

Extraversion and paired-associate recall

ZVONIMIR KNEZOVIĆ and KSENIJA BAUER

The main goal of the study was to check the Walker-Howarth-Eysenck's consolidation-arousal hypothesis concerning the better short term interval recall of extraverts and the better long-term interval recall of introverts. As it can be clearly predicted, the central theoretical expectation is to find interaction effect between the personality dimension (extraversion) and memory process (recall interval). The design used represents a modification of the original Howarth-Eysenck's method (1968) of paired-associate learning. According to the EPI-A results of $N = 180$ male high-school students, nine experimental groups were formed: introverts, ambiverts and extraverts, each randomly divided into three recall interval groups: short (STM), middle (STM-LTM) and long-term (LTM). The data were analyzed in the framework of standard 3×3 two-way ANOVA design with primary reference to the number of correctly recalled CVC pairs.

The interaction effect of extraversion and recall interval was not proved to be statistically significant. This finding was not consistent with the Walker-Howarth-Eysenck's hypothesis and therefore indicates that Eysenck's classical arousal hypothesis of extraversion is not supported by our experiment. The only significant effect reveals better average performance in paired associate recall of ambiverts and introverts, when compared to extraverts. The data was shortly discussed in the context of some similar previous results (Knezović, 1985) and also of Schwartz's (1975, 1979) hypothesis of different tendency of processing physical and semantic materials.

Among the results most strongly in favour of Eysenck's theory of personality is the well-known study on the relation of extraversion and recall interval (Howarth and Eysenck, 1968). The results obtained in this research were simply "too good to be true", being completely in accordance with the theoretical assumptions. Those theoretical assumptions were derived from the combination of Walker's theory of action decrement (Walker, 1958, Walker & Tarte, 1963) and Eysenck's arousal theory of extraversion (Eysenck, 1967). Action decrement theory suggests that high arousal produces a strong consolidation process which interferes with immediate or short-term (STM) recall, but which facilitates later or long term (LTM) recall. Eysenck has proposed that extraverts, in comparison to introverts, have higher arousal thresholds in reticular ascending system (RAS) leading to lower arousal in the cortex. If this is correct, extraverts may be less affected by strong interfering consolidation in STM-recall and may perform better, whereas introverts might perform poorly in short-term intervals but show good long-term recall. Howarth-

Eysenck's (1968) findings were perfectly in accordance with Eysenck's theory. As expected, analysis of variance of the recall scores revealed a significant interaction effect between recall intervals and the extraversion parameter. This interaction accorded with the theoretically predicted trend. Extraverts were better in STM and introverts in LTM intervals. In other words, extraverts are supposed to demonstrate a forgetting process during a certain period of time and introverts should demonstrate "a reminiscence effect". In this respect, extraverts behave as though they had lower level of cortical arousal.

Some experiments (McLaughlin & Eysenck, 1967; Howarth, 1969; McLean, 1968; Allsopp & Eysenck, 1974; 1975) and reviews of literature (Eysenck, 1973) were mostly in support of Eysenck's theory and verified the previous finding that personality differences can systematically affect standard learning tasks. There was however a great deal of research that proved inconsistent with those results (McLaughlin, 1968; Berlyne & Carey, 1968; Scheller & Garske, 1976; Fuller, 1978; Revelle, 1995).

In line with some important findings (Revelle et al., 1980) Knezović (1985) conducted a research with the methodology very similar to Howarth-Eysenck's (1968) approach but with particular respect to superfactor of extraversion and to the subfactors of impulsivity and sociability. On both levels of analysis (carried out in laboratory and

Zvonimir Knezović, Department of Psychology, Faculty of Philosophy, Ivana Lučića 3, 10000 Zagreb, Croatia. E-mail: zvonimir.knezovic@ffzg.hr (Correspondence concerning this article should be sent to this address).

Ksenija Bauer, Ministry of work and social welfare, Prisavlje 4, 10000 Zagreb, Croatia.

with introductory psychology female students) the results were non-confirmative of Eysenck's theory. There was no interaction effect between extraversion and paired-associate recall interval nor between subfactors of impulsivity and sociability, but a significant main effect on the extraversion and sociability was registered. Introverts and low-sociability group were significantly better than extraverts and high-sociability group at both STM and LTM intervals.

It is obvious that there is no minimal concordance in this important field of verification of Eysenck's arousal theory of extraversion.

Accordingly, the goal of the present research is to attempt to verify the basic predictions derived from the Walker-Eysenck hypothesis, using somewhat different and improved methodology. In other words, we have set out to investigate the possibility of recording the significant interaction of personality (extraversion) and recall interval.

METHOD

Design

The methodology was basically quite similar to previous research which used modified Howarth-Eysenck approach (Knezović, 1985).

In order to test the relation between extraversion and recall in non-laboratory experimental settings and in order to improve experimental control, we introduced the following alterations: 1) the sample consisted of laypersons, i.e. of high-school students, in contrast to the introductory psychology students employed in previous experiments; 2) three (STM=45 sec; STM-LTM=5 min; LTM=24 hours) instead of five (Howarth & Eysenck, 1968) or two (Knezović, 1985) recall intervals were used; 3) the experiment was carried out in non-laboratory setting (properly arranged school classroom); 4) lower criteria of learning were used (5 correct anticipations, or 4 in each of the three successive series); 5) in addition to the customary two extreme groups of introverts and extraverts, the middle "control" group of ambiverts was included; 6) sample consisted only of male subjects; 7) possible Rosenthal effect was controlled by the double-blind technique; 8) experimenter and the subjects were of the same sex; 9) total of 7 CVC (consonant-vowel-consonant) pairs were presented automatically by video, instead of using the customary Kodak projector; 10) the time of day circadian effect was controlled by pseudo-random distribution of subjects from 9 am to 4 pm; 11) in addition to the control performed in the short or STM interval task, the control of subjects activity was performed

also in the middle or STM-LTM interval by reading a story out loud.

Participants

The original sample consisted of $N = 180$ male high-school student. Out of the original sample, $n = 72$ subjects have been selected to perform the experimental recall tasks based on their extreme results in the EPI-A (Eysenck & Eysenck, 1968) extraversion scale. Due to the fact that they were not following the instructions, two subjects were excluded. Definite number of subjects was $n = 70$. All subjects were physically healthy. The average age was 17.

Procedure

Groups. Croatian version of EPI-A (see e.g. Knezović & Munivrana, 1981; Knezović & Jurković, 1984), was applied using the standard group procedure.

Based on the results of EPI-A extraversion scale three groups consisting of 24 introverts (I-group), 22 extraverts (E-group) and 24 ambiverts (A-group) subjects have been formed. All the subjects with scores that exceeded 1,5 standard deviation on EPI Neuroticism and Lie scale were excluded from the experimental sample.

I-group consisted of subjects with scores ranging from 4–12 (-3.1 to -0.68 z -value), A-group of those with scores 14–15 (-0.08 to 0.22 z -value), and E-group of those subjects who scored 17–20 (0.82 to 1.73 z -value) on EPI-extraversion scale.

In accordance with 3 (extraversion) \times 3 (recall interval) ANOVA design procedure, 9 approximately equally large experimental groups ($n = 7$ to 9) have been formed based on the random distribution of the subjects.

Recall task

Recall task was organised according to the standard paired-associate paradigm.

The complete list of pairs consisted of 14 nonsense consonant-vowel-consonant (7CVC pairs made one sequence of the experiment) with average associative value (p.e. MEV-BUP, DUZ-JOF, etc.). One presentation of CVC lasted 3 seconds. Learning phase of the experiment lasted 28 minutes and 9 seconds. The criteria for learning were 5 or more correctly anticipated R(response)-members of CVC pairs or correctly anticipated 4 R-members of CVC pairs minimally twice in three successive presentation of sequences. On average, subjects needed 17 attempts to

reach these criteria. A preliminary experiment was organized in order to verify the adequacy of this criteria and also to train the three male experimenter.

Between each sequence subjects named 24 colors on 6 pictures.

CVC pairs were presented automatically by video.

There were three recall intervals: 1. short- 45 seconds (STM) ; 2. middle - 5 minute (STM-LTM) ; 3. long - 24 hours (LTM). During the STM-interval subjects named colors, and during STM-LTM interval they read the story out loud.

Before the first (learning) and the second (recall) phase of the experiment subjects received appropriate instructions. Results were calculated as a number of correctly associated CVC-pairs (correct reproduction of S-stimulus and R-reaction members of each pair). Maximal score was 7.

Due to the reports of voluntary CVC rehearsal during 24-hours LTM interval, at the end of the experiment two subjects were excluded from computerised SPSS statistical analysis.

RESULTS

Basic statistical values for n=180 on the EPI-A were: E scale: M=14.3, SD=3.32; N scale: M=9.1, SD=4.33; L scale: M=3.7; SD=1.55. Intercorrelations between EPI-A scales were statistically significant : $r_{E,N} = -.18$; $r_{E,L} = -.27$; $r_{N,L} = -.36$. Those results indicate moderate tendency for socially desirable behaviour.

First analysis of the number of trials needed to accomplish the declared criteria of learning shows that there are no significant differences between the three groups: $M_E =$

Table 1

Results of recall of paired-associate (CVC-pair) for different level of extraversion and recall intervals

	STM		STM-TM		LTM	
	M	SD	M	SD	M	SD
I - group	n=7		n=9		n=8	
	1.71	1.11	1.78	1.64	2.13	0.99
A-group	n=8		n=8		n=8	
	1.75	0.71	1.88	0.83	2.25	0.89
E-group	n=8		n=7		n=7	
	1.00	1.07	1.00	0.58	1.29	1.50

Note: STM – short-term interval; STM-LTM – middle interval; LTM – long-term interval; I – introverts; A – ambiverts; E – extraverts.

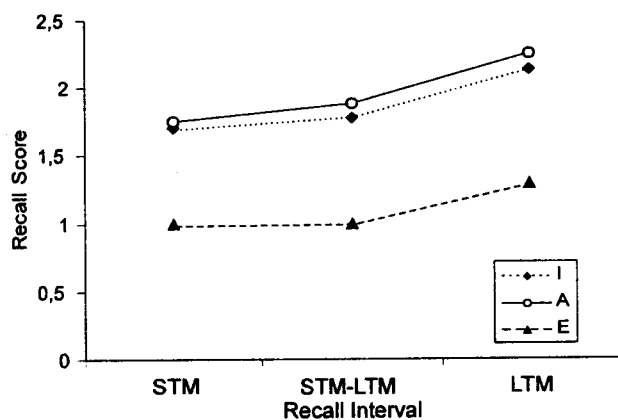


Figure 1. Extraversion and Paired-associate Recall (empirical results).

Table 2

ANOVA 3 (extraversion) x 3 (recall interval) results for CVC - pairs as a measure of dependent variable

Source of variance	SS	df	MS	F	p
extraversion	10.19	2	5.098	4.250	0.019
recall interval	2.11	2	1.057	0.881	0.420
extraversion x recall interval	0.02	4	0.023	0.019	0.999
total intracell variance	85.7	69	1.243		

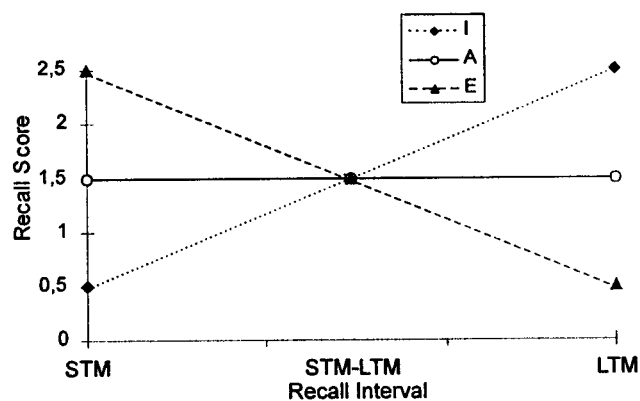


Figure 2. Theoretical relationship between Extraversion and Paired-associate recall.

20.9 ($SD=9.51$); $M_A=21.3$ ($SD=5.16$); $M_I=22.0$ ($SD=6.10$). These results are in accordance with those previously registered on female students sample (Knezović, 1985). Some investigations show different results which indicate a significantly faster learning rate for extraverts (McLaughlin & Eysenck, 1967; McLaughlin, 1968).

For the purposes of this research the results which demonstrate relations between extraversion and recall interval are the most important ones.

As shown in Table 1 and Table 2 a significant interaction effect between extraversion and recall interval measured by CVC-pairs is not registered ($F(4,69)=0.019$; $p=0.999$).

This effect is graphically presented in Figure 1. It shows that all three lines are almost parallel. This means that interaction effect does not exist. Reanalysis of the same data for CVC-elements as a measure of recall scores, revealed similar nonsignificant main effects and the interaction effect ($F(4,69)=0.303$; $p=0.875$). Interpretation of these findings became more clear in comparison to the theoretically expected results represented in Figure 2. Following the declared hypothesis, the interpretation of obtained results is very simple: our experiment does not support Eysenck's hypothesis (Eysenck, 1967) of higher level of cortical arousal for introverts than for extraverts.

The only significant main effect was for the dimension of extraversion. Numerical and graphical representations discovered that, on the average, extraverts obtain the lowest CVC-pair recall results at the all three recall intervals. Similar results were registered in the earlier research (Knezović, 1985). It is interesting to emphasize that ambiverts were not clearly positioned between extremely extravert and introvert groups as it would theoretically be expected (Eysenck, 1967).

DISCUSSION

Using somewhat modified Howarth-Eysenck's methodology, our experiment shows that Eysenck's theory of higher cortical arousal for introverts in comparison to extraverts does not have adequate support in this type of empirical test.

Reasons for that could be different. One of them could be the modification of methodology. Two of these changes should be specifically pointed out: first, the reduction of the criteria in learning could have had relevant effects; second, in our experiment the data are analyzed primarily as CVC pairs instead of CVC elements.

As shown in Figure 1, when the dependent variable is defined in terms of CVC pairs instead of CVC elements,

the results differ. A statistically significant main effect of personality does appear, while the interaction remains non-significant. In other words, ambiverts and introverts proved to be, on average, more successful in CVC paired-associate recall than the group of extraverts. This, as well as some other results (Knezović, 1985), point to the methodological necessity of taking into account the recall scores of CVC pairs in further studies.

Our type of non-confirmative results are not isolated. There is a lot of basically similar results (McLaughlin, 1968; Berlyne & Carey, 1968; Schneller & Garske, 1976; Fuller, 1978; Knezović, 1985; Revelle, 1995). It seems that some new presentations of Eysenck's theory (Eysenck, 1990) accept these "empirical signals". This more recent Eysenck's text does not quote, like the one from 17 years ago, that Howarth-Eysenck's experiments represent a kind of "... the most relevant..." (Eysenck, 1973a., p. 408) evidence in favour of the general arousal theory of extraversion. It is important to note Revelle's quotation of Stelmack's (1990) summary of 20 years of psychophysiological research on Eysenck's hypothesis that introverts have higher arousal levels than extraverts. Stelmack wrote that there "... is a good deal of evidence that introverts are characterized by greater physiological reactivity to sensory stimulation than extraverts ... (but) there is little compelling evidence that introverts and extraverts differ in tonic or basal levels" (p.307, quoted from Revelle, 1995, p. 312). It may be acceptable that our type of memory task primarily induces the "tonic or basal levels". Of course, that could be one of the possible explanations for our results which also give "...little compelling evidence..."

Generally, our results confirm our earlier research (Knezović, 1985). Bearing in mind all these results, we can offer some additional explanations:

a) according to classical Müller-Pilzecker approach *higher levels of arousal generally intensify consolidation processes* and improve recall efficiency at all intervals of retention;

b) our simple *hypothesis of distinctive behaviour characteristics in the intervening long-term time interval* assumes that introverts are more prone to behave in the way which enhances the probability to achieve better recall results than extraverts in all time intervals (introverts are more persistent, inclined to rehearse, responsible to accomplish obligations, have relatively less tendency to engage in extensive activities in the late afternoon or evening, regular sleeping habit, etc.). That refers especially to the long term interval when experimental control of intervening activity does not exist;

c) Schwartz (1974, 1975, 1979) postulates one very interesting hypothesis about *different tendency for processing different type of materials*. Introverts favour physical materials and extraverts prefer semantic ones. It is plau-

sible to assume that CVC nonsense paired associates represent a more physical than a semantic content. Therefore, introverts will be in advantage in all recall intervals because they are permanently more aroused than extraverts. According to some results (Schwartz, 1979), it seems that this difference is relatively more emphasized in long-term intervals. Our results which show non-significant interaction and the tendency for better results for all non-extraverted groups in all recall intervals are closer to Schwartz's, than to Eysenck's type of explanations.

Of course, further empirical research as well as a methodologically sound use of knowledge from different fields of psychology and other sciences (cognitive psychology-memory process, neuroscience, personality research, sociobiology, etc.) should give more precise answers to many of those, still open questions.

CONCLUSION

Our results do not support Walker-Eysenck's prediction that extraverts forget faster and introverts have better reminiscence. This research indicates that Eysenck's (1967) classical arousal hypothesis of extraversion is not supported by our experiment.

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