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A Possible Age-Related Neurological Mechanism in the Formation of Problem-Solving Set

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Running head: Neurological Mechanism in Problem-Solving Set

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Acknowledgements

Without the help of several important people, this project never would have come to its fruition. First of all, I would like to thank Dr. Johnna Shapiro for all the help and (moral) support she gave me (throughout all the word substitutions!) and also Dr. Lon Shapiro for all his computer expertise (especially since I had close to none!) Megan, Sarah, and Zac also provided a lot of assistance with testing the undergraduates. Finally, I'd like to thank my mom for helping me get this paper to acceptable APA format, since she knows a lot more about IBM computers than I do.

Abstract

Problem-solving set is the ability to focus on one successful solution and to screen out other (non) successful solutions. One problem-solving set study by Ransopher and Thompson (1991) showed no main effect or marked difference of responses with age. However, these results are not surprising because the research design perhaps facilitated responses. Two outcomes were thought possible for this particular study. The inhibition-deficit view (Hasher and Zachs, 1988) suggests that older people may be less susceptible to the effects of problem-solving set because they would be less likely to be focused on just one solution set. Dempster (1992) suggests that these inhibitory processes are associated with the frontal lobes, which function less effectively as people age. Alternatively, the other possible hypothesis dealt with perseveration: the abnormal repetition of a specific behavior (Stuss and Benson, 1984). Perseverative characteristics seen in frontal lobe damaged patients (Delis, Squire, Bihrle, and Massman, 1992) may indicate that the lessened activity of the frontal lobes with age would cause the older people to be more susceptible to problem-solving set, since they would not be able to get out of the initial problem-solving set solutions to solve new problems.

This study attempted to determine which hypothesis is more accurate by inducing set with anagrams or scrambled words. Twenty-five undergraduates and 29 older people (over the age of

55) were tested on a completely randomized list of 150 anagrams, in terms of anagram location and letter order, that were in blocks of 6, 9, 12, and 15. Target anagrams that required a different solution were presented after each block, and the mean latency was measured for both block and target anagrams. Main effects of group on anagram reaction times were found, but significant interactions were not found using two two-way ANOVAs.

A Possible Age-Related Mechanism in the Formation of Problem-Solving Set

Problem-solving set is the ability to focus on one successful solution and to screen out other (non)successful solutions. Harlow (1948) defined a "learning set," which can be thought of as problem-solving set, as a highly predictable process of learning how to learn individual problems with a minimum of errors.

Much research has been done on the "mechanization of problem-solving" and the persistence of set starting with Luchins (1942). Problem-solving set or "Einstellung" is defined as "the set which immediately predisposes an organism to one type of motor or conscious act" (p. 3). "Einstellung-habituation-creates a mechanized state of mind, a blind attitude toward problems; one does not look at the problem on its own merits but is led by a mechanical application of a used method" (p. 15). In Luchins' research, water-jar problems were used in which participants had to ascertain on paper how to obtain a required volume of water, given certain hypothetical empty jars for measuring. Following two illustration problems, the second one representing the Einstellung solution (E-solution), participants received four more problems to solve which required the E-solution. Then, two critical problems (C1C2) were given that could be solved either by the E-solution or by a more direct method. These were followed by an extinction problem that could only be solved by

the more direct method. Lastly, participants received two more critical problems (C3C4) that could be solved both ways as before.

In an experimental group of American college students, 82% and 87% of the C1C2 problems and 64% and 72% of the C3C4 problems were solved using the Einstellung method. In contrast, the control group which had not been trained in the Einstellung method and had not received Einstellung problems 2-5 solved all critical problems in the more direct method. Luchins administered his experiment to large groups of high school seniors, adult commercial high school graduates, and adult public school graduates with essentially the same results--significantly large Einstellung effect for all the experimental groups. In order to lessen this large Einstellung effect, Luchins and Luchins (1950) attempted to make the same problems more concrete by using real water jars in the experiment. Even though this change did decrease the Einstellung responses, it did not eliminate them. McKelvie (1990) found, too, that both sexes were equally susceptible to set using a slightly modified version of Luchins' original series of problems.

Ellis and Hunt (1993) summarized the results of these water-jar problems:

> ...most human beings have a strong tendency toward persistence of set. Once you have learned a rule that works, you may tend to continue applying that rule even when a simpler solution is possible. Old strategies continue to

be used even when they are less efficient if we fail to perceive that the situation has changed (p. 274).

On a more positive note, Harlow (1948) stated that appropriate learning sets created by humans have helped them adapt and survive to their environment. However, Duncker (1945) asserted that a "'poor' mathematician is not able to restructure so easily, because his thought-material is relatively inelastic, rigid, and therefore not sufficiently plastic to be reshaped" (110). Considering all this, problem-solving set could be considered a "necessary evil" of sorts for humans.

In addition, it is a widespread and popular notion that as people age, their cognitive capabilities begin to fail, and that this mental deterioration affects all arenas of life. The formation of problem-solving set could also be affected by the age of the individual. However, in a problem-solving set study done by Ransopher and Thompson (1991) including older and younger people, no main effect of age was found. The time "restriction" of five minutes was such that almost everyone could have solved the problem, though.

Scrambled word or anagram solution tasks can be used to measure several different cognitive capacities, including the capacity for forming problem-solving set. Suppression or inhibition is thought to play an important role in problem solving in general; research has indicated that there is an age-related decline in inhibitory efficiency (Hasher, Stoltzfus, Acks, and Rypma, 1991).

Also, research by Dempster (1992) has indicated that the framework of the purported inhibitory mechanism, otherwise known as "resistance to interference," is associated with the frontal lobes of the brain. The frontal lobes are responsible for the highest level of neural activity in humans, but myelination is generally not complete there until the early teenage years. Furthermore, studies have shown declines in cerebral blood flow in this area beyond the sixth decade and, in general, aging contributes to the decrease in size, volume, and density of frontal cortex cells. Therefore, most individuals have significant declines in brain weight and cortical thickness by the seventh or eighth decade of life.

Working from this "inhibition-deficit" view, Hasher et al. (1991) used a selective-attention task that required participants to name one of two letters based on their colors. The younger participants showed negative priming or carryover effects by virtue of slower reaction time when the previous distractor letters became target letters. They were supposedly inhibiting the original distractor letters, so these results indicate a working inhibitory mechanism in those people. However, the older group showed no such negative priming effects, so it is surmised that the inhibitory mechanism was deficient in that group.

In a related study by Shaw (1991) a flanker or visual choice-reaction-time task was used to study inhibition, or lack thereof, in older and younger adults. Three words were shown side by side to participants, and they were asked to categorize

the central target word and to press a key to indicate into which one of two categories it belonged. According to the inhibition-deficit view, the older people would be more distracted by the flanker or non-target words than the younger people, which would slow down the processing of the target word. The younger people would most likely inhibit or ignore the flanker word, and, as expected, a larger flanker effect was found for the older group in all three experiments.

These results suggest that when it comes to problem-solving set, which is inhibitory in nature, older individuals would be less likely to form any kind of set in the first place, since irrelevant as well as relevant stimuli from the problems would be encoded and then activated at retrieval. Moreover, these findings suggest that a diminished inhibitory mechanism related to selective attention may be responsible in part for poor recall and heightened distractibility often reported by older adults (Hasher et al., 1991).

Alternatively, the perseverative characteristics seen in frontal lobe damaged patients may indicate that the deterioration of the frontal lobes with age would cause older people to be more susceptible to problem-solving set if the inhibitory mechanism was activated at the end of a problem-solving sequence. Perseveration can be defined as an abnormal repetition of a specific behavior and can include motor acts, writing, and sorting tasks (Stuss and Benson, 1984). Indeed, it has been proposed by Milner (1963) (as cited in Vikki, 1988, p. 125) that

"the primary deficit of frontal lobe damaged patients is the inability to shift from one sorting principle to another, which is due to perseverative interference of the previous modes of response, rather than a disturbance of abstract thinking."

Studies done on the Wisconsin Card Sorting Test (WCST) by Milner (1964) (as cited in Dempster, 1992, p. 52) have shown that most errors made by frontal lobe patients are perseverative in that the same category is chosen even after it has been labeled incorrect. The frontal lobe deficit makes itself evident as an inability to overcome a previously established response set. Also, WCST experiments done on normal older people have shown them to make significantly more perseverative errors than the younger people. In addition, in a comprehensive neuropsychological study, Daigneault, Braun, and Whitaker (1992) used six prefrontal tasks, including the WCST, Porteus Mazes, Verbal Fluency Task, and the Stroop Task, to show significant perseveration errors for older people (45-65 years) on four of the six tasks.

In order to determine whether the inhibition-deficit or perseverative view is more accurate in forming problem-solving set, the current study used an anagram solution task to induce set, and mean latency to the solutions of the anagrams were measured on a younger and older group of individuals. If the inhibition-deficit view is more accurate, older individuals would not be expected to form set, therefore not showing any difference in reaction times between the target and block anagrams.

However, if the perseverative view is more characteristic, the older people would be expected to form set and have especially long reaction times to target anagrams--longer than the younger people--especially at larger set sizes.

Method

Participants

Twenty-five male and female undergraduates from general psychology classes at a midwestern liberal arts university volunteered. Their mean age was 18.7 years. They all received extra credit points for their participation. Twenty-nine male and females over the age of 55 from the community whose mean age was 71.7 years also participated and received $10/hour for their participation. All participants were in reasonably good health, and must not have had any neurological disorders. All participants were English speaking because of the nature of the anagram task.

Apparatus and Materials

A consent form (see Appendices A & B) and background data sheet (see Appendix C) were filled out by each participant. The Kaufman Brief Intelligence Test (K-BIT) (see Appendix D) was administered as a screening device. The Wisconsin Card Sorting Test (WCST) (see Appendix E) was also administered to detect perseveration. A computer anagram program was run on an Apple Macintosh Centris 610 computer.

Procedure

Following the signing of the consent form and the background

data sheet by all participants (different forms for younger and older group), the K-BIT was administered to make sure that both groups were equated on measures of verbal and non-verbal fluency. The Wisconsin Card Sorting Test was also given in order to analyze degrees of perseveration.

After reading instructions to participants about the nature of the anagram task, a list of 150 randomized four-letter anagrams was presented on the computer screen in lower case letters in font size 36. Participants said their responses out loud, and the tester pressed a computer key as soon as the correct response was said. Reaction times were recorded in milliseconds (msec). (See Appendix F for sample anagram answer sheet). Two minutes was allowed for each solution, and if the participant did not respond within two minutes, the program went on to the next anagram. The reaction time was thus recorded automatically. Correct and incorrect responses were recorded by the experimenter on the answer sheet. The anagrams were randomly presented in terms of anagram location and letter order within the anagram, in blocks of 6, 9, 12, and 15 anagrams. After each block, a target anagram was shown that required a different solution than the previous anagram block's solution. The mean reaction times to the target and block anagrams were the dependent variable. Filler anagrams were also interspersed after each target anagram so patterns could not be as easily detected by the participants. Complete randomization was necessary as to avoid confounding variables, such as fatigue effects of larger

set sizes (12 and 15) at the end of the task. In the pilot study by Shapiro and Meinz (1994), only the words within the fixed sets of anagrams were randomized. Also, studies of Dominowski (1966), Gilhooly and Johnson (1978), Kaplan and Carvellas (1968), and Mayzner and Tresselt (1958) have found that effects of changing letter order on letter strings have been interpreted as influencing the rearrangement process (as cited in White, 1988, p. 383).

Two two-way analyses of variance (ANOVAs) were done--group (older and younger) and set size on both target anagram reaction times and block anagram reaction times. This study was also a complex design since all participants received all the set sizes (within subjects), but each participant could only belong to one of the age groups (between subjects).

Results

A main effect of group on target anagram reaction times was found, F (1,652) = 35.211, p <.001. The mean reaction time was 8381.7 msec for the younger group and 13,282.2 msec for the older group. A main effect of group on block anagrams was found as well, F (1,652) = 5.189, p < .05. The mean reaction time was 10,445.3 msec for the younger group and 14,536.3 msec for the older group. Neither interaction was found to be significant (see Figures 1 & 2). The mean K-BIT scores for both of the groups were in the above average range. A wide range of perseverative responses on the WCST was found for the older people with a range that went from the 2nd percentile to the 99th percentile.

Discussion

In general, older people have slower reaction times in performing virtually all cognitive tasks. No significant interactions were found due in part to the extreme variance shown in the responses of both the younger and older group. The wide variance shown in the anagram task was also mirrored in the WCST. Perhaps this particular participant pool was not the reason for all the variance, but rather the nature of the anagram task itself. One solution to this problem would be to train people on the anagram task to make everyone a little more evenly skilled. Another way could be to find a task that would not be as variable.

A possible future direction could be a correlational analysis between hemisphere dominance (right versus left) and proficiency on the anagram task. Another correlational analysis could be done to study proficiency on the anagram task and verbal ability on the K-BIT. Hasher and Zacks (1988) have suggested that older adults with high verbal ability may use more efficient processing strategies than adults with lower verbal ability.

Finally, an extension of this study could be done with younger and older adults with frontal lobe damage in order to observe possible additional interactions. As the population becomes increasingly older and life expectancy becomes longer, it is crucial that a deeper understanding of cognitive aging is sought, so that we can deal better with the corresponding changes that occur throughout the life span.

References

Daigneault, S., Braun, C. M. J., & Whitaker, H. A. (1992). Early effects of normal aging on perseverative and non-perseverative prefrontal measure. Developmental Neuropsychology, 8(1), 99-114.

Dempster, F. N. (1992). The rise and fall of the inhibitory mechanism: Toward a unified theory of cognitive development aging. Developmental Review, 12, (45-75).

Duncker, K. (1945). On problem solving. Psychological Monographs, 58(5, Whole No. 270).

Ellis, H. C. & Hunt, R. R. (1993). Problem solving and reasoning. In Fundamentals of Cognitive Psychology (pp. 261-302). Madison, WI: Brown & Benchmark Publications.

Harlow, H. F. (1949) The formation of learning sets. Psychological Review, 56, 51-65.

Hasher, L., Stolzfus, E. R., Zacks, R. T., & Rypma, B. (1991). Age and inhibition. Journal of Experimental Psychology: Learning, Memory, and Cognition, 17(1), 163-169.

Hasher, L. & Zacks, R. T. (1988). Working memory, comprehension, and aging: A review and a new view. The Psychology of Learning and Motivation, 22, 193-225.

Kaufman, A. S. & Kaufman, N. K. (1990). Kaufman Brief Intelligence Test. Circle Pines, MN: American Guidance Service, Inc.

Luchins, A. S. (1942). Mechanization in problem-solving. Psychological Monographs, 54(6, Whole No. 248).

Luchins, A. S. & Luchins, E. H. (1950). New experimental attempts at preventing mechanization in problem solving. The Journal of General Psychology, 42, 279-297.

McKelvie, S. J. (1990). Einstellung: Luchins' effect lives on. Journal of Social Behavior and Personality, 5(4), 105-121.

Ransopher, S. B. & Thompson, D. N. (1991). Einstellung rigidity, set induction, and problem-solving in the elderly. Educational Gerontology, 17, 2,19-227.

Shaw, R. J. (1991). Age-related increases in the effects of automatic semantic activation. Psychology and Aging, 6,(4), 595-604.

Stuss, D. T. & Benson, D. F. (1984). Neuropsychological studies of the frontal lobes. Psychological Bulletin, 95(1), 3-28.

Vikki, J. (1988). Problem solving deficits after focal cerebral lesions. Cortex, 24, 119-127.

White, H. (1988). Semantic priming of anagram solutions. American Journal of Psychology, 101(3), 383-399.

Figure Caption

Figure 1. Interaction of group and set size on latency to target anagram reaction times.

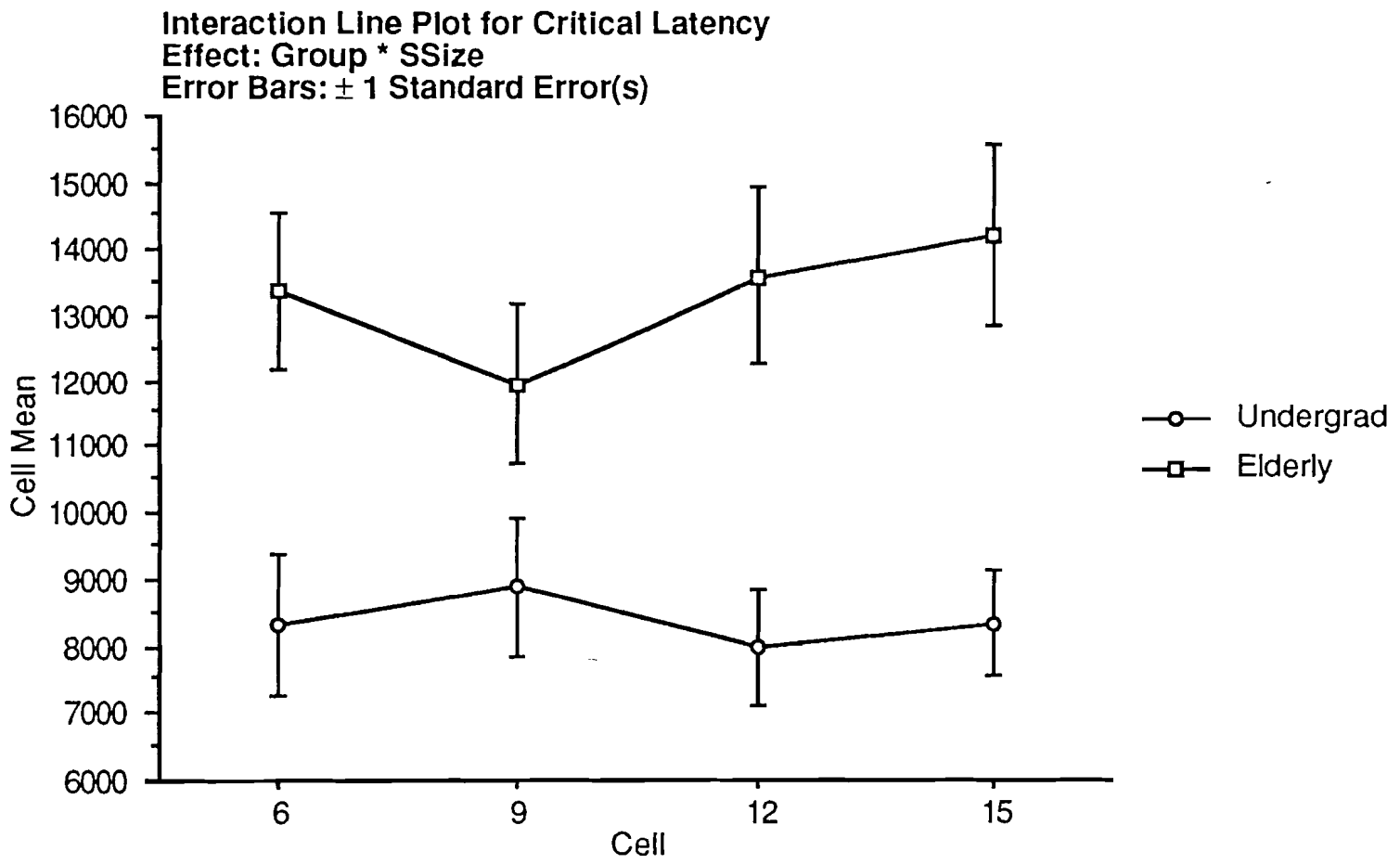
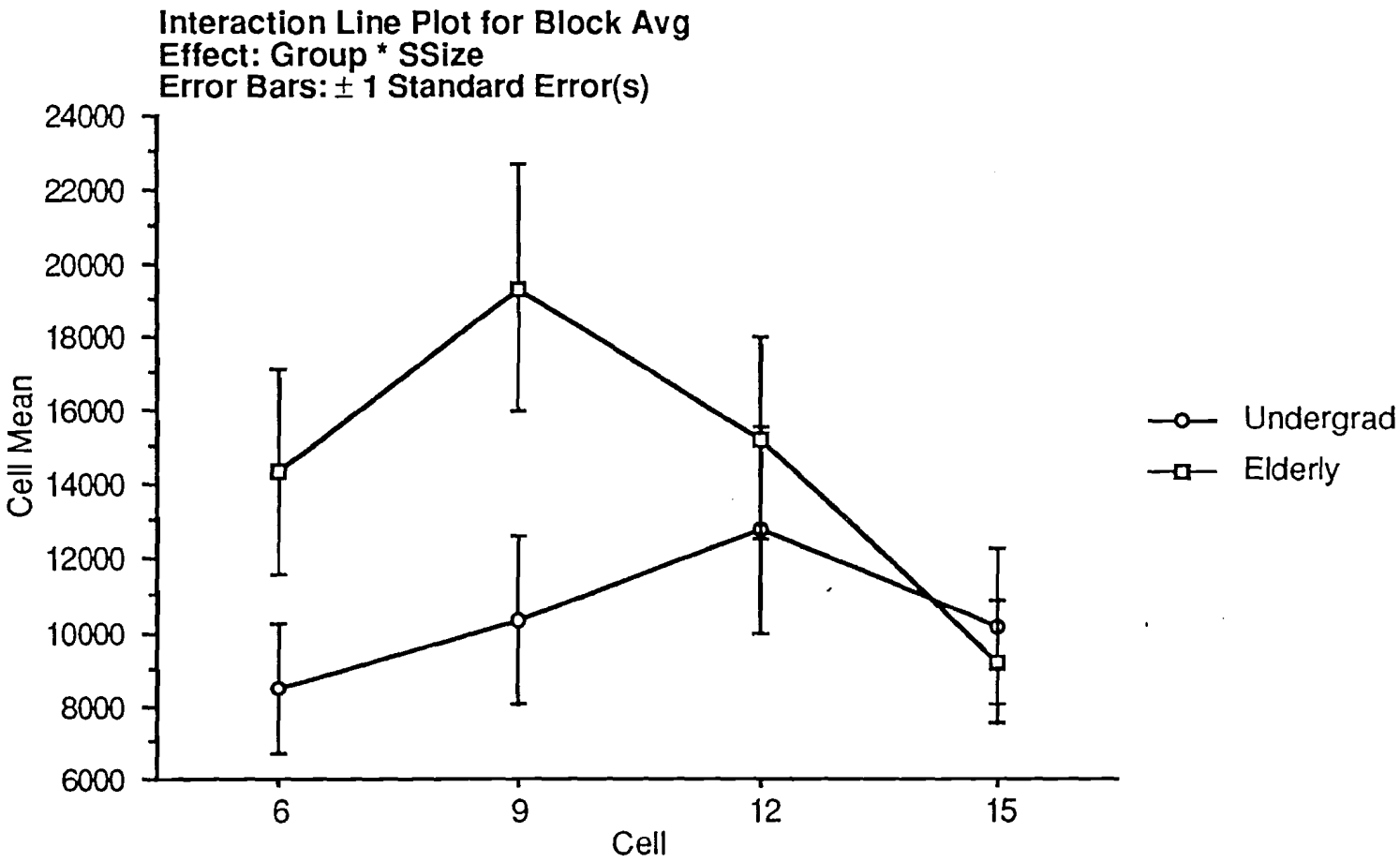

Interaction Line Plot for Critical Latency
Effect: Group * SSize
Error Bars: ± 1 Standard Error(s)
16000
15000
14000
13000
12000
11000
10000
9000
8000
7000
6000
Cell Mean
6
9
12
15
Cell
Undergrad
Elderly

Figure Caption

Figure 2. Interaction of group and set size to latency of block anagram reaction times.


Interaction Line Plot for Block Avg
Effect: Group * SSize
Error Bars: ± 1 Standard Error(s)
Cell Mean
24000
22000
20000
18000
16000
14000
12000
10000
8000
6000
6
9
12
15
Cell
Undergrad
Elderly

Appendix A

Illinois Wesleyan University

Department of Psychology

Consent Form for Undergraduate Research Participants

Title of Study: Inhibitory Mechanisms in the Development of Problem Solving Set
Principle Investigator: Johnna K. Shapiro, Ph.D.

This is a study of thinking and how thinking may change under different conditions. We are investigating whether factors such as age and presence or absence of brain-injury change the way that people solve problems. As a participant, you may be asked some general information questions pertaining to your medical and educational background and then be given two tests: a brief intelligence test which takes approximately 30 minutes, and a test involving the solution of word problems called **anagrams**, which also takes approximately 30 minutes and is administered on a computer. (Please note that no computer expertise is required and that your use of the computer will consist only of pressing one of two keys.)

The intelligence test contains items related to your vocabulary and your ability to solve spatial problems. The word test requires you to unscramble four letters to make a common word. You will be given several sets of these word problems and the time it takes you to solve them will be measured.

Your intelligence test score, as well as your solution times, will be kept completely confidential. Although the data collected today may be published in the future, your name will never be connected with your scores or with the study in published form.

There are no known risks involved with this study, and although some participants may find the problems challenging, most do not find the tasks uncomfortable.

There are no known direct benefits to you as a result of your participation in this study, but your participation may help others indirectly by providing us with information on the nature of memory as a result of aging or brain-injury.

As a participant in this study, you have the right to ask questions pertaining to the clarification of your tasks, and to be informed of the nature of the study before you begin. Your participation is voluntary, and as such, you have the right to refuse to participate or to withdraw from the study at any time, with no penalty or loss of benefit. You will receive additional information about the study following your participation. You may, if you wish, receive a copy of this consent form.

By signing below, you acknowledge that you have read this consent form and you understand your rights in this study.

Name of participant (please print)_____

Signature of participant_____

Date signed _____

Experimenter and witness signatures required on the back of this page.

Name of experimenter _____

Signature of experimenter _____

Date signed _____

Name of witness _____

Signature of witness _____

Date signed _____

Consent Form for Participation in Research

Title of Study: Inhibitory Mechanisms in the Development of Problem Solving Set
Principal Investigator: Johnna K. Shapiro, Ph.D.

This is a study of thinking and how thinking may change under different conditions. We are investigating whether factors such as age and presence or absence of brain-injury change the way that people solve problems. As a participant, you may be asked some general information questions pertaining to your medical and educational background and then be given two tests: a brief intelligence test which takes approximately 30 minutes, and a test involving the solution of word problems called **anagrams**, which also takes approximately 30 minutes and is administered on a computer. (Please note that no computer expertise is required and that your use of the computer will consist only of pressing one of two keys.)

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There are no known direct benefits to you as a result of your participation in this study, but your participation may help others indirectly by providing us with information on the nature of memory as a result of aging or brain-injury.

As a participant in this study, you have the right to ask questions pertaining to the clarification of your tasks, and to be informed of the nature of the study before you begin. Your participation is voluntary, and as such, you have the right to refuse to participate or to withdraw from the study at any time, with no penalty or loss of benefit. You will receive additional information about the study following your participation. You may, if you wish, receive a copy of this consent form.

Name of participant (please print) _____

Signature of participant _____

Date signed _____

Investigator and witness signatures required on the back of this page.

Name of participant (please print) _____

Signature of participant _____

Date signed _____

Name of investigator _____

Signature of investigator _____

Date signed _____

Name of witness _____

Signature of witness _____

Date signed _____

Location of testing: Date 1_____ **Date 2**_____

Background Data Sheet

Department of Psychology-Illinois Wesleyan Unviersity

General Information

Name_____

Address_____

Phone_____

Birthdate_____

Family Background

Marital Status S M D W

Children _____

Medical History

Current medications_____

Any past neurological problems (e.g., stroke(s), epilepsy, fainting, numbness, tingling)

Any current health problems:

Educational History

Highest level of formal education/degrees_____

Occupation_____

Special training/courses

Current classes or projects

See "Discontinue Rule" in Chapter 2 of the K-BIT manual for information on when to discontinue testing on each task.

See "Obtaining Raw Scores" in Chapter 3 of the K-BIT manual for information on how to calculate raw scores.

Suggestions for follow-up testing or other recommendations

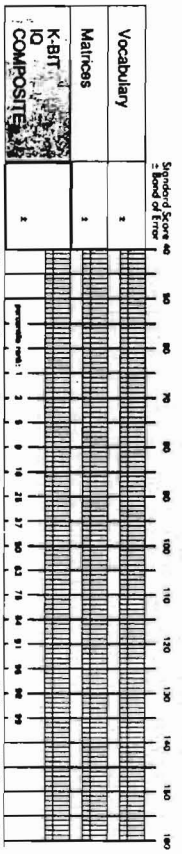
For additional forms, call or write AGS, 4201 Woodland Road, Circle Pines, MN. 55014-1796; toll-free 1-800-328-2560, in Canada 1-800-263-3558. Ask for item # QT3352, K-BIT Individual Test Records (25/package).

Printed on recycled paper

Kaufman Brief Intelligence Test

SCORE PROFILE

See "Graphing Standard Scores" in Chapter 3 of the K-BIT Manual for directions.



K-BIT KAUFMAN BRIEF INTELLIGENCE TEST

by Alan S. Kaufman and Nadeen L. Kaufman

Individual Test Record

Name _____ Sex ___

Parents' names _____

Home address _____ Phone _____

Grade (if enrolled in school) _____ Highest grade completed (if no longer in school) ____

Current or previous occupation (if applicable) _____

Examiner _____

	YEAR	MONTH	DAY
Test date			
Birth date			
Chronological age			

SUBTESTS	Raw Score	Subtest Standard Score ± Band of Error % Confidence (Table C.1, C.2)	National % Rank (Table C.4)	Description Category (Table C.4)	Other Data (please specify)
Expressive Vocabulary					
Definitions	+				
VOCABULARY		±			
MATRICES		±			

Sum of Subtest Standard Scores _____ Transfer sum to K-BIT IQ Composite below

COMPOSITE	Sum of Subtest Standard Scores	Composite Standard Score ± Band of Error % Confidence (Table C.2, C.3)	National % Rank (Table C.4)	Description Category (Table C.4)	Other Data (please specify)
K-BIT IQ COMPOSITE		±			

Subtest Standard Score Comparison	Vocabulary Standard Score	Matrices Standard Score	Standard Score Difference	Significance Level (please circle) Table C.5
				NS .05 .01

Subtest 1 – VOCABULARY
Part A – Expressive Vocabulary

	Item	Response	Score (circle)
	1. bed		1 0
	2. fork		1 0
	3. frog		1 0
	4. hammer		1 0
	5. bus		1 0
AGES 4-5	6. umbrella		1 0
	7. window		1 0
	8. piano		1 0
	9. ladder		1 0
	10. drum		1 0
AGES 6-7	11. leaf		1 0
	12. lamp		1 0
	13. flashlight		1 0
	14. owl		1 0
	15. smoke		1 0
AGES 8-9	16. feather		1 0
	17. bridge		1 0
	18. water fountain		1 0
	19. pencil sharpener		1 0
	20. calendar		1 0
AGES 9-10	21. lock		1 0
	22. doorknob		1 0
	23. penguin		1 0
	24. hook		1 0
	25. ruler		1 0
AGES 11-12	26. screw		1 0
	27. saddle		1 0
	28. binoculars		1 0
	29. globe		1 0
	30. cactus		1 0
AGES 13-90	31. cash register		1 0
	32. battery		1 0
	33. magnifying glass		1 0
	34. anchor		1 0
	35. antlers		1 0
	36. escalator		1 0
	37. tweezers		1 0
	38. fire extinguisher		1 0
	39. life jacket		1 0
	40. fire hydrant		1 0
	41. funnel		1 0
	42. outlet		1 0
	43. compass		1 0
	44. hexagon		1 0
	45. thermostat		1 0

Ceiling Item = highest item administered
Errors = total number of items scored 0

Ceiling Item ( )
minus Errors ( )
equals Raw Score [ ]

Comments and Observations

Subtest 1 – VOCABULARY
Part B – Definitions

	Item	Response	Score (circle)
AGES 4-5	Sample A	brown	
	Sample B	ambque	
AGES 6-7	1. school		1 0
	2. rainbow		1 0
	3. sunshine		1 0
	4. delicious		1 0
	5. plow		1 0
AGES 8-90	6. chimney		1 0
	7. daisy		1 0
	8. uncle		1 0
	9. Eskimos		1 0
	10. lie		1 0
	11. gallant		1 0
	12. experiment		1 0
	13. evacuate		1 0
	14. jeopardy		1 0
	15. gratitude		1 0
	16. elevate		1 0
	17. sufficient		1 0
	18. indicate		1 0
	19. vitamin		1 0
	20. relinquish		1 0
	21. confound		1 0
	22. tenacious		1 0
	23. hypo-chondriac		1 0
	24. chaos		1 0
	25. caricature		1 0
	26. apathetic		1 0
	27. indelible		1 0
	28. enamored		1 0
	29. clandestine		1 0
	30. omnipotent		1 0
	31. lethargic		1 0
	32. contingent		1 0
	33. rancor		1 0
	34. valedictorian		1 0
	35. acquiesce		1 0
	36. enigma		1 0
	37. serendipity		1 0

Ceiling Item ( )
minus Errors ( )
equals Raw Score [ ]

Comments and Observations

Subtest 2 – MATRICES

	Item	Response	Score (circle)
AGES 4-5	Sample A	A	
	1. A	___	1 0
	2. C	___	1 0
	3. E	___	1 0
	4. D	___	1 0
	5. A	___	1 0
	6. C	___	1 0
	7. B	___	1 0
	8. D	___	1 0
	9. E	___	1 0
AGES 6-90	Sample B	C	
	Ages 6-10 go to item 10. Ages 11-90 go to item 15.		
	10. A	___	1 0
	11. F	___	1 0
	12. B	___	1 0
	13. F	___	1 0
	14. C	___	1 0
	15. B	___	1 0
	16. A	___	1 0
	17. H	___	1 0
	18. C	___	1 0
	19. G	___	1 0
	20. A	___	1 0
	21. D	___	1 0
	22. F	___	1 0
	23. E	___	1 0
	24. E	___	1 0
	25. A	___	
	26. H	___	
	27. D	___	
	28. H	___	
	29. C	___	
	30. F	___	
	31. B	___	
	32. G	___	
	33. G	___	
	34. G	___	
	35. C	___	
	36. E	___	
	37. C	___	
	38. D	___	
	39. A	___	
	40. H	___	
	41. A	___	
	42. H	___	
	43. B	___	
	44. A	___	
	45. B	___	
	46. B	___	
	47. A	___	
	48. G	___	

Ceiling Item ( )
minus Errors ( )
equals Raw Score [ ]

Comments and Observations

WCST Record Booklet

Name _____ Test Date ____ / ____ / ____
(year / month / day)

ID # _____ Birth Date ____ / ____ / ____
(year / month / day)

Gender _____ Race _____ Handedness _____ Age _____

Occupation _____ Education _____

Examiner _____

Referral Information

Referral Question _____

Background Information/Presenting Complaints _____

Current Medications/Dosage _____

Behavioral Observations _____

TESTING SITUATION

Rapport	Cooperation	Effort on Test
☐ Excellent	☐ Excellent	☐ Excellent
☐ Good	☐ Adequate	☐ Adequate
☐ Fair	☐ Variable	☐ Fair
☐ Poor	☐ Resistant	☐ Variable
	☐ Noncompliant	☐ Poor

PAR Psychological Assessment Resources, Inc./P.O. Box 998/Odessa, FL 33556

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CATEGORY SEQUENCE: C F N C F N

___ 1. C F N O	___ 33. C F N O	___ 1. C F N O	___ 33. C F N O
___ 2. C F N O	___ 34. C F N O	___ 2. C F N O	___ 34. C F N O
___ 3. C F N O	___ 35. C F N O	___ 3. C F N O	___ 35. C F N O
___ 4. C F N O	___ 36. C F N O	___ 4. C F N O	___ 36. C F N O
___ 5. C F N O	___ 37. C F N O	___ 5. C F N O	___ 37. C F N O
___ 6. C F N O	___ 38. C F N O	___ 6. C F N O	___ 38. C F N O
___ 7. C F N O	___ 39. C F N O	___ 7. C F N O	___ 39. C F N O
___ 8. C F N O	___ 40. C F N O	___ 8. C F N O	___ 40. C F N O
___ 9. C F N O	___ 41. C F N O	___ 9. C F N O	___ 41. C F N O
___ 10. C F N O	___ 42. C F N O	___ 10. C F N O	___ 42. C F N O
___ 11. C F N O	___ 43. C F N O	___ 11. C F N O	___ 43. C F N O
___ 12. C F N O	___ 44. C F N O	___ 12. C F N O	___ 44. C F N O
___ 13. C F N O	___ 45. C F N O	___ 13. C F N O	___ 45. C F N O
___ 14. C F N O	___ 46. C F N O	___ 14. C F N O	___ 46. C F N O
___ 15. C F N O	___ 47. C F N O	___ 15. C F N O	___ 47. C F N O
___ 16. C F N O	___ 48. C F N O	___ 16. C F N O	___ 48. C F N O
___ 17. C F N O	___ 49. C F N O	___ 17. C F N O	___ 49. C F N O
___ 18. C F N O	___ 50. C F N O	___ 18. C F N O	___ 50. C F N O
___ 19. C F N O	___ 51. C F N O	___ 19. C F N O	___ 51. C F N O
___ 20. C F N O	___ 52. C F N O	___ 20. C F N O	___ 52. C F N O
___ 21. C F N O	___ 53. C F N O	___ 21. C F N O	___ 53. C F N O
___ 22. C F N O	___ 54. C F N O	___ 22. C F N O	___ 54. C F N O
___ 23. C F N O	___ 55. C F N O	___ 23. C F N O	___ 55. C F N O
___ 24. C F N O	___ 56. C F N O	___ 24. C F N O	___ 56. C F N O
___ 25. C F N O	___ 57. C F N O	___ 25. C F N O	___ 57. C F N O
___ 26. C F N O	___ 58. C F N O	___ 26. C F N O	___ 58. C F N O
___ 27. C F N O	___ 59. C F N O	___ 27. C F N O	___ 59. C F N O
___ 28. C F N O	___ 60. C F N O	___ 28. C F N O	___ 60. C F N O
___ 29. C F N O	___ 61. C F N O	___ 29. C F N O	___ 61. C F N O
___ 30 C F N O	___ 62. C F N O	___ 30. C F N O	___ 62. C F N O
___ 31. C F N O	___ 63. C F N O	___ 31. C F N O	___ 63. C F N O
___ 32. C F N O	___ 64 C F N O	___ 32. C F N O	___ 64. C F N O

SCORING AREA

	Raw score	Standard score	*T* score	Percentile score
Number of Trials Administered				
Total Number Correct				
Total Number of Errors				
Percent Errors				
Perseverative Responses				
Percent Perseverative Responses				
Perseverative Errors				
Percent Perseverative Errors				
Nonperseverative Errors				
Percent Nonperseverative Errors				
Conceptual Level Responses				
Percent Conceptual Level Responses				

	Raw score	Percentile range
Number of Categories Completed		
Trials to Complete First Category		
Failure to Maintain Set		
Learning to Learn		

Normative table _____

Learning to Learn Score Worksheet				
Category number	**Number of trials**	**Errors**	**Percent errors**	**Percent errors difference score**
1				
2				
3				
4				
5				
6				
			Average difference	

Sub 519
Wednesday, April 26, 1995

1 : girl	51 : hand	101 : jump
2 : sigh	52 : swim	102 : fake
3 : mind	53 : hair	103 : harp
4 : jinx	54 : echo	104 : gold
5 : math	55 : hole	105 : back
6 : unit	56 : loan	106 : stay
7 : know	57 : fund	107 : fact
8 : hunt	58 : fork	108 : tack
9 : lash	59 : wage	109 : cent
10 : hope	60 : wish	110 : cart
11 : wife	61 : oven	111 : give
12 : bump	62 : walk	112 : help
13 : song	63 : hang	113 : chat
14 : lend	64 : gown	114 : push
15 : melt	65 : card	115 : myth
16 : womb	66 : suit	116 : duty
17 : word	67 : curl	117 : pick
18 : bank	68 : ruin	118 : date
19 : wait	69 : want	119 : boat
20 : dirt	70 : luck	120 : bone
21 : park	71 : whip	121 : cite
22 : sake	72 : size	122 : road
23 : defy	73 : wave	123 : dock
24 : farm	74 : boil	124 : firm
25 : mark	75 : wipe	125 : load
26 : foam	76 : stir	126 : milk
27 : gift	77 : warn	127 : gaze
28 : corn	78 : band	128 : stem
29 : camp	79 : axis	129 : hour
30 : cash	80 : plan	130 : yank
31 : hurl	81 : glow	131 : type
32 : dump	82 : mold	132 : moth
33 : find	83 : worm	133 : path
34 : term	84 : plot	134 : tick
35 : burn	85 : fail	135 : talk
36 : trim	86 : duck	136 : join
37 : cope	87 : drip	137 : like
38 : pray	88 : gate	138 : loft
39 : fish	89 : crew	139 : copy
40 : frog	90 : folk	140 : pair
41 : bind	91 : home	141 : base
42 : urge	92 : hunk	142 : club
43 : mock	93 : come	143 : jury
44 : film	94 : obey	144 : bite
45 : lung	95 : grow	145 : shed
46 : trip	96 : hold	146 : body
47 : bend	97 : lady	147 : work
48 : bond	98 : vary	148 : soul
49 : pack	99 : wind	149 : land
50 : neck	100 : rice	150 : city