenth daily series. That for R does not improve markedly until after the twenty-fifth series.

References to the averages in the right hand columns of Tables I and II will make this difference obvious. The average improvement for K is continuous. The improvement for R is slight for the first 30 series and very rapid for the fifth series of 10-day learning periods. Both *Ss* show a decrease in score at the end of the learning.

TABLE I
SHOWING DAILY SCORES FOR K

Days	Daily Scores										Ave.
1st 10	10	9	8	9	9	9	9	8	9	9	8.9
2nd 10	8	9	9	9	12	9	9	10	9	11	9.5
3d 10	10	10	11	10	11	13	12	14	12	13	11.6
4th 10	13	13	11	11	14	11	11	12	12	14	12.2
5th 10	13	13	13	11	15	11	16	13	15	11	13.1
Last 2	12	14									

TABLE II
SHOWING DAILY SCORES FOR R

Days	Daily Scores										Ave.
1st 10	12	10	9	10	11	12	12	10	11	12	10.9
2nd 10	12	10	11	10	12	12	12	11	12	11	11.3
3d 10	11	12	11	10	12	11	11	13	11	11	11.3
4th 10	11	12	13	10	13	12	11	13	11	12	11.8
5th	13	12	14	16	16	14	14	12	12	15	14.8
Last 7	15	15	13	12	13	14	14				13.7

How are these results to be interpreted? Witmer early identified memory span with the range of attention experiment when he said that memory span referred to the "number of discrete perceptions associated in a single act of attention, and the combination of the associated component parts of a single perception."³ Since 1902, there has been a much more complete analysis of the old 'range of attention' experiment and of memory span. Both turn out to be at a higher level of mental process and to be much more complex than had been formerly supposed. The work of Oberly,⁴ and Gill and Dallenbach⁵ has shown that 'range of attention' is a misnomer for this experiment which, it turns out, may involve various levels of cognition and thus give various liminal values. Oberly, confirmed by Gill and Dallenbach, find normally three such levels: (1) an immediate reproduction; (2) grouping; and (3) re-imaging and counting.

Brotemarkle,⁶ and Easby-Grave⁷ have both shown that the mental processes underlying memory spans may be very different. They find an immediate

³L. Witmer, *Analytical Psychology*, 1902, 251.

⁴H. S. Oberly, 'The range of visual attention, cognition and apprehension, this JOURNAL, 35, 1924, 332-352.

⁵N. F. Gill and K. M. Dallenbach, 'A preliminary study of the range of attention, this JOURNAL, 37, 1926, 256.

⁶R. A. Brotemarkle, 'Some memory span problems, *Psychol. Clin.*, 15, 1924, 251.

⁷C. Easby-Grave, 'Tests and norms at the six year old performance level, *Psychol. Clin.*, 15, 1924, 279.

reproductive process underlying the shorter series, for adults, while for the longer series there is grouping and organization. Easby-Grave questions whether the result of this later sort of process can be considered a true memory span.

More recently Oberly⁸ has shown the relationship between the various levels of memory span and the same levels of 'attention' span.

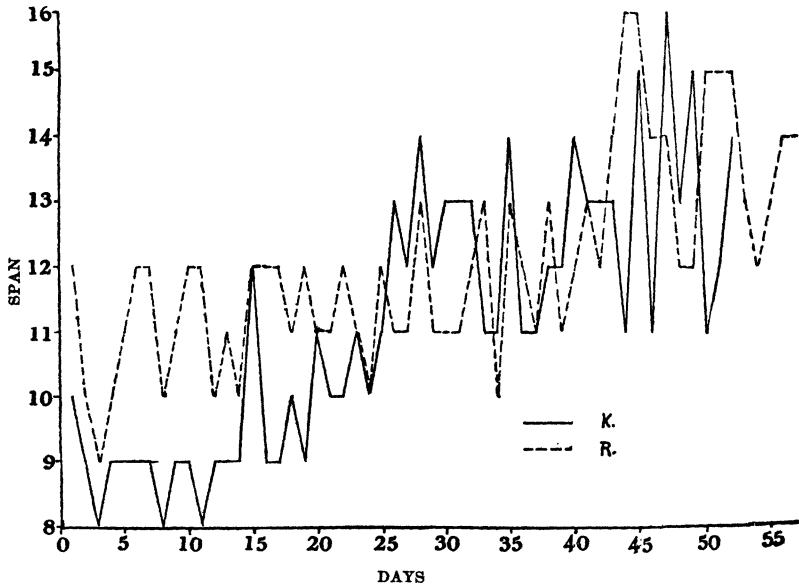


FIG. 1. Showing daily scores in memory span

Our introspective data show that the improvement all occurs at this higher level of organization. From the beginning of the training, R attempted to try various methods of grouping much more actively than K. This seems to account for R's more rapid improvement. It was only later in the experiment that K attempted this and then the improvement was marked in his case. This higher organization consisted primarily in attempting to increase the number of items in each group. This both Ss succeeded in doing and hence materially increased their span. Eventually both became proficient in grouping by 5s. The decline for both Ss at the end of the experiment was due, apparently, to an effort to increase the number of items in each group to six. In this they failed. Whether or not they might have succeeded had the experiment been longer continued cannot be predicted.

It is then rather obvious that no unqualified statement can be made with regard to improvement in memory span. If one means by memory span the number of items which may be immediately reproduced after a single, un-

⁸H. S. Oberly, A comparison of the spans of 'attention' and memory, this JOURNAL, 40, 1928, 295-302.

grouped act of attention, we can probably say very definitely that this is only slightly improvable with practice, if it is improvable at all. It may well be that we are here dealing with a congenital ability, the ultimate limits of which are fixed at birth.

On the other hand, the memory span obtained by grouping by the *S* during stimulation is highly improvable even in intelligent educated adults in whom a high degree of practice and competency in this process might be expected. This improvement is based on the development of more efficient methods of grouping and does not seem to depend on the utilization of new modalities of imagery or on any other factors which we have discovered.

It seems from our results that this grouping process is employed in all memory spans involving more than approximately 5 digits.⁹ In the light of this improvement, which in one case is nearly 50% and in the other nearly 40% it would seem doubtful if we were here dealing with an ability whose limits were clearly congenitally fixed.

⁹Cf. also Brotemarkle, Easby-Grave, *opp. citt.*