

Idea Organization and Idea Recall

S.R. Young and L.E. Bourne, Jr.

University of Colorado

Navy

- 1 Dr. Meryl S. Baker
Navy Personnel R&D Center
San Diego, CA 92152
- 1 CDR Robert J. Biersner
Naval Medical R&D Command
National Naval Medical Center
Bethesda, MD 20814
- 1 Liaison Scientist
Office of Naval Research
Branch Office, London
Box 39
FPO New York, NY 09510
- 1 Dr. Richard Cantone
Navy Research Laboratory
Code 7510
Washington, DC 20375
- 1 Dr. Stanley Collyer
Office of Naval Technology
800 N. Quincy Street
Arlington, VA 22217
- 1 CDR Mike Curran
Office of Naval Research
800 N. Quincy St.
Code 270
Arlington, VA 22217
- 1 Dr. Tom Duffy
Navy Personnel R&D Center
San Diego, CA 92152
- 1 Dr. Carl E. Englund
Naval Health Research Center
Code 8060 Environmental Physiology Dept
P.O. Box 85122
San Diego, CA 92138
- 1 DR. PAT FEDERICO
Code P13
NPRDC
San Diego, CA 92152
- 1 Dr. John Ford
Navy Personnel R&D Center
San Diego, CA 92152
- 1 Dr. Mike Gaynor
Navy Research Laboratory
Code 7510
Washington, DC 20375

Navy

- 1 Dr. Jim Hollan
Code 304
Navy Personnel R & D Center
San Diego, CA 92152
- 1 Dr. Ed Hutchins
Navy Personnel R&D Center
San Diego, CA 92152
- 1 Dr. Norman J. Kerr
Chief of Naval Technical Training
Naval Air Station Memphis (75)
Millington, TN 38054
- 1 Dr. Peter Kincaid
Training Analysis & Evaluation Group
Dept. of the Navy
Orlando, FL 32813
- 1 Dr. James Lester
ONR Detachment
495 Summer Street
Boston, MA 02210
- 1 Dr. Ray Main
Code 14
Navy Personnel R&D Center
San Diego, CA 92152
- 1 Dr. William L. Maloy
Principal Civilian Advisor for
Education and Training
Naval Training Command, Code 00A
Pensacola, FL 32508
- 1 Dr William Montague
NPRDC Code 13
San Diego, CA 92152
- 1 Library, Code P201L
Navy Personnel R&D Center
San Diego, CA 92152
- 1 Technical Director
Navy Personnel R&D Center
San Diego, CA 92152
- 6 Commanding Officer
Naval Research Laboratory
Code 2627
Washington, DC 20390

Navy

- 1 Office of Naval Research
Code 433
800 N. Quincy Street
Arlington, VA 22217
- 6 Personnel & Training Research Group
Code 442PT
Office of Naval Research
Arlington, VA 22217
- 1 Office of the Chief of Naval Operations
Research Development & Studies Branch
OP 115
Washington, DC 20350
- 1 Dr. Worth Scanland
CNET (N-5)
NAS, Pensacola, FL 32508
- 1 Mr. Irving Schiff
Dept. of the Navy
Chief of Naval Operations
OP 113
Washington, DC 20350
- 1 Dr. Robert G. Smith
Office of Chief of Naval Operations
OP-987H
Washington, DC 20350
- 1 Dr. Alfred F. Smode, Director
Training Analysis & Evaluation Group
Dept. of the Navy
Orlando, FL 32813
- 1 Dr. Richard Sorensen
Navy Personnel R&D Center
San Diego, CA 92152
- 1 Dr. Frederick Steinheiser
CNO - OP115
Navy Annex
Arlington, VA 20370
- 1 Roger Weissinger-Baylon
Department of Administrative Sciences
Naval Postgraduate School
Monterey, CA 93940
- 1 Dr. Douglas Wetzel
Code 12
Navy Personnel R&D Center
San Diego, CA 92152

Navy

- 1 Mr John H. Wolfe
Navy Personnel R&D Center
San Diego, CA 92152

Marine Corps

- 1 H. William Greenup
Education Advisor (E031)
Education Center, MCDEC
Quantico, VA 22134
- 1 Special Assistant for Marine
Corps Matters
Code 100M
Office of Naval Research
800 N. Quincy St.
Arlington, VA 22217
- 1 DR. A.L. SLAFKOSKY
SCIENTIFIC ADVISOR (CODE RD-1)
HQ, U.S. MARINE CORPS
WASHINGTON, DC 20380

Army

- 1 Technical Director
U. S. Army Research Institute for the
Behavioral and Social Sciences
5001 Eisenhower Avenue
Alexandria, VA 22333
- 1 Mr. James Baker
Army Research Institute
5001 Eisenhower Avenue
Alexandria, VA 22333
- 1 Dr. Beatrice J. Farr
U. S. Army Research Institute
5001 Eisenhower Avenue
Alexandria, VA 22333
- 1 Dr. Milton S. Katz
Training Technical Area
U.S. Army Research Institute
5001 Eisenhower Avenue
Alexandria, VA 22333
- 1 Dr. Marshall Narva
US Army Research Institute for the
Behavioral & Social Sciences
5001 Eisenhower Avenue
Alexandria, VA 22333
- 1 Dr. Harold F. O'Neil, Jr.
Director, Training Research Lab
Army Research Institute
5001 Eisenhower Avenue
Alexandria, VA 22333
- 1 Dr. Joseph Psotka
Army Research Institute
5001 Eisenhower Avenue
Alexandria, VA 22333
- 1 Dr. Robert Sasmor
U. S. Army Research Institute for the
Behavioral and Social Sciences
5001 Eisenhower Avenue
Alexandria, VA 22333
- 1 Dr. Robert Wisher
Army Research Institute
5001 Eisenhower Avenue
Alexandria, VA 22333

Air Force

- 1 AFHRL/LRS
Attn: Susan Ewing
WPAFB
WPAFB, OH 45433
- 1 U.S. Air Force Office of Scientific
Research
Life Sciences Directorate, NL
Bolling Air Force Base
Washington, DC 20332
- 1 Air University Library
AUL/LSE 76/443
Maxwell AFB, AL 36112
- 1 Dr. Earl A. Alluisi
HQ, AFHRL (AFSC)
Brooks AFB, TX 78235
- 1 Bryan Dallman
AFHRL/LRT
Lowry AFB, CO 80230
- 1 Dr. Genevieve Haddad
Program Manager
Life Sciences Directorate
AFOSR
Bolling AFB, DC 20332
- 1 Dr. T. M. Longridge
AFHRL/OTGT
Williams AFB, AZ 85224
- 1 Dr. Joseph Yasatuke
AFHRL/OT
Williams AFB, AZ 58224

Department of Defense

- 12 Defense Technical Information Center
Cameron Station, Bldg 5
Alexandria, VA 22314
Attn: TC
- 1 Military Assistant for Training and
Personnel Technology
Office of the Under Secretary of Defense
for Research & Engineering
Room 3D129, The Pentagon
Washington, DC 20301
- 1 Major Jack Thorpe
DARPA
1400 Wilson Blvd.
Arlington, VA 22209

Civilian Agencies

- 1 Dr. Patricia A. Butler
NIE-BRN Bldg, Stop # 7
1200 19th St., NW
Washington, DC 20208
- 1 Dr. Paul G. Chapin
Linguistics Program
National Science Foundation
Washington, DC 20550
- 1 Dr. Susan Chipman
Learning and Development
National Institute of Education
1200 19th Street NW
Washington, DC 20208
- 1 Dr. John Mays
National Institute of Education
1200 19th Street NW
Washington, DC 20208
- 1 Dr. Arthur Melmed
OERI
1200 19th Street NW
Washington, DC 20208
- 1 Dr. Andrew R. Molnar
Office of Scientific and Engineering
Personnel and Education
National Science Foundation
Washington, DC 20550
- 1 Dr. Judith Orasanu
National Institute of Education
1200 19th St., N.W.
Washington, DC 20208
- 1 Dr. Ramsay W. Selden
National Institute of Education
1200 19th St., NW
Washington, DC 20208
- 1 Chief, Psychological Reserch Branch
U. S. Coast Guard (G-P-1/2/TP42)
Washington, DC 20593
- 1 Dr. Frank Withrow
U. S. Office of Education
400 Maryland Ave. SW
Washington, DC 20202

Civilian Agencies

- 1 Dr. Joseph L. Young, Director
Memory & Cognitive Processes
National Science Foundation
Washington, DC 20550

Private Sector

- 1 Dr. Erling B. Andersen
Department of Statistics
Studiestraede 6
1455 Copenhagen
DENMARK
- 1 Dr. John R. Anderson
Department of Psychology
Carnegie-Mellon University
Pittsburgh, PA 15213
- 1 Dr. Nancy S. Anderson
Department of Psychology
University of Maryland
College Park, MD 20742
- 1 Dr. Thomas H. Anderson
Center for the Study of Reading
174 Children's Research Center
51 Gerty Drive
Champaign, IL 61820
- 1 Dr. John Annett
Department of Psychology
University of Warwick
Coventry CV4 7AJ
ENGLAND
- 1 Dr. Michael Atwood
Bell Laboratories
11900 North Pecos St.
Denver, CO 80234
- 1 Psychological Research Unit
Dept. of Defense (Army Office)
Campbell Park Offices
Canberra ACT 2600
AUSTRALIA
- 1 Dr. Alan Baddeley
Medical Research Council
Applied Psychology Unit
15 Chaucer Road
Cambridge CB2 2EF
ENGLAND
- 1 Dr. Patricia Baggett
Department of Psychology
University of Colorado
Boulder, CO 80309
- 1 Dr. Jonathan Baron
80 Glenn Avenue
Berwyn, PA 19312

Private Sector

- 1 Dr. George R. Bieger
B-110 Coleman Hall
Bucknell University
Lewisburg, PA 17837
- 1 Dr. John Black
Yale University
Box 11A, Yale Station
New Haven, CT 06520
- 1 Dr. John S. Brown
XEROX Palo Alto Research Center
3333 Coyote Road
Palo Alto, CA 94304
- 1 Bundministerium der Verteidigung
-Referat P II 4-
Psychological Service
Postfach 1328
D-5300 Bonn 1
F. R. of Germany
- 1 Dr. C. Victor Bunderson
WICAT Inc.
University Plaza, Suite 10
1160 So. State St.
Orem, UT 84057
- 1 Dr. Jaime Carbonell
Carnegie-Mellon University
Department of Psychology
Pittsburgh, PA 15213
- 1 Dr. Pat Carpenter
Department of Psychology
Carnegie-Mellon University
Pittsburgh, PA 15213
- 1 Dr. William Chase
Department of Psychology
Carnegie Mellon University
Pittsburgh, PA 15213
- 1 Dr. Micheline Chi
Learning R & D Center
University of Pittsburgh
3939 O'Hara Street
Pittsburgh, PA 15213
- 1 Dr. William Clancey
Department of Computer Science
Stanford University
Stanford, CA 94306

Private Sector

- 1 Dr. Allan M. Collins
Bolt Beranek & Newman, Inc.
50 Moulton Street
Cambridge, MA 02138
- 1 Dr. Lynn A. Cooper
LRDC
University of Pittsburgh
3939 O'Hara Street
Pittsburgh, PA 15213
- 1 Dr. Kenneth E. Cross
Anacapa Sciences, Inc.
P.O. Drawer Q
Santa Barbara, CA 93102
- 1 LCOL J. C. Eggenberger
DIRECTORATE OF PERSONNEL APPLIED RESEAR
NATIONAL DEFENCE HQ
101 COLONEL BY DRIVE
OTTAWA, CANADA K1A
- 1 Dr. Jeffrey Elman
University of California, San Diego
Department of Linguistics
La Jolla, CA 92093
- 1 ERIC Facility-Acquisitions
4833 Rugby Avenue
Bethesda, MD 20014
- 1 Dr. Paul Feltovich
Department of Medical Education
Southern Illinois University
School of Medicine
P.O. Box 3926
Springfield, IL 62708
- 1 Professor Reuven Feuerstein
HWCRI Rehov Karmon 6
Bet Hakerem
Jerusalem
Israel
- 1 Mr. Wallace Feurzeig
Department of Educational Technology
Bolt Beranek & Newman
10 Moulton St.
Cambridge, MA 02238
- 1 Dr. Victor Fields
Dept. of Psychology
Montgomery College
Rockville, MD 20850

Private Sector

- 1 Univ. Prof. Dr. Gerhard Fischer
Liebiggasse 5/3
A 1010 Vienna
AUSTRIA
- 1 Dr. Dexter Fletcher
WICAT Research Institute
1875 S. State St.
Orem, UT 22333
- 1 Dr. John R. Frederiksen
Bolt Beranek & Newman
50 Moulton Street
Cambridge, MA 02138
- 1 Dr. Alinda Friedman
Department of Psychology
University of Alberta
Edmonton, Alberta
CANADA T6G 2E9
- 1 Dr. Robert Glaser
Learning Research & Development Center
University of Pittsburgh
3939 O'Hara Street
PITTSBURGH, PA 15260
- 1 Dr. Marvin D. Glock
217 Stone Hall
Cornell University
Ithaca, NY 14853
- 1 Dr. Josph Goguen
SRI International
333 Ravenswood Avenue
Menlo Park, CA 94025
- 1 Dr. Daniel Gopher
Department of Psychology
University of Illinois
Champaign, IL 61820
- 1 DR. JAMES G. GREENO
LRDC
UNIVERSITY OF PITTSBURGH
3939 O'HARA STREET
PITTSBURGH, PA 15213
- 1 Dr. Barbara Hayes-Roth
Department of Computer Science
Stanford University
Stanford, CA 95305

Private Sector

- 1 Dr. Kristina Hooper
Clark Kerr Hall
University of California
Santa Cruz, CA 95060
- 1 Glenda Greenwald, Ed.
Human Intelligence Newsletter
P. O. Box 1163
Birmingham, MI 48012
- 1 Dr. Earl Hunt
Dept. of Psychology
University of Washington
Seattle, WA 98105
- 1 Dr. Steven W. Keele
Dept. of Psychology
University of Oregon
Eugene, OR 97403
- 1 Dr. Scott Kelso
Haskins Laboratories, Inc
270 Crown Street
New Haven, CT 06510
- 1 Dr. David Kieras
Department of Psychology
University of Arizona
Tucson, AZ 85721
- 1 Dr. Walter Kintsch
Department of Psychology
University of Colorado
Boulder, CO 80302
- 1 Dr. Stephen Kosslyn
Department of Psychology
Brandeis University
Waltham, MA 02254
- 1 Dr. Pat Langley
Carnegie-Mellon University
Pittsburgh, PA 15213
- 1 Dr. Marcy Lansman
The L. L. Thurstone Psychometric
Laboratory
University of North Carolina
Davie Hall 013A
Chapel Hill, NC 27514

Private Sector

- 1 Dr. Jill Larkin
Department of Psychology
Carnegie Mellon University
Pittsburgh, PA 15213
- 1 Dr. Alan Lesgold
Learning R&D Center
University of Pittsburgh
3939 O'Hara Street
Pittsburgh, PA 15260
- 1 Dr. Jim Levin
University of California
at San Diego
Laboratory of Comparative
Human Cognition - D003A
La Jolla, CA 92093
- 1 Dr. Michael Levine
Department of Educational Psychology
210 Education Bldg.
University of Illinois
Champaign, IL 61801
- 1 Dr. Robert Linn
College of Education
University of Illinois
Urbana, IL 61801
- 1 Dr. Jay McClelland
Department of Psychology
MIT
Cambridge, MA 02139
- 1 Dr. James R. Miller
Texas Instruments, Inc.
Central Research Laboratory
P. O. Box 226015, MS238
Dallas, TX 75266
- 1 Dr. Mark Miller
Computer Thought Corporation
1721 West Plane Parkway
Plano, TX 75075
- 1 Dr. Tom Moran
Xerox PARC
3333 Coyote Hill Road
Palo Alto, CA 94304
- 1 Dr. Allen Munro
Behavioral Technology Laboratories
1845 Elena Ave., Fourth Floor
Redondo Beach, CA 90277

Private Sector

- 1 Dr. Donald A Norman
Cognitive Science, C-015
Univ. of California, San Diego
La Jolla, CA 92093
- 1 Dr. Jesse Orlansky
Institute for Defense Analyses
1801 N. Beauregard St.
Alexandria, VA 22311
- 1 Dr. James W. Pellegrino
University of California,
Santa Barbara
Dept. of Psychology
Santa Barbara, CA 93106
- 1 Dr. Nancy Pennington
University of Chicago
5801 S. Ellis Avenue
Chicago, IL 60637
- 1 Mr. L. Petrullo
2431 N. Edgewood Street
ARLINGTON, VA 22207
- 1 DR. PETER POLSON
DEPT. OF PSYCHOLOGY
UNIVERSITY OF COLORADO
BOULDER, CO 80309
- 1 Dr. Fred Reif
Physics Department
University of California
Berkeley, CA 94720
- 1 Dr. Lauren Resnick
LRDC
University of Pittsburgh
3939 O'Hara Street
Pittsburgh, PA 1521
- 1 Mary S. Riley
Program in Cognitive Science
Center for Human Information Processing
University of California, San Diego
La Jolla, CA 92093
- 1 Dr. Andrew M. Rose
American Institutes for Research
1055 Thomas Jefferson St. NW
Washington, DC 20007

Private Sector

- 1 Dr. Ernst Z. Rothkopf
Bell Laboratories
Murray Hill, NJ 07974
- 1 Dr. William B. Rouse
Georgia Institute of Technology
School of Industrial & Systems
Engineering
Atlanta, GA 30332
- 1 Dr. David Rumelhart
Center for Human Information Processing
Univ. of California, San Diego
La Jolla, CA 92093
- 1 Dr. Michael J. Samet
Perceptronics, Inc
6271 Variel Avenue
Woodland Hills, CA 91364
- 1 Dr. Arthur Samuel
Yale University
Department of Psychology
Box 11A, Yale Station
New Haven, CT 06520
- 1 Dr. Roger Schank
Yale University
Department of Computer Science
P.O. Box 2158
New Haven, CT 06520
- 1 Dr. Walter Schneider
Psychology Department
603 E. Daniel
Champaign, IL 61820
- 1 Dr. Alan Schoenfeld
Mathematics and Education
The University of Rochester
Rochester, NY 14627
- 1 DR. ROBERT J. SEIDEL
INSTRUCTIONAL TECHNOLOGY GROUP
HUMRRO
300 N. WASHINGTON ST.
ALEXANDRIA, VA 22314
- 1 Mr. Colin Sheppard
Applied Psychology Unit
Admiralty Marine Technology Est.
Teddington, Middlesex
United Kingdom

Private Sector

- 1 Dr. H. Wallace Sinaiko
Program Director
Manpower Research and Advisory Services
Smithsonian Institution
801 North Pitt Street
Alexandria, VA 22314
- 1 Dr. Edward E. Smith
Bolt Beranek & Newman, Inc.
50 Moulton Street
Cambridge, MA 02138
- 1 Dr. Richard Snow
School of Education
Stanford University
Stanford, CA 94305
- 1 Dr. Elliott Soloway
Yale University
Department of Computer Science
P.O. Box 2158
New Haven, CT 06520
- 1 Dr. Kathryn T. Spoehr
Psychology Department
Brown University
Providence, RI 02912
- 1 Dr. Robert Sternberg
Dept. of Psychology
Yale University
Box 11A, Yale Station
New Haven, CT 06520
- 1 Dr. Albert Stevens
Bolt Beranek & Newman, Inc.
10 Moulton St.
Cambridge, MA 02238
- 1 David E. Stone, Ph.D.
Hazeltine Corporation
7680 Old Springhouse Road
McLean, VA 22102
- 1 DR. PATRICK SUPPES
INSTITUTE FOR MATHEMATICAL STUDIES IN
THE SOCIAL SCIENCES
STANFORD UNIVERSITY
STANFORD, CA 94305
- 1 Dr. Kikumi Tatsuoka
Computer Based Education Research Lab
252 Engineering Research Laboratory
Urbana, IL 61801

Private Sector

- 1 Dr. Perry W. Thorndyke
Perceptronics, Inc.
545 Middlefield Road, Suite 140
Menlo Park, CA 94025
- 1 Dr. Douglas Towne
Univ. of So. California
Behavioral Technology Labs
1845 S. Elena Ave.
Redondo Beach, CA 90277
- 1 Dr. Benton J. Underwood
Dept. of Psychology
Northwestern University
Evanston, IL 60201
- 1 Dr. Kurt Van Lehn
Xerox PARC
3333 Coyote Hill Road
Palo Alto, CA 94304
- 1 Dr. Keith T. Wescourt
Perceptronics, Inc.
545 Middlefield Road, Suite 140
Menlo Park, CA 94025
- 1 DR. SUSAN E. WHITELY
PSYCHOLOGY DEPARTMENT
UNIVERSITY OF KANSAS
Lawrence, KS 66045
- 1 William B. Whitten
Bell Laboratories
2D-610
Holmdel, NJ 07733
- 1 Dr. Christopher Wickens
Department of Psychology
University of Illinois
Champaign, IL 61820
- 1 Dr. Mike Williams
Xerox PARC
3333 Coyote Hill Road
Palo Alto, CA 94304



DEPARTMENT OF THE NAVY
OFFICE OF NAVAL RESEARCH
ARLINGTON, VIRGINIA 22217

IN REPLY REFER TO
442:MJF:dfg
Ser 83- 78
15 Dec 1982

Dr. Lyle E. Bourne, Jr.
Institute of Cognitive Science
University of Colorado
Muenzinger Building, Campus Box 345
Boulder, Colorado 80309

Dear Lyle:

The title and abstract of your technical report "Idea Organization and Idea Recall" have been reviewed.

I am enclosing an updated distribution list for the report, together with two DTIC Form 50 cards. You should refer to the enclosed Research Reporting Requirements and Procedures package for detailed guidance regarding preparation and distribution. Please read this document carefully before you issue any report. Your attention is called particularly to the requirement involving the DTIC Accession Notice. Special plans on your part to comply with this requirement would be particularly appreciated.

Please note that, with respect to the enclosed distribution list, the number immediately preceding each name indicates how many copies should be sent to that addressee.

Sincerely,

Dorothy F. Gabor
Secretary for
MARSHALL J. FARR
Leader,
Personnel and Training
Research Group

Enclosures:

- (1) Distribution List
- (2) DTIC Form 50 Cards
- (3) Research Reporting Requirements
and Procedures Package

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER ONR-119	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) Idea Organization & Idea Recall		5. TYPE OF REPORT & PERIOD COVERED Technical Report
		6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) S.R. Young, Lyle E. Bourne, Jr.		8. CONTRACT OR GRANT NUMBER(s) N00014-78-C-0433
9. PERFORMING ORGANIZATION NAME AND ADDRESS Institute of Cognitive Science University of Colorado Boulder, CO		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS NR-157-422
11. CONTROLLING OFFICE NAME AND ADDRESS Personnel and Training Research Programs Office of Naval Research (Code 458) Arlington, VA		12. REPORT DATE December, 1982
		13. NUMBER OF PAGES 10
		15. SECURITY CLASS. (of this report) Unclassified
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE
16. DISTRIBUTION STATEMENT (of this Report) Approved for public release; distribution limited		
17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)		
18. SUPPLEMENTARY NOTES		
19. KEY WORDS (Continue on reverse side if necessary and identify by block number) recall, memory, writing		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number) The effects of organizing ideas to produce a written text are investigated and discussed in terms of models of long term memory (Raijmakers & Shiffrin) and of composition (Flower & Hayes). Subjects generated ideas relevant to a specific topic on Day 1. Then they organized their ideas and wrote a coherent text on the topic. Twenty four hours later, subjects tended to free recall groups of ideas that had been clustered together during the text organization phase of the experiment, consistent with the time locking cluster of Raijmakers and Shiffrin.		

Abstract

The effects of organizing ideas to produce a written text are investigated and discussed in terms of models of long term memory (Raijmakers & Shiffrin) and of composition (Flower & Hayes). Subjects generated ideas relevant to a specific topic on Day 1. Then they organized their ideas and wrote a coherent text on the topic. Twenty four hours later, subjects tended to free recall groups of ideas that had been clustered together during the text organization phase of the experiment, consistent with the time locking cluster hypotheses of Raijmakers and Shiffrin.

Idea Organization and Idea Recall

Writing draws upon many of the same psychological processes involved in reading and text comprehension (Kintsch & van Dijk, 1978). Notably, both reading and writing involve the use of knowledge stored in long term memory. The writer draws ideas relevant to his/her topic from long term memory. Similarly, the reader draws upon relevant knowledge to construct a frame suitable for comprehending text. In the study that follows, we investigate changes in the organization of ideas in long term memory as a result their retrieval and use in various writing-related activities.

One of the most widely accepted and empirically well-documented models of long term memory was developed by Raijmakers and Shiffrin (1981). In their model, long term memory is conceived as a propositional network of ideas. It is organized in the sense that certain propositional nodes are related to one another, i.e., stored in proximity to one another. Within a knowledge cluster, there may exist many subclusters. This general structure of knowledge clusters and related subclusters is revealed when subjects freely generate ideas. It is our intent to investigate how the relationships among items within a subcluster and between subclusters change, after generation as a result of the organizational processes involved in writing.

Flower and Hayes (1979) have developed an analysis of writing that sets forth certain expectations about how the writing task should affect permanent memory structures. In their model, the writing process is conceived as three major subprocesses with distinct psychological characteristics. The subprocesses are planning, translating, and editing. The planning process is subdivided into three components: generating and organizing ideas, and goal setting (the latter is a control process that

decides when to schedule generating, organizing, translating, or reviewing). The generating process is initiated by retrieval cues. In writing, the first memory probe is provided by information about the topic and the intended audience. As items are retrieved, associative chains are formed. Associative links are broken whenever something not useful to the writing task is retrieved. Generally, the ideas retrieved from long term memory are fragmentary and disconnected. The subprocess of organizing thus becomes important in determining the final written product.

Organizing involves hierarchically arranging goals or particular aspects of the topic to be discussed. These goals have subgoals or subtopics and supporting arguments. Flower and Hayes describe five elementary operators that work to organize the writer's goals -- identify first or last topic; order with respect to previous topic; find subordinate topic; find superordinate topic; and identify category. These operators are believed to be primarily responsible for transforming the generated ideas into written text.

While other processes are also involved in constructing a written text, we concentrate here on the subprocesses of generating and organizing. Our rationale is based on Flower and Hayes' predictions that the associative connections revealed in the generating stage will appear in the same sequence later unless an organizing process intervenes. Thus, we attempt to test whether the organizing subprocess affects items stored in permanent knowledge structures by assessing whether a later recall task is influenced by an intervening organizational task.

We conducted two pilot studies to determine whether recall order was more closely correlated with generation order or order of subsequent organization. In Study 1, subjects generated 12 ideas on a given topic and rank ordered them for importance to an article that they might write about

that topic. Twenty-four hours later they free recalled as many ideas as possible. Then subjects ordered their ideas to form a coherent text outline three times independently. The results of Spearman rank order correlations revealed that recall order was uncorrelated with both generation and organization orders.

Study 2 was similar to Study 1 except that subjects generated ideas, rank ordered them and performed a free recall task during the same session. Again, order was unrelated to recall order although free recall order was negatively correlated with generation order.

As a result of these pilot findings, we decided to evaluate possible changes in long term memory in a different way. As the order of ideas recalled seemed unrelated to organization order, we investigated whether units of main and supporting ideas produced during organization cohered during recall, as might be suggested by the cluster/subcluster hypothesis of Raijmakers and Shiffrin.

Method

Subjects

Eighteen undergraduate students from the University of Colorado served as subjects for this experiment, thus fulfilling course requirements. Two experimental groups were formed by randomly assigning nine subjects to a group.

Procedure

On Day 1 (Generation), all subjects generated 20 ideas on how college differs from high school. Each idea was written on a numbered index card to reflect the generation order. Subjects in Group 1 (Organization) then

arranged their ideas in sequence using two orders, main ideas and supporting ideas. They were instructed to develop a coherent outline of a text, using only the ideas generated on the preceding day. This outline was then written on a sheet of paper. Subjects in Group 2 (Writing) were asked to write a text using the ideas they generated. The index cards were then used to identify the idea numbers corresponding to the texts of Group 2.

Subjects returned for a third session 24 hours later and were instructed to number their papers from 1-20 and recall their original ideas.

Results

As we were interested in the effects of organization on memory, our first analysis correlated generation and organization or writing (Day 1) orders with the order of ideas produced in recall (Day 2). Spearman rank order statistics were obtained for each subject and averaged across subjects in each group. The results of our pilot studies were replicated. There were no statistically significant effects for either group of subjects $r = .136$ and $r = .145$ for Groups 1 and 2 respectively. Recall order appears to be unrelated to both generation and organization order.

We then looked at recall probabilities for major topics and supporting arguments as identified either in outlines (Group 1) or written products (Group 2). Major ideas (93.5%) were recalled significantly more frequently than supporting ideas (77.6%) for both groups of subjects, $F(1,16) = 10.47$, $p < .01$. In addition, a significant group effect was obtained, $F(1,16) = 10.21$, $p < .01$. Subjects who wrote texts recalled more ideas in all (90.5%) than subjects who merely ordered their ideas (80.7%). This group

than subjects who merely ordered their ideas (80.7%). This group difference is reflected in both the percentage of main ideas and supporting arguments recalled, as depicted in Table 1.

Insert Table 1 about here

Further analyses were conducted to determine whether units produced in the organization stage were preserved during recall. Units consisted of a main idea and its supporting ideas. The average unit consisted of 4.5 ideas (one main idea and 3.5 supports) and did not vary between groups. Thus, we examined whether the ideas composing a unit created during the organization stage were recalled together during the recall stage. Overall, only 80% of the ideas used during the organization phase of the experiment were recalled. To determine whether these ideas were clustered as they were during organization, we calculated the percentage of ideas recalled together in each unit produced during organization. These percentages were then averaged for each group. Groups did not significantly differ in the percent of ideas cohering to the organization grouping (Group 1 = 55.4%, Group 2 = 58.0%). Of the ideas recalled, 57.7% preserved their organization unit grouping 24 hr. later. Many of the larger units ($\bar{x}$ size = 7.2 ideas) were recalled in two separate clusters. However, only the cluster containing the originally identified main idea was used in calculating the above percent of unit coherence.

Discussion

Raijmakers and Shiffrin (1980) account for the free recall of items from long term memory in terms of retrieval strategies that provide a

certain structure for the items produced. Retrieval is presumed to operate on long term memory on a one unit or cluster at a time basis. Which unit is retrieved via a particular strategy may vary, however, from moment to moment even when the same retrieval cue is utilized. In the present experiment, initial generation reveals the inter-item or cluster relationships in long term memory as it is structured in subjects at the outset of this experiment.

As a subject creates a coherent text, certain items retrieved from long term memory are input into short term memory where they are rehearsed and recoded. According to Raijmakers and Shiffrin, items recoded together in short term memory are then re-input as units to long term memory. These units created in short term memory do not replace the initial structure. Rather, they enter long term memory as another copy of the same information. Which copy is most accessible at any given point in time is indeterminate in the Raijmakers and Shiffrin model except when subsequent retrieval is closely time-locked to unitization in short term memory.

Results of the present experiment are consistent with the Raijmakers and Shiffrin model in the sense that free recall subsequent to unitizing items in short term memory is as much or more consistent with how the items were reorganized than it is with initial free recall or generation. The results further reflect positively on the suggestion of Flower and Hayes (1979) that the organization subprocess of writing results in marked changes in associative connections in long term memory. The final recall of items corresponded more with item organization produced during writing than with initial free recall. That is to say, subjects tended to recall items in the units created while organizing ideas to form a written text.

The time locking hypothesis of Raijmakers and Shiffrin is an important consideration that might distinguish their model from expectations based on

the postulates of Flower and Hayes. That is, as time is allowed to pass between the writing exercise and subsequent regeneration or free recall of items related to a particular topic, the correlation between initial and final free recall should increase. Final free recall should correlate better with the organization during writing if that free recall is taken close in time to the writing exercise. Correlation should decrease with the writing organization and increase with the initial free recall structure as time passes, according to Raijmakers and Shiffrin. As the theory of Flower and Hayes is presently written, no similar expectation can be stated.

References

Flower, L.S. & Hayes, J.R. A process model of composition. Technical Report
No. 1, 1979, Document Design Project.

Kintsch, W. & van Dijk, T.A. Toward a model of text comprehension and
production. Psychological Review, 1978, 85, 363-394.

Raijmakers, J.G.W. & Shiffrin, R.M. Search of associative memory.
Psychological Review, 1981, 88, 93-134.

Table 1

Group Differences in Recall
of Main and Supporting Ideas

	Ideas	
	Major	Supporting
Group 1	89.5	71.5
Group 2	97.8	83.8

UNIVERSITY OF COLORADO, BOULDER

Institute of Cognitive Science



December 6, 1982

Dr. Marshall Farr
Personnel & Training Research Program
Office of Naval Research
800 North Quincy Avenue
Arlington, VA 22217

Dear Dr. Farr:

Enclosed is the abstract for a manuscript prepared under ONR Contract N00014-78-C-0433. It is entitled "Idea Organization and Idea Recall", by Sheryl R. Young and Lyle E. Bourne, Jr. We would like permission to make it a technical report. Please an updated listing.

Thank you,

A handwritten signature in cursive script, appearing to read "Lyle E. Bourne, Jr.", written in dark ink.

Lyle E. Bourne, Jr.
Director
Institute of Cognitive Science

LEB/dec
enclosure