AN EXAMINATION OF THE INTERACTION BETWEEN INTRINSIC MOTIVATION AND THE FOSTERING OF CREATIVITY IN ADULTS WITHIN A HIGH TECHNOLOGY ORGANIZATION

by

Judy Laws

Dr. Janice A Leroux, Thesis Director

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Canada

Appendix G

northern telecom

Conflict of interest

BNR

The research subsidiary of Northern Telecom

Policy

Directors, officers, and employees of Northern Telecom and subsidiaries shall refrain from activities that conflict with the interests of the corporation.

Implementation

1. Every director, officer, and employee will at all times, be conscious of the interests of the corporation, and will not:

   a) appropriate or convert the corporation's property, tangible or intangible, including trade secrets, confidential information, and other proprietary information;

   b) offer bribes, or accept corrupt payments or other like illegal or unethical considerations;

   c) accept gifts or gratuities that cannot be reciprocated in the ordinary course of business;

   d) disparage the corporation or the corporation's products, services or personnel;

   e) influence, in a manner unfavorable to the corporation, negotiations or transactions between the corporation and its suppliers, contractors, customers and others, because of a personal, commercial, or financial interest in the outcome of the negotiations or transactions;

   f) without prior written permission, or having previously declared the activity in a prescribed manner, serve or continue to serve as a director, officer, or employee of, or perform, directly or indirectly, services for, or act as a consultant to, a business that is or may be:
      i) in competition with the corporation; or
      ii) a supplier of goods and/or services to the corporation;

   g) without prior written permission, directly or indirectly invest in, or control, an entity that:
      i) competes or may compete with a business or activity of the corporation; or
      ii) is or may be a supplier of goods and/or services to the corporation;

   except, in the case of publicly traded shares, when the investment does not exceed five percent of the issued shares.

The above examples are merely illustrations of sources of possible conflicts. It is anticipated that the activities of directors, officers, employees, and immediate members of their families will comply with both the letter and the spirit of this policy.

Directors, officers, and employees will only trade in shares or securities of the corporation (or of any company with which it has dealings), having full regard to the provisions of the relevant securities laws dealing with insider trading and trading in securities.

The corporation has adopted a specific conflict of interest policy that establishes the policy governing an actual or perceived conflict of interest on the part of the corporation and any directors, officers, employees or agents of the corporation having responsibilities related to the corporation's pension funds insofar as any such conflict of interest affects their duties and powers related to the corporation's pension funds. This policy also establishes disclosure requirements with respect to any actual or perceived conflict of interest, including the timing of the disclosure. A copy of this policy may be obtained from your manager or COKOL, and the procedure which reflects this policy is attached.

Objective

The objective of this policy is to establish basic rules of conduct for all the corporation's directors, officers, and employees in order to ensure that the business of the corporation is conducted with a high level of integrity and that the likelihood of conflicts of interest between the corporation and its directors, officers, and employees is minimal.

Employee name (print) Employee signature Date

Appendix 4

northern telecom

Agreement relating to intellectual property and confidentiality.

Engagement relatif à la confidentialité et à l'information protégée par des droits de propriété.

In consideration of my employment, respectively and collectively by Northern Telecom Limited or Northern Telecom Canada Limited (hereinafter called "the Company"), I agree to the following:

1. I am under no obligation to anyone, including a former employer, in any manner whatsoever which is in any way an impediment to my entering into this Agreement or which imposes any restriction on the activities or duties which may be assigned to me from time to time by the Company.

2. I hereby assign to the Company all my rights in and to all inventions, discoveries, improvements, designs, know-how, technical or commercial information, computer programs in any form, written materials, data bases, integrated circuit topologies, plans, diagrams, drawings, models, and other things, which I may conceive, develop or reduce to practice during the period of my services with the Company and which:

(i) relate, directly or indirectly, to the Company's present or reasonably foreseeable business or research or development; or,
(ii) result from any work performed by me for the Company; or,
(iii) are created or made using any equipment, supplies, facility, resources, or "Confidential Information" of the Company

whether or not they are made during or after working hours, on or off the Company's premises, or alone or with others.

3. I shall make prompt and full disclosure to the Company of any of the things covered in paragraph 2. During and subsequent to my employment, I shall execute all documents, and provide such assistance, as may be reasonably required by the Company to obtain, maintain, enforce, protect or grant any rights which I have assigned to the Company and which the Company may desire in respect of such things in all countries of the world.

4. I shall not (except as expressly permitted by the Company in writing) at any time during and subsequent to my employment with the Company:

(i) disclose, or authorize the disclosure, to anyone other than authorized officers or employees of the Company; or,
(ii) use for non-Company purposes or other non-permitted purposes

any of the Company's Confidential Information or any information disclosed to the Company by a third party in circumstances which oblige the Company to protect such information from unauthorized use and/or disclosure.

5. "Confidential Information" for the purposes of this Agreement shall mean all information, including trade secrets, formulas, patterns, compilations, programs, devices, methods, techniques, or processes, of a business, planning, marketing, scientific, technical, or other nature, that derives actual or potential value from not being generally known, or readily ascertainable.

6. I shall keep on the Company's premises (except when required elsewhere in connection with the conduct of the Company's business) and shall deliver to the Company upon termination of my employment, all things including models, circuits, instructions, drawings, notes, files, memoranda or other writings, software programs in source code or object code form, and magnetically or electronically stored information, which embody or contain any of the rights or information described in paragraphs 2 and 4 above. I further agree not to make or retain any copy, duplication, facsimile, reproduction or replication of any of the foregoing.

7. This Agreement shall supersede any and all previous oral or written communications, discussions or agreements between me and the Company relating to the general subject matter addressed herein.

8. I shall reaffirm this Agreement or execute such further or other agreements with respect to the general subject matter addressed herein as the Company, or an affiliate company (being Northern Telecom Limited's direct or indirect subsidiaries) may from time to time require.

MY SIGNATURE HEREUNDER INDICATES UNDERSTANDING AND ACCEPTANCE OF THE ABOVE AND AN ACKNOWLEDGEMENT OF RECEIPT OF A COPY OF THIS AGREEMENT.

EMPLOYEE'S SIGNATURE

EMPLOYEE'S NAME

WITNESS' SIGNATURE

WITNESS' NAME

Eu égard à l'emploi qui m'a été confirmé par Northern Telecom Limitée ou par Northern Telecom Canada Limitée (dénommée ci-après la Société), ou par les deux,

1. Je certifie que je suis libre vis-à-vis de toute personne, incluant mes anciens employeurs, de toute obligation incompatible avec le présent engagement ou susceptible de faire obstacle à l'exercice de mes fonctions pour le compte de la Société.

2. Je cède, par les présentes, à la Société, la propriété et tous les droits résultant des inventions, découvertes, améliorations, conceptions, savoir, informations techniques ou commerciales, programmes informatiques sous quelque forme que ce soit, documents écrits, base de données, topologies de circuits intégrés, plans, diagrammes, dessins, modèles industriels et de toute autre chose que j'aurai conçus, mis au point ou mis en pratique pendant la durée de mon emploi à la Société, et

(i) dont l'objet sera directement ou indirectement relié à l'activité ou aux efforts de recherche et développement, actuels ou prévus dans un délai raisonnable; ou
(ii) qui résultent de mon travail pour le compte de la Société; ou
(iii) qui sont créés ou réalisés en utilisant le matériel, les fournitures, les installations, les ressources ou "l'information confidentielle" de la Société

que ces travaux aient été réalisés durant mes heures de travail ou à tout autre moment, seul ou en collaboration avec d'autres, dans les établissements de la Société ou à l'extérieur.

3. Je communiquerai sans délai à la Société tous les éléments visés au paragraphe 2. Pendant la durée de mon emploi et ultérieurement, je signerai tous les documents et fournirai, dans une mesure raisonnable, toute l'assistance nécessaire à la Société pour lui permettre d'obtenir, de maintenir, de faire exécuter, de protéger ou d'accorder tous les droits sur les éléments visés que j'aurai cédés à la Société et que la Société peut souhaiter obtenir pour n'importe quel pays du monde.

4. Pendant la durée de mon emploi dans la Société et ultérieurement, je m'engage (sauf autorisation écrite et préalable de la Société):

(i) à ne communiquer ni à permettre la communication à quiconque, sauf aux dirigeants de la Société et aux membres de son personnel dûment mandatés; ou
(ii) à ne pas utiliser à des fins autres que celles permises par la Société "l'information confidentielle" de la Société ou toute information divulguée à la Société par un tiers dans des circonstances qui obligent la Société à protéger cette information contre l'utilisation non autorisée ou la divulgation.

5. Aux fins du présent engagement, on entend par "l'information confidentielle" toute information, notamment les secrets industriels, les formules, les modèles, les compilations, les programmes, les dispositifs, les méthodes, les techniques, les procédés de nature commerciale, scientifique, technique ou relatifs à la planification et au marketing, ou de toute autre nature, dont la valeur réelle ou éventuelle découle du fait que la connaissance en est restreinte ou qu'ils sont difficilement accessibles.

6. Je reconnais que tous les éléments décrits aux paragraphes 2 et 4, y compris les modèles industriels, circuits, spécifications, dessins, notes, mémoires ou autres documents, les logiciels en code source ou en code résultant, et l'information en mémoire électronique ou en mémoire magnétique, qui contiennent des informations décrites aux paragraphes 2 et 4 ne doivent pas sortir des établissements de la Société, sauf si leur présence est requise dans un autre lieu en raison des activités de la Société et je m'engage à les remettre à la Société au moment de la cessation de mon emploi. Je m'engage également à ne conserver ou faire aucune copie, facsimilé ou reproduction des supports d'information cités plus haut.

7. Le présent engagement annule et remplace tous les engagements, communications ou entretiens antérieurs, qu'ils soient oraux ou écrits, entre la Société et moi-même, ayant trait au sujet traité dans les présentes.

8. Je confirmerai le présent engagement et signerai tout autre engagement relatif au sujet traité dans les présentes que la Société ou une société affiliée (soit une filiale directe ou indirecte de Northern Telecom Limitée) pourra me demander de signer.

PAR MA SIGNATURE APPOSÉE CI-DESSOUS, JE CONFIRME QUE J'ACCEPTE LES CONDITIONS PRÉCITÉES DONT JE RECONNAIS AVOIR PRIS CONNAISSANCE, ET ACCUSE RÉCEPTION D'UNE COPIE DU PRÉSENT ENGAGEMENT.

SIGNATURE DE L'EMPLOYÉ

NOM DE L'EMPLOYÉ

#_____

7:10/07/86

Work Preference Inventory
Working Adult Version
Teresa M. Amabile, Ph.D.
Department of Psychology
Brandeis University

Please rate each item in terms of how true it is of you. Please circle one and only one letter for each question according to the following scale:

N = Never or almost never true of you
S = Sometimes true of you
O = Often true of you
A = Always or almost always true of you

N S O A 1. I am not that concerned about what other people think of my work.
N S O A 2. I prefer having someone set clear goals for me in my work.
N S O A 3. The more difficult the problem, the more I enjoy trying to solve it.
N S O A 4. I am keenly aware of the income goals I have for myself.
N S O A 5. I want my work to provide me with opportunities for increasing my knowledge and skills.
N S O A 6. To me, success means doing better than other people.
N S O A 7. I prefer to figure things out for myself.
N S O A 8. No matter what the outcome of a project, I am satisfied if I feel I gained a new experience.
N S O A 9. I enjoy relatively simple, straightforward tasks.
N S O A 10. I am keenly aware of the promotion goals I have for myself.
N S O A 11. Curiosity is the driving force behind much of what I do.
N S O A 12. I'm less concerned with what work I do than what I get for it.
N S O A 13. I enjoy tackling problems that are completely new to me.
N S O A 14. I prefer work I know I can do well over work that stretches my abilities.
N S O A 15. I'm concerned about how other people are going to react to my ideas.
N S O A 16. I seldom think about salary and promotions.
N S O A 17. I'm more comfortable when I can set my own goals.
N S O A 18. I believe that there is no point in doing a good job if nobody else knows about it.
N S O A 19. I am strongly motivated by the money I can earn.
N S O A 20. It is important for me to be able to do what I most enjoy.
N S O A 21. I prefer working on projects with clearly specified procedures.
N S O A 22. As long as I can do what I enjoy, I'm not that concerned about exactly what I'm paid.
N S O A 23. I enjoy doing work that is so absorbing that I forget about everything else.
N S O A 24. I am strongly motivated by the recognition I can earn from other people.
N S O A 25. I have to feel that I'm earning something for what I do.
N S O A 26. I enjoy trying to solve complex problems.
N S O A 27. It is important for me to have an outlet for self-expression.
N S O A 28. I want to find out how good I really can be at my work.
N S O A 29. I want other people to find out how good I really can be at my work.
N S O A 30. What matters most to me is enjoying what I do.

Please also complete the following. This information is essential for our statistical records.

Name _____ Age_____ Sex_____

Occupation _____ # years in occupation _____

Highest educational degree _____ Today's date _____

SCHOLASTIC TESTING SERVICE, INC.

480 MEYER ROAD
BENSENVILLE, ILL. 60106
(708) 766-7150

4320 GREEN ASH DRIVE
EARTH CITY, MISSOURI 63045
(314) 739-3650

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SHIP TO 613-765-2564	BILL TO
[illegible]	[illegible]

PROCESSING	TEST DATE	CODES	CUSTOMER ORDER NO.	ACCOUNT	REFERENCE
[illegible]	[illegible]		CHARGE		[illegible]

QUANTITY	MATERIALS/SERVICE	DESCRIPTION	FM	GR
[illegible]	[illegible]	FIGURAL B BOOKLETS		
		SCORING CHARGES		
		SHIPPING HANDLING		
		TOTAL		

SHIPPING DATE 2-23-94

#CTNS WT VIA

PACKING SLIP

TORRANCE TESTS OF CREATIVE THINKING -- FIGURAL-STREAMLINED FORM: A

SCHOOL: P. TELECOM-HIGH PERF (UIC001) GRADE: 00 SECTION: REPORT DATE: 10/94

GROUP SUMMARY: FREQUENCY DISTRIBUTIONS

STAND SCR INTERVALS	FLUENCY FREQ	FLUENCY PER	ORIG FREQ	ORIG PER	TITLES FREQ	TITLES PER	ELAB FREQ	ELAB PER	RESIST FREQ	RESIST PER	AVERAGE FREQ	AVERAGE PER	CR INDEX FREQ	CR INDEX PER
159-									1	3				
156-158			1	3									1	3
153-155			1	3	1	3								
150-152									1	3				
147-149					2	7	2	7					2	7
144-146													1	3
141-143									2	7				
138-140	1	3			2	7							1	3
135-137			1	3					4	15	2	7	1	3
132-134													1	3
129-131			2	7	1	3			1	3	2	7		
126-128			1	3	1	3	1	3					1	3
123-125			1	3	1	3	2	7	3	10	2	7	4	13
120-122	3	10									1	3	1	3
117-119			1	3	1	3	1	3	2	7			4	13
114-116	4	13	2	7	5	17								
111-113			3	10			4	13	1	3	3	10	1	3
108-110	1	3	2	7	3	10					4	13	3	10
105-107			3	10			1	3	3	10	1	3	2	7
102-104	2	7	2	7	2	7					1	3	1	3
99-101	2	7	2	7					1	3	3	10	2	7
96- 98	2	7			2	7	7	23			2	7		
93- 95	2	7	1	3	2	7			4	13	1	3	2	7
90- 92	3	10							1	3	2	7	1	3
87- 89	5	17	1	3	3	10					2	7		
84- 86			1	3			10	33	3	10	1	3		
81- 83	2	7	1	3							1	3	1	3
78- 80	1	3	1	3	2	7			1	3	1	3		
75- 77											1	3		
72- 74	1	3	1	3	1	3	2	7						
69- 71			2	7					1	3				
66- 68														
63- 65									1	3				
60- 62	1	3												
57- 59														
54- 56					1	3								
51- 53														
48- 50														
45- 47														
42- 44														
- 41														
SUMMARY STATS MN=	97.9		107.7		108.8		99.9		111.2		105.1		117.7	
SUMMARY STATS SD=	16.6		21.7		23.4		19.5		24.7		16.3		18.1	

NUMBER OF STUDENTS = 30

(SCHOLASTIC TESTING SERVICE, INC.)

TORRANCE TESTS OF CREATIVE THINKING -- FIGURAL-STREAMLINED FORM: B

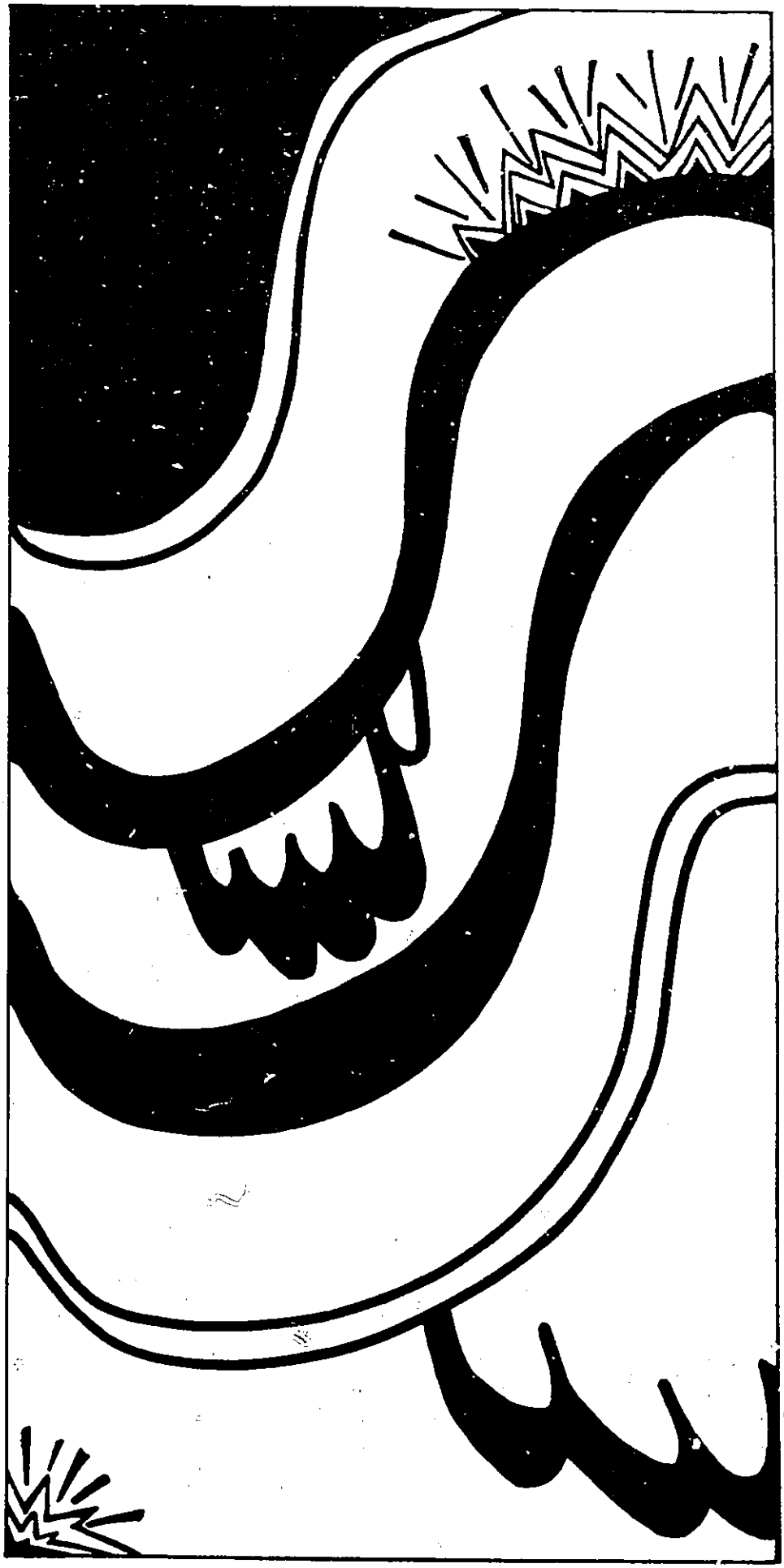
SCHOOL: N. TELECOM-SOLID PER (UC002) GRADE: CO SECTION: REPORT DATE: 10/94

GROUP SUMMARY: FREQUENCY DISTRIBUTIONS

STAND SCR INTERVALS	FLUENCY FREQ	FLUENCY PER	ORIG FREQ	ORIG PER	TITLES FREQ	TITLES PER	ELAB FREQ	ELAB PER	RESIST FREQ	RESIST PER	AVERAGE FREQ	AVERAGE PER	CR INDEX FREQ	CR INDEX PER
159-														
156-158														
153-155					1	3								
150-152														
147-149					1	3								
144-146			1	3										
141-143					1	3			6	20			1	3
138-140					3	10								
135-137			1	3	3	10			3	10			1	3
132-134			1	3									4	13
129-131													1	3
126-128					2	7								
123-125			1	3	2	7			2	7	1	3	5	17
120-122	1	3	1	3									1	3
117-119			1	3			2	7	4	13	4	13	2	7
114-116	2	7	2	7	1	3								
111-113			1	3			5	17	3	10	2	7	2	7
108-110	1	3	1	3	4	13								
105-107	4	13	3	10			5	17	3	10				
102-104	3	10	2	7	1	3								
99-101			2	7					3	10			1	3
96- 98			2	7	2	7	5	17			1	3		
93- 95	2	7	3	10	1	3			2	7	2	7		
90- 92	1	3							1	3				
87- 89	5	17	4	13	5	17					3	10	1	3
84- 86			1	3			7	23	2	7				
81- 83	4	13	1	3							2	7		
78- 80	3	10	1	3	2	7					1	3		
75- 77														
72- 74	1	3	1	3			4	13						
69- 71	2	7							1	3				
66- 68					1	3								
63- 65	1	3	1	3										
60- 62														
57- 59							2	7						
54- 56														
51- 53														
48- 50														
45- 47														
42- 44														
- 41														
SUMMARY STATS	MN= 91.7 SD= 15.0		MN= 102.2 SD= 18.1		MN= 112.6 SD= 23.6		MN= 93.3 SD= 16.9		MN= 115.0 SD= 20.3		MN= 103.1 SD= 13.4		MN= 114.7 SD= 14.9	

NUMBER OF STUDENTS = 30

(SCHOLASTIC TESTING SERVICE, INC.)



THINKING CREATIVELY WITH PICTURES

By E. Paul Torrance

FIGURAL BOOKLET B

NAME _____

AGE _____ SEX _____

SCHOOL _____

GRADE _____

CITY _____

DATE _____

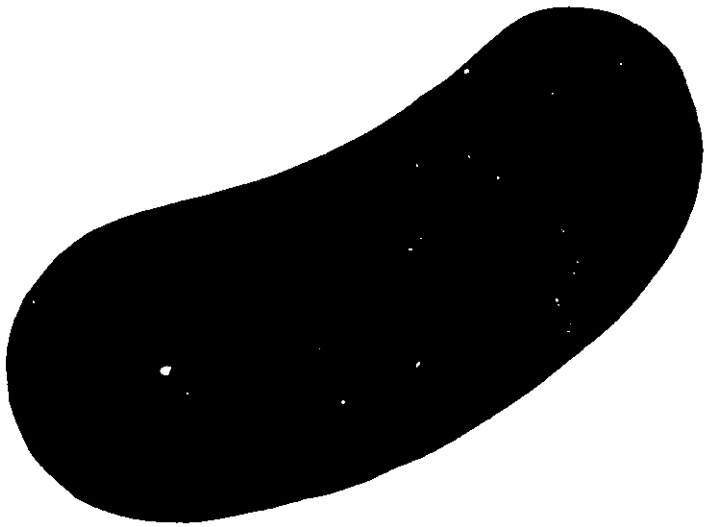
SCHOLASTIC TESTING SERVICE, INC.
480 Meyer Rd., P.O. Box 1056
Bensenville, IL 60106-8056

Activity 1. PICTURE CONSTRUCTION

On the opposite page is a curved shape. Think of a picture or an object which you can draw with this shape as a part.

Try to think of a picture that no one else will think of. Keep adding new ideas to your first idea to make it tell as interesting and as exciting a story as you can.

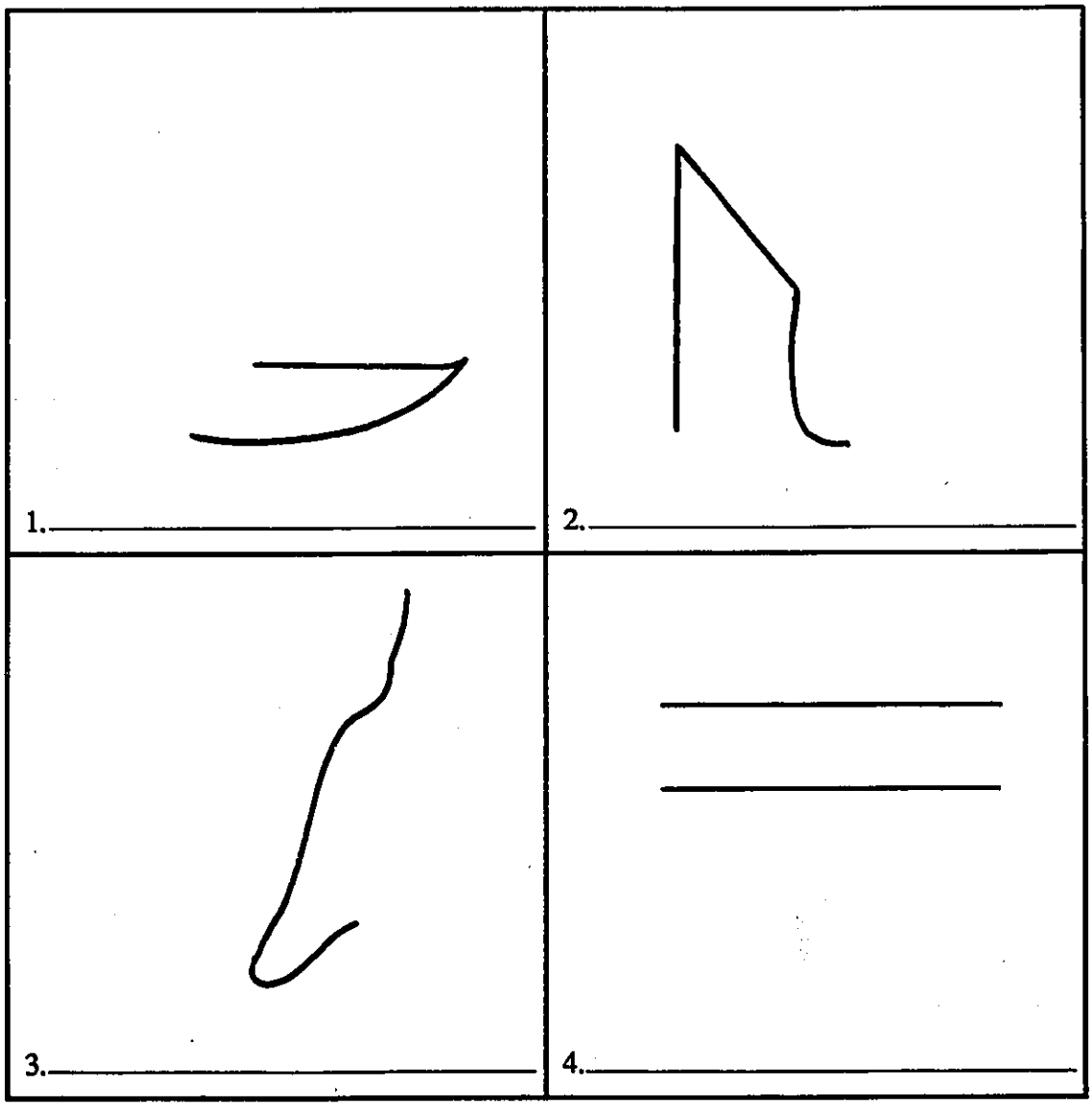
When you have completed your picture, think up a name or title for it and write it at the bottom of the page in the space provided. Make your title as clever and unusual as possible. Use it to help tell your story.

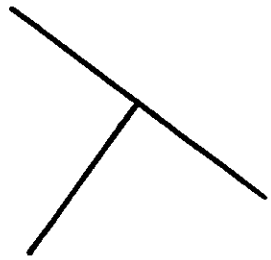
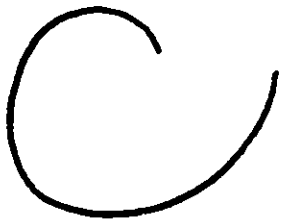
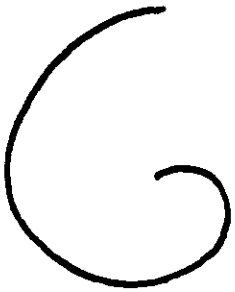


YOUR TITLE: _____

Activity 2. PICTURE COMPLETION

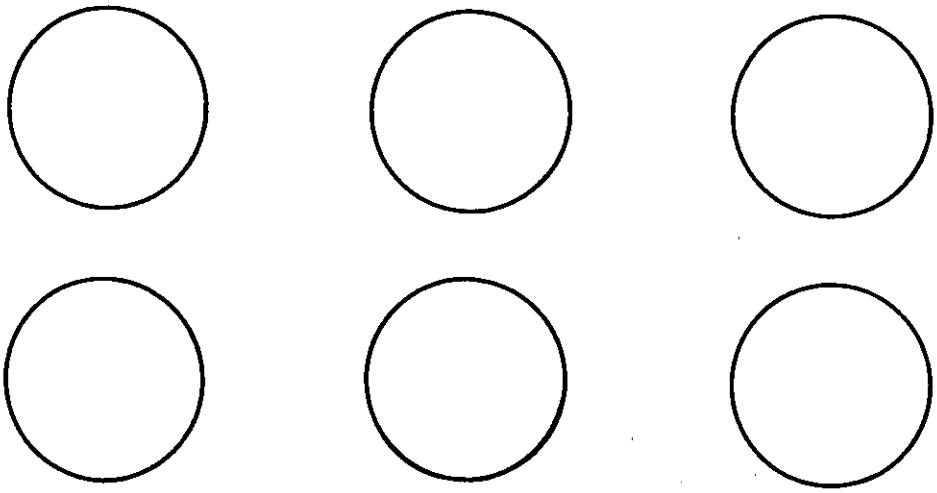
By adding lines to the incomplete figures on this and the next page, you can sketch some interesting objects or pictures. Again, try to think of some picture or object that no one else will think of. Try to make it tell as complete and as interesting a story as you can by adding to and building up your first idea. Make up an interesting title for each of your drawings and write it at the bottom of each block next to the number of the figure.

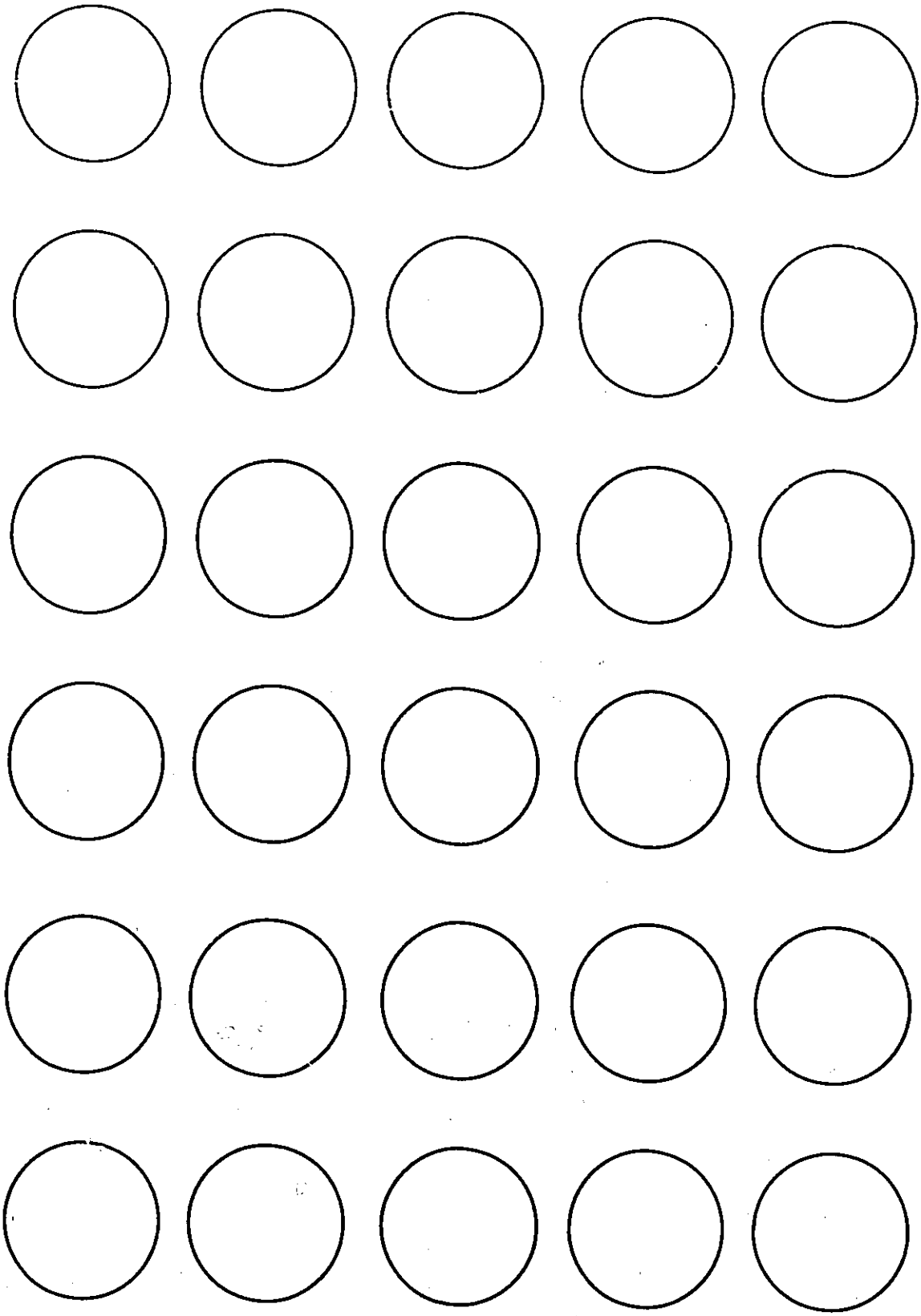


 5._____	 6._____
 7._____	 8._____
 9._____	 10._____

Activity 3. ...CLES

In ten minutes see how many objects or pictures you can make from the circles below and on the next page. The circles should be the main part of whatever you make. With pencil or crayon add lines to the circles to complete your picture. You can place marks inside the circles, outside the circles, or both inside and outside the circles—wherever you want to in order to make your picture. Try to think of things that no one else will think of. Make as many different pictures or objects as you can and put as many ideas as you can in each one. Make them tell as complete and as interesting a story as you can. Add names or titles below the objects.





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ACKNOWLEDGEMENTS

My sincere thanks to my advisor, Dr. Janice Leroux, and committee members, Dr. Mary Foster and Dr. Colla MacDonald. Each of you provided me with the support, direction, and inspiration I needed throughout this study. Also thanks goes to Rahim Habib, research assistant, who was extremely helpful and a joy to work with. Michel Brabant, Research Support Services, also deserves credit for providing me with the direction I needed in my quantitative analysis.

To the BNR designers themselves who contributed so much to this research, I offer my deepest appreciation. And special thanks to senior management, specifically, Jules Meunier, Joanne Murtagh, Lewis Lockhart, and Paulette Kestelman, who gave me the opportunity to conduct this study.

Finally, I would like to thank my family, especially, my husband, Raymond, and my children Caroline and Richard, who stood by me and gave me lots of encouragement and support throughout the duration of this project. Special thanks also to Linda Pickard, my stepmother and friend, who not only connected me to Mary, but acted as a great resource and private library. And to my Mom and Dad, who have always been there for me, giving me lots of love and encouragement, a big thanks.

ABSTRACT

Organizations that utilize the knowledge and creativity of their professionals will have the greatest success in gaining competitive advantage, profits, and leadership in the global marketplace. The purpose of this investigation was to explore the role of creativity in performance, specifically, the interaction between intrinsic motivation and the fostering of creativity in adults within a high technology organization. A sample of sixty experienced Research and Development (R&D) designers from Bell Northern Research (BNR) were evenly divided into two categories: high performing and solid performing designers. A two stage research design employed quantitative and qualitative methods to conduct the study. The results indicated while the designers at BNR scored high on creativity there was no significant difference between high and solid performers on the level of intrinsic motivation and creativity. Instead other factors like taking intiative, the need for interesting and challenging work, hands-off management, and recognition and encouragement, differentiated high performers from solid performers. Conditions highlighted by R&D designers as being necessary to facilitate intrinsic motivation, therefore creativity, where: freedom and control versus constraint; challenge and interest in the work versus the lack of challenge or keeping things the same; various organizational characteristics such as collaboration and cooperation versus the organizational characteristics of lack of support from others; good versus poor management or supervision; pressure versus insufficient time; and recognition and encouragement versus inappropriate or no evaluation. Several recommendations for both

Human Resources professionals and organizations who want to improve employee satisfaction, productivity and their competitiveness in the global marketplace, are provided.

CHAPTER 1: INTRODUCTION

> A new, low-cost optoelectronic device developed by scientists at Bell-Northern Research, Northern Telecoms's research and development subsidiary, will help unlock the potential of the information superhighway (NT Quarterly report, 1994).

Technological innovations like this coupled with the collapse of global boundaries are transforming organizations as they struggle to maintain their competitive advantage. Organizations which will succeed and grow in the 21st century will be those which unlock the creative and personal power of their knowledge workers.

Senior management at Northern Telecom (NT) recognizes the future challenges that it faces. Don McCreesh, Senior Vice President, Human Resources, NT, stated at a recent Senior Management Conference:

> Global competition is dramatically changing the roles and relationships of people in business. Making these changes will not be easy or quick. But Northern Telecom must move to this new way of thinking if we are to make our corporation a dynamic, exciting, and rewarding place to work. Only by unleashing the full creativity of our people can we create a more effective organization (NT Universe, 1994, p.15).

It will be those organizations that can best capitalize on their intellectual and creative capacity that will be able to successfully ride the two great currents of the 21st Century:

globalization and the information revolution. High technology companies, such as Bell Northern Research (BNR), rely on the productivity and creativity of their knowledge workers in order to survive in the global marketplace. Therefore, the purpose of this investigation is to explore creativity, specifically, by examining the interaction between intrinsic motivation and the fostering of creativity in adults within NT's Research and Development (R&D) organization, BNR.

NT is a leading global manufacturer of telecommunications equipment, providing products and services to telephone companies, cable television companies, corporations, governments, universities, and other institutions worldwide. BNR, NT's R&D subsidiary, operates or supports facilities in five countries including Australia and Japan and is a world leader in designing and developing advanced telecommunications systems. NT had 1994 revenues of $US8.87 billion and 57,054 employees worldwide. In the Ottawa region BNR employs over 4500 employees with about 80 percent holding either engineering or computer science degrees.

Although the literature is plentiful on creativity and intrinsic motivation, there has been minimal research on the interaction between intrinsic motivation and the fostering of creativity in adults within a high technology organization. There was evidence of a strong and positive link between a person's motivational state, called motivational orientation, and the creativity of the person's performance. (Amabile, 1983a, b,1985; Hennessey & Amabile, 1988; Brown, 1989; Perkins, 1984; Lepper & Greene, 1978). Specifically, Amabile (1983a, b, 1985) proposed an intrinsic motivation hypothesis of creativity which states that an intrinsically motivated state is conducive to creativity, whereas an

extrinsically motivated state is detrimental. In order to effectively research this area, she and her colleagues developed the Work Preference Inventory, for assessing the motivational orientation of individuals which was used in this investigation.

While literature on scientists and R&D covers those characteristics or attributes of a scientist, and of a R&D environment that facilitates creativity, very few studies considered the interaction of creativity and intrinsic motivation in adults within a high technology organization, and more specifically, the differences between high performing and solid performing R&D scientists. This gap will be investigated in the research, specifically:

1) To what extent and to what degree will Amabile and Hennessey's (1992) Intrinsic Motivation Principle of creativity ("People will be most creative when they feel motivated by the interest, enjoyment, satisfaction and the challenge of the work itself - rather than by external pressures" (p. 55) be evident in adults within BNR? Will there be a significant difference between the level of intrinsic motivation and creativity in high performing designers versus solid performing designers? If so, how and in what ways?

2) What are the conditions necessary to facilitate intrinsic motivation, therefore creativity, in adults in BNR?

The research report begins by emphasizing the rationale for this study, followed by a review of the literature on: the nature and scope of creativity and of intrinsic motivation; the interaction between creativity and intrinsic motivation; the creative environment in high technology organizations; and creative adults in high technology

organizations. A combined quantitative and qualitative design will investigate the research questions. Finally, this investigation offers practical recommendations that will assist organizations, like BNR, and Human Resources (HR) professionals, who want to improve employee satisfaction, productivity and their competitiveness in the global marketplace.

CHAPTER 2: REVIEW OF THE LITERATURE

The purpose of this study is to examine the interaction between intrinsic motivation and the fostering of creativity in adults within a high technology organization, specifically, BNR. With this in mind, the chapter begins by presenting the rationale for the study, and the research questions. Next, the nature and scope of creativity is discussed with the intent of providing a definition of creativity suitable for the business environment. Following this, a definition of intrinsic motivation is provided, along with a discussion of the interaction of intrinsic motivation with creativity. Then, the literature on external facilitators for creativity within a high technology organization is investigated. The chapter ends with a discussion of the creativity and motivation orientational differences between high performing and solid performing adults working in a high technology organization.

RATIONALE FOR THE STUDY

Economists and business analysts point to a shift from an industrial economy to an information-driven economy, where knowledge and creative production are seen as far more important than physical labor or natural resources (Beck, 1993). Beck indicates that no matter how the statistics are massaged or produced, the numbers show plainly that a new economy, embodied in a third circle of growth and driven by technology, information and innovation has emerged. This technology economy, replacing the

commodity and mass-manufacturing economies, includes inexpensive chips (microchips) which fuel what she calls four engines: computers and semiconductors, health and medical, communications and telecommunications, and instrumentation. High Technology organizations such as NT rank in the top six in the world of telecommunication equipment suppliers. Its R&D arm, BNR, has been operating within this technology-driven circle for some time. In BNR's case, the majority of the workforce has been hired to design and develop telecommunications products and services. The employees fit the definition of Drucker's (1993) knowledge workers, where the majority have either an engineering or computer science background.

The increasing pace of technological change and the collapse of global boundaries are putting pressure on organizations to change in order to maintain their competitive advantage. Virtually all of the experts, the management theorists, futurists, and industrial psychologists, believe that: "the organization of the future must be able to adapt to change in order to survive" (Albrecht & Albrecht, 1987, p.7; Drucker, 1993; Morgan, 1988;). Beck (1993) stated that the technology-driven economy will require knowledge workers with a mental mindset of innovating to survive. Innovation has a significant creative component in that its focus is turning creative ideas into practical solutions with economic merit. It is clear that organizations can no longer rely on the old paradigms for the conduct of business if they are to survive the rapidly accelerating rate of technological and environmental changes. Innovation, based on creativity, will be an enabler for organizations to adapt quickly to change.

Successful organizations in the 21st century will be those which not only utilize their intellectual capital, but also unlock the creative and personal power of their knowledge workers. High technology companies, such as NT/BNR, must rely on the productivity and creativity of their knowledge workers in order to remain competitive in the global telecommunications industry. People, not technology or capital, are the key to productivity (Brewer, 1992). "Human capital" theory offers a useful way of thinking about elements of creativity and learning. The theory, originating from Adam Smith and much enlarged by economists (Becker, 1976; Mincer, 1979), is based on the premise that "the wealth of nations depends on the ability of the people. 'Human capital' refers not to mere hours of labor, but to the quality of work or the motivation, skills and creativity of the worker" (Walberg, 1988, p. 343). Therefore, the key success factors for organizations doing business in the global marketplace will be the ability to utilize human capital.

Not only is the utilization of human capital important for an organizations' success, but also a commitment to organizational learning. Strata (1989) described organizational learning occurring through shared insights, knowledge, and mental models, building on past knowledge and experiences (memory). Garvin (1993) suggested that when employees are exposed to new ideas, they expand their knowledge, begin to think differently, and as they internalize these new insights, their behaviour changes leading to tangible gains in customer satisfaction and market share. The capacity of an organization to gain insight from its own experience, the experience of others, and to modify the way it functions according to such insights, will allow it to differentiate itself from its competitors. Senge (1990) proposed that people's natural impulse to learn is

unleashed when they are engaged in an endeavor they consider worthy of their fullest commitment. He also proposed that leaders can use creative tension - the gap between seeing clearly where the organization wants to be (vision), and telling the truth about where the organization is (current reality) - as an intrinsic motivator. Organizations have to reward people for being creative, for developing new ideas, and for continually learning about new products, new customers, and new markets. Therefore, the utilization of human capital will be strengthened within a learning organization. If employees are able to work in an environment where creativity and learning is supported, the organization will learn and become creative, thus leading to more efficiency, innovation and profitability.

Unfortunately, leading business journals, newspapers, and discussions around the water cooler point to the fact that most organizations have not been utilizing this intellectual capacity and creative production to the fullest. Poor employee and customer satisfaction survey results suggest that the pain and career dislocation from organizational downsizing may be responsible for some of the low employee morale prevalent in organizations today. Companies like NT/BNR want to identify those factors that can increase employee morale and at the same time unleash creativity to allow the organization to become high performing and competitive to meet the challenges of the 21st Century. Thus, the internal need and external pressures which companies like NT/BNR are experiencing, provides the grounds for this study.

The broad areas of creativity and intrinsic motivation have been studied extensively, mostly within the disciplines of psychology and sociology. Minimal

research, however, has been conducted in exploring the relationship between intrinsic motivation and creativity in adults within the business arena, and more specifically within a High Technology organization. Because of the importance of having a common language for discussion, the literature review will begin with defining the nature and scope of creativity.

THE NATURE AND SCOPE OF CREATIVITY

Creativity is described as a multi-faceted phenomenon, defying a precise definition. Psychologists' disagreement over the definition of creativity has been from the perspective of the creative process, the creative person and the creative product. For those researching the area, this lack of a clear definition can be problematic, especially in the business context where it is expected that concepts be clearly defined. For this reason, the researcher attempted to extract a definition that was most inclusive of the definitions in the literature, that could build on the work of others, and that would be suitable from an organizations' viewpoint. Both Torrance's (1979) model for studying and predicting creative behaviour, and Amabile's (1983a) components of creative performance provided some direction in crafting a suitable definition. Both show some degree of overlap, particularly in relation to the level of motivation or commitment to the task and creativity skills. As well, both Torrance and Amabile point to a definition of creativity requires creative abilities, creative skills, and an intrinsic task motivation to be evident for an individual to achieve a high level of creative achievement. Before presenting the

researcher's definition of creativity, both Torrance and Amabile's perspectives will be discussed below.

Torrance (1988) claimed that creativity involved every sense, sight, smell, hearing, feeling, taste and perhaps even the extrasensory. He suggested that much of creativity is unseen, nonverbal, unconscious, and thus difficult to explain. Over the past 25 years, Torrance's work has focused on the abilities that must be developed in order to achieve what he calls "satori" (that sudden feeling of enlightenment) and creativity. Abilities important to creativity are outlined in Table 1 (Torrance, 1979; Tardif & Sternberg, 1988; Davis, 1992). Torrance defines the term "creative thinking abilities" in the Torrance Test for Creative Thinking (TTCT), as "that constellation of generalized mental abilities that is commonly presumed to be brought into play in creative achievements" (Torrance, 1990, p.1).

Table 1: Creative Abilities

• Fluency	• Able to predict outcomes, consequences
• Flexibility	• Analysis
• Originality	• Synthesis
• Elaboration	• Evaluation
• Transformation	• Logical thinking
• Sensitivity to problems	• Able to regress
• Able to define problems	• Intuition
• Visualization, imagination	• Concentration
• Analogical/Metaphorical thinking	

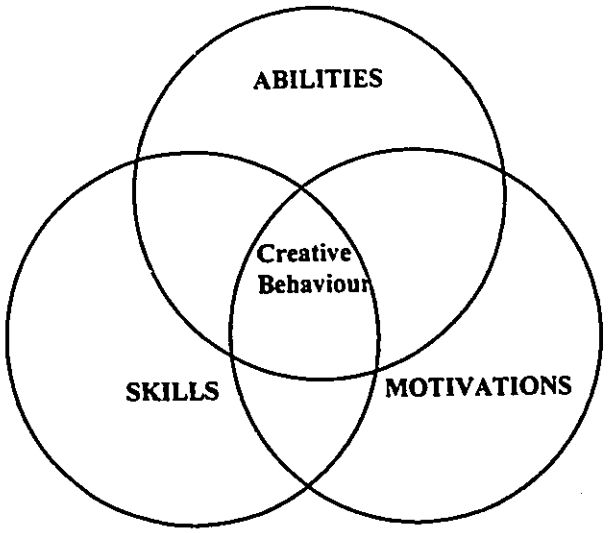
Source: Adapted from Torrance, 1979; Tardif & Sternberg, 1988; Davis, 1992.

Torrance maintained that high degrees of the abilities measured by tests such as the TTCT increase chances that the possessor will behave creatively. Figure 1 shows a

multi-faceted model for understanding, predicting and developing creative behaviour. Torrance's model not only takes into consideration creative abilities, but also creative skills and creative motivations.

According to Torrance (1979), a high level of creative achievement can be consistently expected from those who are able to combine creative abilities, such as, fluency, flexibility, originality, elaboration; creative skills, such as, problem definition, idea generation, creative problem solving, provocative questioning; and creative motivations (commitment towards a task). Torrance indicated that a person who has a high level of creative abilities and skills may become a creative achiever, if the creative motivations can be aroused. In the same way, a person with creative abilities and motivations can become a creative achiever with the development and utilization of the necessary creative skills.

Figure 1: Torrance's Model for studying and predicting creative behaviour



Source: Torrance (1979)

In support of Torrance, Perkins (1981) claimed that creativity concerns what we do with our abilities, and that, any normal person can be creative in terms of whatever abilities he or she has or can acquire. He proposed that creativity has to be understood as the combination of traits which fosters the creative use of the mind to create its best work.

Coming from a different perspective, Amabile (1983b) asserted that social-psychological issues have been ignored in the study of creativity and that personality and cognition must be integrated into a general framework. In an attempt to consolidate the definitions of creativity, she argued that creativity is best conceptualized not as a personality trait or a general ability, but as a behaviour resulting from particular constellations of personal characteristics, cognitive abilities, and social environments.

She proposed that this behaviour, which is evidenced in products or responses, can only be completely explained by a model that encompasses all three sets of factors. Table 2 outlines Amabile's (1983a) componential conceptualization of creativity which includes three components (domain-relevant skills, creativity-relevant skills, and task motivation) necessary for individual creativity and describes the ways in which each of those factors contribute to the creative process.

Table 2: Components of creative performance

1 DOMAIN-RELEVANT SKILLS	2 CREATIVITY-RELEVANT SKILLS	3 TASK MOTIVATION
INCLUDES: - knowledge about the domain - Technical skills required - Special domain-relevant "Talent" DEPENDS ON: - Innate cognitive abilities - Innate perceptual and motor skills - Formal and informal education	INCLUDES: - Appropriate cognitive style - Implicit or explicit knowledge of heuristics for generating novel ideas - Conducive work style DEPENDS ON: - Training - Experience in idea generation - Personality characteristics	INCLUDES: - Attitudes toward the task - Perceptions of own motivation for undertaking the task DEPENDS ON: - Initial level of intrinsic motivation toward the task - Presence or absence of salient extrinsic constraints in the social environment - Individual ability to cognitively minimize extrinsic constraints

Source: Amabile (1983b).

Domain-relevant skills are specific and include knowledge about and experience in the task domain, special technical skills required for work in the domain, and domain-specific talents. Creativity-relevant skills operate at the general level; they include

heuristics for generating creative ideas as well as cognitive styles, working styles, and personality traits. Finally, task motivation is seen as the narrowly specific component, because it can vary importantly from one task in a domain to another. An individual can have an intrinsic orientation toward one task in a particular domain (such as painting a scene that has special emotional significance to the artist) and an extrinsic orientation toward a seemingly similar task in the same domain (such as painting a commissioned portrait (Amabile, 1985). Therefore, the higher level of domain-relevant skills, creativity-relevant skills, and intrinsic task motivation, the higher the final level of creativity in a given product.

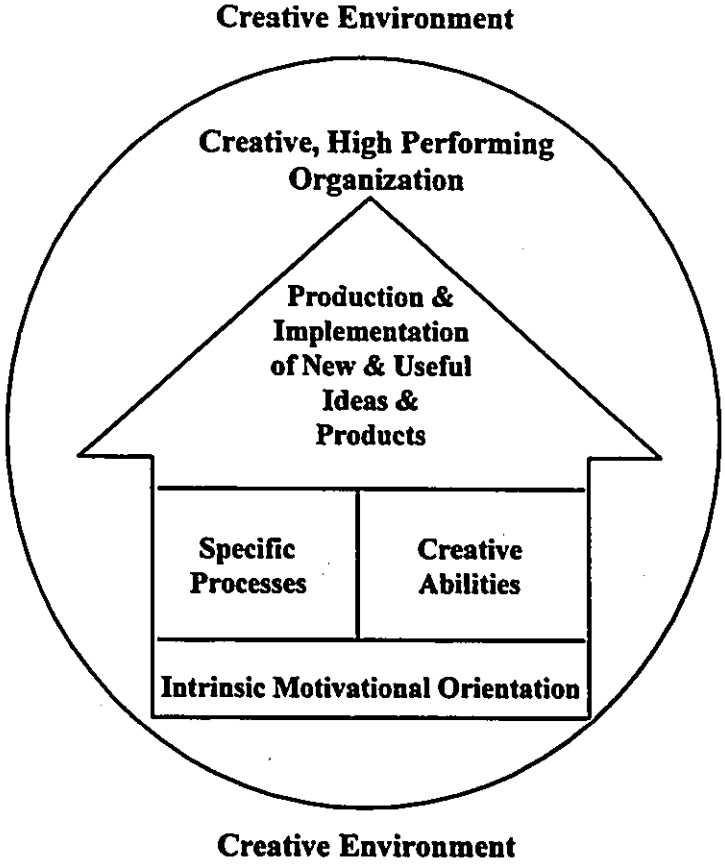
Amabile's (1983a, b) framework attempts to account for the fairly well-established creativity phenomena: the importance of talents, education, cognitive skills, innate interests, and personality dispositions, all functioning interactively to influence creative behaviour, as well as the apparently contradictory importance of both "work" and "play" in the motivation for creative behaviour (Shaughnessy, 1991; Torrance, 1991a). She concluded that this social psychology of creativity cannot be proposed as an answer to all questions of creativity any more than a personality approach or a cognitive approach can be proposed as the complete answer. Finally, Amabile (1990) argued that social factors may be responsible for only a small part of the total variance in creative behaviour, but they may account for the lion's share of the variance over which people have control. She believed this fact to be true and vitally important for anyone wishing to enhance creativity in practice.

In alignment with the framework presented above, Amabile (1983b) offered a conceptual definition of creativity which is consistent with most of definitions in the literature for a creative product: "A product or response will be judged as creative to the extent that (a) it is both a novel and appropriate, useful, correct, or valuable response to the task at hand and (b) the task is heuristic rather than algorithmic" (p.360). Accordingly, a product or idea is creative to the extent that expert observers agree that it is creative (Amabile, 1982). Algorithmic tasks are those for which the path to the solution is clear and straightforward, tasks for which an algorithm exists, whereas heuristic tasks are those not having a clear and readily identifiable path to solution and include tasks for which algorithms must be developed. The path to a solution refers to that set of cognitive and motor operations that leads to an acceptable response or product in the domain of endeavor. Minimal empirical research has been done on the topic of creative products (MacKinnon, 1975, 1978; Besemer & Treffinger, 1981; Amabile, 1982; Pearlman, 1983). Mostly this is because the identification of creative products seems obvious, meaning that everyone can recognize a creative product when they see one (MacKinnon, 1978). These same criteria are operating in high technology organizations, where products must not only be novel and useful, but also must have economic merit (Drucker, 1986).

Based on the insights taken from both Torrance and Amabile's models of creativity, and Amabile's conceptual definition of creativity, for purposes of this study, **creativity will be defined as including the production of novel and useful ideas and products, and is dependent upon specific processes, creative abilities and motivation**

towards the task. This definition, as well as the essence of this study, is presented in Figure 2 below.

Figure 2: Model for understanding creativity and its importance to organizations



Source: Adapted from Torrance (1979; 1988); Amabile (1982; 1983 a,b; 1985) & others

The model suggests that an intrinsic motivational orientation lies as the foundation of creativity, along with creative abilities and specific processes, to the production and implementation of new and useful ideas and products. A creative work environment encompasses this and is fundamental to creative performance. Combined

with creative production, this leads to a creative, high performing organization; one that must strive to remain competitive and survive in today's global marketplace.

The definition of creativity outlined above is consistent with the areas seen as essential for productivity and success within a high technology environment. In BNR the production and implementation of novel and useful ideas and products is seen as the lifeblood of the organization. In a recent announcement regarding NT/BNR's new organization structure, increased investment and emphasis is being placed on developing new products and services in an effort to put NT into the leadership position by the next century. Several processes within BNR, for hardware and software design and new product introduction, include specific elements related to creativity (i.e.; conceptual definition in the New Product Introduction process). Finally, BNR's hiring criteria looks at a potential employee's creative ability and motivation towards work as being critical to working in a R&D environment. Also, successful teams and projects within BNR are often attributed to individuals with creative ability and motivation. The Conference Board of Canada's document, "Employability Skills Profile: The Critical Skills required of the Canadian Workforce (July 1992)", focused on creative ability and motivation also, and identified them as important for Canadians employed in the new economy industry.

In summary, creativity is a multifaceted phenomenon that defies a precise definition. In an effort to formulate a definition suitable for a high technology organization one was developed drawing from the work of Amabile, Torrance, and others. From this, a model for understanding creativity and its importance to organizations was presented. In the next section, intrinsic motivation, an important

element of the model, will be defined and its relationship to creativity will be discussed further.

THE NATURE AND SCOPE OF INTRINSIC MOTIVATION

In the model depicted in Figure 2, intrinsic motivation is presented as the foundation to creativity. To explore this we will first define intrinsic motivation, and then examine whether a relationship between intrinsic motivation and creativity is truly evident. Intrinsic motivation, often described as the 'labor of love aspect' driving human behaviour, is defined as "the motivation to engage in work primarily for its own sake, because the work itself is interesting, engaging or in some way satisfying" (Amabile et al., 1994, p. 950). In contrast, extrinsic motivation is defined as "the motivation to work primarily in response to something apart from the work itself, such as reward or recognition or the dictates of other people" (Amabile et al., 1994, p.950). Deci & Ryan (1985a) characterized intrinsic motivation as the innate, natural propensity to engage one's interest and exercise one's capacities, and in so doing, to seek and conquer optimal challenges. Such motivation emerges spontaneously from internal tendencies and could motivate behaviour even without the aid of extrinsic rewards or environmental controls.

From another perspective, Lepper and Greene et al. (1973; 1978) operationally defined intrinsic motivation as the presumed motivation behind any behaviour that occurs in the apparent absence of extrinsic incentives. They focused primarily on the undermining of intrinsic motivation by the imposition of extrinsic constraints, an

occurrence that they called the overjustification effect. This "overjustification hypothesis" has been confirmed in several studies examining constraints as diverse as rewards for work (Deci, 1972; Lepper, Greene & Nisbett, 1973), surveillance (Lepper & Greene, 1975), and deadlines (Amabile, Dejong, and Lepper, 1976). In all cases, subsequent intrinsic interest was undermined by socially imposed constraints.

An abundance of research indicates that the most significant experience of maintaining intrinsic motivation is that of competence and self-determination. Theorists such as White (1959) and Harter (1978) claimed that intrinsic motivation was based on the innate human need for competence in meeting optimal challenges. Deci, Ryan et al. (1975; 1978; 1985a) included both competence and self-determination as primary to intrinsic motivation. They stated that it is not the need for competence alone that underlies intrinsic motivation, but the need for self-determined competence. Self-determination is the quality of human functioning that involves the experience of choice (an internal perceived locus of causality), "rather than reinforcement contingencies, drives, or any other forces or pressures, be the determinants of one's actions. Any factor that undermines this experience will decrease intrinsic motivation" (Deci & Ryan, 1985a, p. 24).

The concept that people attribute their behaviour to either an internal or an external source is supported by Bem (1972) and deCharms's (1968). People ask themselves if they are conducting an activity because they choose to do so or because of some external incentive. Of these two control perceptions, people are said to be more

intrinsically motivated when they perceive themselves to be the source of their behaviour, which deCharms (1968) termed "personal causation".

The concept of intrinsic motivation is also embedded in many of the major theories of work motivation, such as, self-actualization, the need to fulfill one's potentialities (Maslow, 1943); redesigning jobs so the work itself provides opportunity for growth, challenge, stimulation, learning and recognition (Herzberg, 1959); growth needs which describe a person's need to investigate, explore and master his or her environment (Alderfer, 1972); theory Y (McGregor, 1960); and achievement motivation theory (McClelland, 1961). Each stressed the importance of an internal desire to succeed at challenging tasks and to seek responsibility, and each supported the common theme that people need to feel competent.

In order to effectively research the motivational orientation area, Amabile and her colleagues (1994, 1987) developed a reliable instrument for assessing intrinsic and extrinsic motivational orientations in adults, called The Work Preference Inventory (WPI). Although both theoretical and empirical data supported the expectation that intrinsic and extrinsic motivation are distinct from each other, the relationship between them still requires further investigation. Thus, the WPI was designed as a "direct, explicit assessment of individual differences in the degree to which adults perceive themselves to be intrinsically and extrinsically motivated toward what they do" (Amabile et all, 1994, p.952).

Scales in the WPI are scored independently, guided by the underlying assumption that intrinsic and extrinsic motives might coexist. Unlike Deci and Ryan (1985b), who designed their scales to assess general causality orientations that might result in intrinsic or extrinsic motivations, the WPI directly assesses intrinsic and extrinsic motivations. The WPI attempts to include not only self-perceptions of competence and self-determination needs, but also the entire range of cognitions and emotions that are proposed to be part of intrinsic or extrinsic motivation.

In general the literature suggests advantages to adopting an intrinsic versus extrinsic motivational orientation. Primary to intrinsic motivation are self-determination and the experience of competence. To be explored further is the interaction between creativity and intrinsic motivation.

THE INTERACTION BETWEEN CREATIVITY AND INTRINSIC MOTIVATION

The review of the creativity and intrinsic motivation literature showed a strong and positive link between a person's motivational state, called motivational orientation, and the creativity of the person's performance (Amabile, 1983a, b, 1985; Hennessey & Amabile, 1988; Brown, 1989; Lepper & Greene, 1978; Perkins, 1984). After an extensive study of the area, Amabile (1983a, b, 1985) proposed what she called the intrinsic motivation hypothesis of creativity - that "an intrinsically motivated state is conducive to creativity, whereas an extrinsically motivated state is detrimental" (p. 370). In several studies of celebrated creative individuals, she found support for the hypothesis that

people are more creative when they are intrinsically motivated, and that creativity will be affected by variables similar to those that affect free-choice behaviour and interest, particularly those related to the perceived locus of causality (Amabile, 1982, 1985; Deci & Ryan, 1985a).

More specifically, overjustification studies have generally shown decreases in creativity under reward conditions, whereas behaviour motivation studies have shown increments under such conditions. Amabile (1979) proposed that while we might expect that some professional scientists or artists succumb to the overjustification effect, it seemed eminently clear that many highly creative people go on being creative in light of numerous extrinsic constraints. It is possible that exceptional individuals have largely internalized the norms and standards by which their work would be judged, (for example, Bill Gates, head of Microsoft, who is able to be creative within the highly extrinsic high technology environment) or highly creative and successful people almost always have a very high level of intrinsic interest in their work (for example, the Canadian skater, Elvis Stojko, who enjoys what he does and performs for himself within a highly competitive lucrative sport). Therefore, the overjustification effect was proposed to occur only when internal states were ambiguous or nonsalient (Amabile, 1979). It will be valuable to come back to this point when analyzing the results of this study.

Deci and Ryan (1985a) claimed that the feeling of self-determination that Einstein and many other creative people saw as central to their best work, is the core of the Intrinsic Motivation Principle of Creativity: People will be most creative when they feel motivated by the interest, enjoyment, satisfaction and the challenge of the work itself,

rather that by external pressures(Amabile & Hennessey, 1992, p. 55). Csikszentimihalyi's (1975) pioneer work on individuals who were deeply intrinsically involved in activities supported this principle and the importance of enjoyment. He called the experience of being totally involved in the activity, where one action flows smoothly into the next and extrinsic concerns disappear, the "flow experience". Csikszentmihalyi's (1975) description of the flow experience, along with Crutchfield's (1962) statements of ego-involvement, fit well with Amabile's (1983a, 1990) first-person descriptions of the creative process. Amabile (1983a) found a recurring theme while reading autobiographies, letters and journals of people such as Albert Einstein and Sylvia Plath. The latter felt most inhibited in their creative work when focusing on extrinsic concerns such as expected evaluation, surveillance, or promised reward, while, they did their most creative work when they experienced the "flow" of deep intrinsic rewards (Amabile, 1990). Such studies, combined with the program of experimental research that Amabile and her colleagues have conducted during the past fifteen years, have supported the principle of intrinsic motivation as a powerful foundation for the creative process.

The literature on intrinsic motivation and creativity complimented the studies on research scientists who are depicted as being achievement oriented and self-starters, internally motivated, enthusiastic and highly involved in their work (Amabile & Gryskiewicz, 1985; Amabile & Sensabaugh, 1986; Bailey, 1978; Roe, 1972). In an organization such as BNR, where the majority of the workforce is university educated and working in a design and development function, adopting an intrinsic motivational orientation is seen as pivotal to creative and knowledge production. Because employees

are highly educated and have high expectations in terms of rewards and recognition, it is often difficult for an organization to successfully satisfy these extrinsic motivators. Therefore, it is expected that a strong intrinsic motivational orientation, allowing them to stay focused and creative, would shield employees from extrinsic constraints which can often disrupt productivity and creativity,.

Although the literature points to a strong link between creativity and intrinsic motivation, most of the research involved children or university students, not adults working within organizations. The current study is designed to lessen this gap by exploring the conditions are necessary to enhance intrinsic motivation, and therefore creativity in adults in a high technology organization.

THE CREATIVE ENVIRONMENT IN HIGH TECHNOLOGY ORGANIZATIONS

Another element of the model presented in Figure 2, still to be addressed, is that of the creative environment in which employees work, meaning those external factors that either inhibit or facilitate creativity. Nolan and Nolan (1988) maintained that many companies and organizations are poor at innovation because of the dual problem of individual employees not being creative or the creative employee not knowing how to turn their creative ideas into innovations; and the organization not supporting the process of creativity and innovation. A creative work environment, supported and nurtured within a high technology organization, will provide the competitive advantage necessary for the

organization to survive in the global marketplace. Given the nature of this study, it is important to start with a definition of a high technology organization.

High technology organizations are often defined as those which spend three percent of their revenue on R&D (Hayes, Wheelwright, & Clark, 1988). In addition, Ramo (1988) defined high technology companies, such as NT/BNR, as not only a company with products that embodied recent advances in science, but also potentially one with a manufacturing process that has unusual ingenuity in the application of current technology. He indicated that technology-based organizations, in particular, have given attention to facilitating a steady utilization of creativity because of the rapid advance of science-based fields. A high technology company is in constant danger that a scientific advance or technological breakthrough occurring outside the organization may destroy its market position, threaten revenues and earnings, and require the write-off of inventory and facilities (Ramo, 1988). High technology companies must be in a position to capitalize on the shifting technological environment on which they depend. Certainly this is the case for NT/BNR where scientists must develop innovative wireless and broadband communications products and network services in order to stay ahead of the competition. Add to this, the need to find creative ways to bring new and existing technology into foreign markets.

Current research into what inhibits or promotes creativity within high technology organizations has identified freedom and control, successful project management, sufficient resources and various organizational characteristics, such as a collaborative atmosphere, a high expression of creativity, and acceptance of failure, and/or a non-

bureaucratic structure, as factors that lead to a creative work environment (Amabile & Sensabaugh, 1986; Amabile & Gryskiewicz, 1985, 1987,1988; Bailey, 1978; Yong, 1994). New hires to high technology organizations often join for a combination of: the opportunity to work on leading-edge research projects, the outstanding reputation of the organization as an applied R&D think tank, and/or the job security that comes with working for such an organization.

In an effort to facilitate creativity a challenge organizations often face is how best to balance the freedom of individuals with the organizational needs for structure, meeting deadlines, and consistent processes. In considering factors that stimulate creativity and ones which inhibit it, freedom and control are the most commonly mentioned environmental factors (Amabile & Gryskiewicz, 1985, 1987, 1988). Freedom means deciding what to do and how to do it; a sense of control over one's ideas, a freedom from having to meet someone else's constraints; a generally open atmosphere. Specifically, when a project manager and higher-level manager played an important role in setting the direction of the project, scientists felt that their freedom came from the sense that their own ideas contributed in a major way to the day-by-day scientific conduct of their work. A good example of an organization with success in doing this is 3M where management allow researchers time to pursue their ideas, such as the post-it note concept which has reaped millions for 3M. In an effort to balance freedom and structure, companies like IBM, Hewlett-Packard, Texas Instrument and AT & T have adopted in-house entrepreneur development, often called "intrapreneurship", within their organizations (Yong, 1994). Research & Development (R&D) organizations that are able to provide

scientists with both the freedom to explore ideas and the autonomy to pursue them are more apt to be successful both competitively and financially.

The culture or climate of the organization can either help or hinder creativity. Morgan (1988) insisted that a vibrant corporate culture creates an effective context for innovation; however, much more could be done to foster learning and creativity on a continual basis. He went on to say that: "The allocation of time for creative work, the ability to ensure that this time results in the generation of ideas and opportunities that resonate with the challenges facing the organization, and the ability to keep key people are competencies critical to the management of innovation. Often, people have the capacity to think critically and productively, but they must be encouraged and supported in this endeavor" (p. 76).

In one study, researchers suggested that at least within the R&D laboratory, the work climate was more instrumental than personal characteristics in making the difference between high and low creativity (Amabile & Gryskiewicz, 1988). In this study, the scientists felt that much could be done to improve the work environment to facilitate creativity, as "they had not yet realized their full potential for creativity" (p. 504-505). Amabile and Gryskiewicz (1988) indicated that because high-powered R&D laboratories are so stringent about hiring only the most skilled, most highly talented, and most productive scientists, they see the strongest effects on creative output coming from the work environment and the way it influences motivation.

Also fundamental to high technology organizations is how creativity is managed. Lewis and Delaney (1991) concluded that creativity and innovation can be advanced in a research organizations when managers 1) give signals that trying new ideas is good for the organization, and not penalize employees when they freely express values on work related issues or try new approaches; 2) respect individuality, not only in the diversity of people, but also in nontraditional approaches to solving research problems; 3) relieve research scientists of administrative burdens and allow them to concentrate on scientific tasks; and 4) fund good ideas promptly, building into the research budget discretionary funds to allow for new innovations to be pursued in a timely fashion. Himes (1987) suggested that a "loose-rein" management style in which management tolerates and expects a certain degree of reasonable risk-taking is most conducive to a creative work environment.

Just as there are many factors that facilitate creativity, there are many inhibitors to creativity that need to be noted. Many organizations have work environments that are characterized by caution, inhibition and constrained thinking which is known to stifle creativity (Davis, 1992; Taylor, 1972; Van Gundy, 1987). Politics within an organization, managers with a high need for control, and unhealthy competition amongst will definitely suppress creative production. Other factors identified as inhibitors to creativity include: inappropriate reward systems, too frequent meetings, status issues, and poor communications between divisions; constraints, meaning a lack of freedom or choice in deciding what to do and/or how to go about it; organizational disinterest for a project or idea; and poor project management (Amabile & Sensabaugh, 1986). However, the most

striking detriment to creativity can be the reward system, with either too much emphasis on rewards or insufficient or unfair distribution of rewards (including recognition for good work) (Amabile & Gryskiewicz, 1988; Davis, 1992).

The current research suggests that high technology organizations wishing to survive in a competitive, global arena will need both highly self-motivated high technology professionals and active adoption of environmental factors, such as freedom and control, successful project management, sufficient resources and various organizational characteristics, such as a collaborative atmosphere, a high expression of creativity, and acceptance of failure, and/or a non-bureaucratic structure, that act as stimulants to creativity. Organizations that neglect to nurture and cultivate creativity in the work environment do so to their detriment. The next section will investigate the characteristics of high performing employees, and the environmental factors which foster and support these characteristics.

CREATIVE ADULTS IN HIGH TECHNOLOGY ORGANIZATIONS

An area that deserves attention is considering whether there are differences in creativity and the motivational orientations between high performing adults and solid performing adults. Torrance (1991a) is one of the few researchers who has examined the differences between high and solid performing adults. He observed that a few subjects had had so many notable creative achievements that they did not fit on the same scale as the other subjects. He termed this group "beyonders" as they demonstrated characteristics such as, "delight in deep thinking, tolerance of mistakes, love of one's work, clear purpose, enjoying one's work, feeling comfortable as a minority of one, being different, not being well-rounded, sense of mission, and courage to be creative" (Torrance, 1991a, p. 74), that distinguished them from other subjects.

Anne Roe (1952), a pioneer in the field of relating occupation to personality, found that creative physical scientist were very open to experience, highly observant and prone to see things in unusual ways, extremely curious, accepting of unconventional thoughts, ready to recognize and reconcile apparent opposites and tolerant of ambiguities but liking to resolve disorder into order, appreciative of complexity, highly independent in judgment, though, and action, self-reliant and not responsive to group standards and control. In addition, Roe found that when circumstances prevail, creative scientists will exhibit great perseverance and personal discipline. These traits parallel the findings of other researchers (Amabile, 1990; Amabile & Gryskiewicz, 1988), and point to creative scientists' having an intrinsic motivational orientation.

Kelly & Chaplan (1993) found that when managers were asked what makes the difference between high and solid performing adults, higher IQs, better problem solving skills, and an enormous will to win were the common traits mentioned. However, Kelly and Chaplan (1993) argued that the strategic ways top performers do their jobs, such as networking, self-management, and taking initiative, made up the real difference between what they called "star" and "average" performers. Common to both Torrance and Kelly's and Chaplan`s research is the aspect of intrinsic motivation. The literature frequently mentions positive personal characteristics of producers of high creativity including personality traits such as "persistence, curiosity, energy and intellectual honesty; self-motivation, the intrinsic motivation of being excited in the work itself; special cognitive abilities; risk orientation; social skill; and brilliance" (Amabile, 1990, p. 75). The successful scientists are often not the most talented, but the ones who are just impelled by curiosity, they have to know the answer is (Amabile & Gryskiewicz, 1988). This suggests that given a particular level of skill and ability, intrinsic task motivation differentiates high from solid performing adults.

Negative personal characteristics frequently mentioned in the low-creativity cases were "being unmotivated, unskilled, inflexible, externally motivated, or socially unskilled" (Amabile, 1990, p. 76). Just as self-motivation was seen as a positive influence on creativity, being unmotivated, that is, having a lack of motivation for work, not being challenged by a problem, having a pessimistic attitude toward the likely outcome, being complacent or lazy, was seen as a major detriment. Is it possible that some individuals may not have the potential to become high performers? Kelly and Caplan (1993) found

through surveying major companies that "one third of knowledge workers don't feel tied to their company's destiny, nor do they feel that their productivity and good ideas are sufficiently rewarded", pointing to the lack of motivation to become high performers (p. 138).

BNR has defined in its hiring policy that level of performance is positively related to marks. Thus, it tries to only hire the top of the class. The challenge for the organization is ensuring that these high performers remain at this level and do not fall to a level of average performance. This is often difficult given that BNR's current reward and recognition programs often conflict with this effort. Specifically, only a certain percentage of employees can receive an "exceeds" rating (typically about 25 percent) on their performance appraisal, with the remaining receiving an "achieved" or lower. Those employees who were in the top ten percent of their class often find this reality demotivating and frustrating. It would be interesting to see if this aspect or other factors are raised in the study as contributing to the differences between high and solid performers.

The literature on creative adults suggests that competitive R&D organizations will have some individuals who may serve as sparks to ignite the flame of innovation and creativity, while others may constantly add fuel to the fire (Lewis & Delaney, 1991). There appear to be differences in creativity and motivational orientation between high and solid performing adults, which will be examined further as this study explores the profile of high and solid performing designers within BNR.

SUMMARY

As this century ends, two great currents are running through the world economy: globalization and the information revolution (Drucker, 1993; Kanter, 1995; Ohmae, 1995; Tapscot & Caston, 1993). These two great currents are creating spectacular new growth opportunities for companies like NT/BNR. Because of this knowledge, organizations, specifically NT/BNR, are well positioned to capitalize on their intellectual and creative capital. The current challenge, however, is how best to unleash the knowledge and creative production resident within their employees, and to develop and maintain an environment that nurtures and fosters its creative and intellectual capital. The literature points to the need for both self-motivated employees and a work climate that facilitates creativity.

Previous investigations on creativity suggest that it is a concept that is difficult to define. However, for the purpose of this study the following definition of creativity will be used: **Creativity is the production of novel and useful ideas and products, and is dependent upon specific processes, creative abilities and motivation towards the task.** As illustrated in Figure 2 the model suggests that an intrinsic motivational orientation lies as the foundation of creativity, along with creative abilities and specific processes, to the production and implementation of new and useful ideas and products. A creative work environment encompasses this and is fundamental to creative performance. Combined with creative production, this leads to a creative, high performing organization; one that must strive to remain competitive and survive in today's global marketplace.

The literature on intrinsic motivation provided definitions of motivation, and discussed the elements of an intrinsic motivational orientation, and the effect of extrinsic constraints. Intrinsic motivation, often described as the 'labor of love aspect' driving human behaviour, is defined as "the motivation to engage in work primarily for its own sake, because the work itself is interesting, engaging or in some way satisfying" (Amabile et al., 1994, p. 950). The literature suggests advantages to adopting an intrinsic versus extrinsic motivational orientation. Also primary to intrinsic motivation are self-determination and the experience of competence.

The literature also revealed theory and research establishing that an interaction between intrinsic motivation and creativity does exist. Specifically, an intrinsically motivated state is conducive to creativity, whereas the extrinsically motivated state is detrimental. This concept will provide a clear basis for discussion and after analysis of data from this particular research.

The creative environment in high technology organizations was also discussed indicating that organizations that neglect to nurture and cultivate creativity in the work environment will do so to their detriment. High technology organizations wishing to survive in a competitive, global arena need both highly self-motivated high technology professionals and active adoption of environmental factors, such as freedom and control, good project management, sufficient resources and various organizational characteristics, such as a collaborative atmosphere, a high expression of creativity, and acceptance of failure, and/or a non-bureaucratic structure, that act as stimulants to creativity.

Finally, there is a gap in the current research. Most of the research is related to children and young adults, with very few studies considering the interaction of creativity and intrinsic motivation in adults within organizations. In the few studies available differences were seen in creativity and motivational orientation between high and solid performers. Consequently, by studying a successful high technology organization, such as BNR, the research will attempt to uncover the conditions necessary for intrinsic motivation and creativity to occur so that organizations may create superior work environments.

RESEARCH QUESTIONS

This study will examine the following:

1) To what extent and to what degree will Amabile and Hennessey's (1992) Intrinsic Motivation Principle of creativity be evident in adults within BNR? Will there be a significant difference between the level of intrinsic motivation and creativity in high performing designers versus solid performing designers? If so, how and in what ways?

2) What are the conditions necessary to bring out intrinsic motivation, therefore creativity, in adults in BNR?

The next chapter will describe the research methodology used to conduct the study. Following this, the results of the study will be presented and discussed.

CHAPTER 3: METHODOLOGY

The intent of this chapter is to present the research methodology. Specifically it will outline the design approaches chosen and why, the constraints experienced and how they guided the approach taken, and the methodology used to meet these criteria.

RATIONALE FOR METHODOLOGY

To thoroughly investigate the two research questions, a combination of quantitative and qualitative research design was chosen. The value of quantitative research is that it provides hard, projectable results, while qualitative research is advantageous in that it can add insights and explore hypotheses. A quantitative approach was used to investigate the first research question. The qualitative approach was reflected in the second research question.

The study was conducted in two stages. The intent of stage one was to replicate the work of Amabile and Hennessey, but with adults in a high technology organization. To do this, standardized tests were used because they offer the technical qualities of reliability and validity, are widely used in educational research (McMillian & Schumacher, 1984), and they are also easy to administer in a business environment. Using the results of the tests, descriptive statistics, correlational analysis and tests of significance were used to serve as a validation on what seemed evident from the literature review on the positive relationship between intrinsic motivation and creativity.

Stage two of the study's design and procedures was intended to parallel the methodology used by Burnside, Amabile, and Gryskiewicz (1988) in assessing organizational climates for creativity and innovation. This involved interviewing a subset of the participants to determine greater depth and detail, and to strengthen the data from the tests. The interview provided descriptive data, in the subjects' own words, on when they felt most and least creative, and how they viewed the ideal work conditions. The interviews only involved a subset of the participants and were intended to be 30 minutes long.

Finally, it was important to validate the results from the quantitative data with the interview data. The approach used to do this was Triangulation. Although it can take many forms, its basic feature is the combination of two or more different research strategies in the study of the same empirical units (Denzin, 1978). Lincoln and Guba suggest that no single item of information should ever been given serious consideration unless it can be triangulated. The only time this may not hold true is if the information is coming from an elite and irrefutable source (Lincoln and Guba, 1985).

The methodology for this study combined both quantitative and qualitative research so that both research questions could be investigated extensively. To aid understanding of the methodology, relevant terms will be defined.

OPERATIONAL DEFINITIONS

Throughout the study the terms R&D designer, High performing designer, and Solid performing designer were used. A definition of each term is provided below.

R&D designer: An employee of BNR, with either a computer science or engineering background, who works in a design capacity either on hardware or software design of telecommunications products for NT/Bell-Northern Research.

High performing R&D designer: An experienced R&D designer who has year over year demonstrated exceptional ability and performance; consistently demonstrates core values; is considered critical to the business; would be difficult to replace in kind; is a role model and mentor to others; has broad acceptance and respect as a key contributor; has depth in specialized area or has unique skills or knowledge and; who may or may not be promotable within a five year window. (taken from BNR's Switching Networks Division Key Resource Development (KRD) definitions, 1992). The core values referred to above are those identified within NT's vision statement, and are included in the Managing for Achievement (NT's performance appraisal) process. These values are: commitment, people, customers, teamwork, innovation, shareholder value, and excellence.

Solid performing designer: An experienced R&D designer who has consistently maintained an "achieved" rating year after year on their performance appraisal and who is judged by management and peers as a Solid performer. (The term "achieved" rating is taken from the NT, Managing for Achievement Guide, 1992).

SUBJECTS

The research subjects were 60 experienced BNR R&D designers; 30 High performing R&D designers, and 30 Solid performing R&D designers, from the Switching Networks Division, Ottawa, Ontario. The Switching Networks Division is the largest division within BNR with a total population of approximately 1900 employees, with a large percentage of employees working in the design capacity. R&D designers from the Switching Networks division are considered representative of the total R&D designer population of BNR across North America.

The 60 subjects were randomly selected from BNR's Human Resources (HR) databases. Thirty High performing R&D designers, 23 male and 7 female, were randomly selected from a pool of 150 experienced designers from the 1994 Key Resource database. This database was derived by Management and Human Resources of the Switching Networks Division. As per the definition stated above, a High performing R&D designer must have year over year demonstrated exceptional ability and performance, and be seen as critical to the business. Of the 30, ages ranged from 25 to 45, with a mean age of 31. Years of experience within BNR for this group ranged from 0 to 13, with a mean of six years.

Thirty Solid performing R&D designers, 22 male and 8 female, were randomly selected from a pool of 394 experienced designers (again from the Switching Networks Division) from the BNRInfo database. A Solid performing R&D designer must have consistently maintained a "achieved" rating year after year on their performance

appraisal, and be judged by management and peers as a Solid performer. Ages for this group ranged from 26 to 50, with a mean age of 34. Years of experience within BNR ranged from 2 to 26, with a mean of 7. Random selection was continued until the total of 30 for each group was achieved. Both groups were homogeneous in terms of similar disciplines - 93 percent Computer Science and 7 percent Engineering. The measuring instruments used to study subjects' level of creativity and motivational orientation will be discussed.

MEASURING INSTRUMENTS

Stage one

The purpose of stage one of the study was to ensure that what was identified in the literature regarding the positive relationship between intrinsic motivation and creativity was evident in adults in a high technology organization such as BNR. For this reason, the instruments selected were those that would best evaluate creativity and intrinsic motivation. The two instruments selected were the Torrance Tests of Creative Thinking (TTCT) (Torrance, 1966), "Thinking Creatively with Pictures - Figural Form B"; and the Work Preference Inventory (WPI) (Amabile, 1987; Amabile, Hennnessey & Tighe, 1994). The TTCT was selected for measuring creativity for three reasons: (1) the figural nature of the test which reduces the possible influence of reading ability or vocabulary development, i.e.; more suitable for cultural diversity; (2) the extensive reliability and validity of the TTCT; and (3) the wide use of the TTCT in creativity research (Davis,

1992; Khatena, 1982). The WPI was selected because it is seen as a useful tool for research on intrinsic motivation and extrinsic motivation (Amabile et al, 1994). Each instrument is discussed below in more detail.

Torrance Tests of Creative Thinking - Thinking Creatively with Pictures: Figural B

The TTCT , "Thinking Creatively with Pictures - Figural Form B", was used to measure creativity (see Appendix 2). This is a three-part test of picture construction and is scored on five norm-referenced measures: fluency, originality, elaboration, abstractness of titles, and resistance to premature closure, and thirteen criterion-referenced measures (Torrance, 1990). An average (mean) raw score and creativity index (CRI) is also provided (Torrance, 1990). The TTCT is considered to have reasonable reliability, and content and construct validity (Torrance, 1990; Davis, 1992). Test-retest reliability point out a range from .50 to .93 with most retest figures in the .60's and .70's (Torrance, 1990), and was first developed to identify creativity of adults in business settings. The TTCT is considered suitable for grades kindergarten through to adults (Torrance, 1990). The TTCT is by far the best known, most widely used, most extensively validated, and the most soundly criticized of all creativity tests (Davis, 1992).

The five norm-referenced measures, fluency, originality, elaboration, abstractness of titles and resistance to premature closure are described as:

Fluency - There has been considerable demonstration that the more alternatives a person or group produces and considers, not only the more viable those solutions are likely to be, but also there is also greater likelihood of success in solving the problem (Osborn, 1963; Parnes, 1967; Parnes, Noller & Biondi, 1977 in Torrance, 1979). The measurement of this score is based upon the total number of relevant responses, and as such, all other scores depend in part upon the fluency score inasmuch as no subsequent scores may be given in other dimensions unless a response is first found to be relevant (Torrance, 1991). "If two or more figures are combined, credit is given for the number of figures used" (Davis, 1992, p. 199).

Originality - "Originality involves getting away from the obvious and common place or breaking away from habit bound thinking" (Torrance, 1979, p. 40). "This score is based upon the statistical infrequency and unusualness of the response" (Torrance, 1991, p. 7).

Elaboration - "The basis of this score is two underlying assumptions: the minimum primary response to the stimulus figure is a single response; the imagination and exposition of detail is a function of creative ability, appropriately labeled elaboration" (Torrance, 1991, p. 7). One elaboration point is given for adding such elements as decorations, color, shading. Each major variation of design, and each elaboration of the title beyond minimal labeling is considered to be elaboration, as well (Davis, 1992).

Abstractness of titles - "This score relates to the subject's synthesizing and organizing processes of thinking. At the highest level, there is the ability to capture the essence of the

information involved, to know what is important, enabling the viewer to see the picture more deeply and richly" (Torrance, 1990, p. 7).

Resistance to premature closure - "The basis of this score is a person's ability to keep open and delay closure long enough to make the mental leap that makes possible original ideas. Less creative persons tend to leap to conclusions prematurely without considering the available information, cutting off chances of more powerful original images" (Torrance, 1990, p. 7).

Pooling of the scores for the creative strengths, from the Checklist of Creative Strengths, and the average standard score (pooling of the five norm-reference scores) from the profile yields the creativity index (CRI), which has been found to serve well as an overall indicator of creative potential (Torrance, 1990). The second instrument to be used, to measure motivational orientation, will be The Work Preference Inventory. It is outlined in more detail below.

The Work Preference Inventory

The WPI (Amabile, 1987; Amabile, Hennnessey & Tighe, 1994) was used to assess individual differences in intrinsic and extrinsic motivational orientations (see Appendix 3). The instrument has meaningful factor structures, adequate internal consistency, good short-term (six month) test-retest reliability, and good longer-term (up to four years) stability (Amabile et al, 1994). In order to establish construct validity of the

WPI scales, several questionnaire and behavioural measures of motivation were correlated with WPI scores (Amabile et al, 1994). Correlations between these measures and the WPI scales largely supported the validity of the instrument (Amabile et al, 1994). Correlation between WPI scores and behavioural creativity measures are also encouraging (Amabile et al, 1994). Intrinsic scores correlated positively with creativity, while extrinsic scores correlated negatively with creativity (Amabile et al, 1994).

The WPI describes an individuals' preference for various types of tasks and work environments. It gives information on the factors that motivate persons in their work. Through exploratory factor analyses, Amabile et al (1994) yielded virtually identical and conceptually interpretable scales labeled Intrinsic Motivation and Extrinsic Motivation, which are referred to as primary scales. Second, each of the primary scales was itself factor analyzed with meaningful and almost identical groupings of items into subfactors. These secondary scales serve as more fine-grained breakdowns of the elements of intrinsic and extrinsic motivation. The secondary scales are Challenge, Enjoyment, Outward, and Compensation. Primary and secondary scales are described as follows:

Intrinsic Motivation (Primary) - the motivation to engage in work primarily for its own sake; because the work itself is interesting, engaging, or in some way satisfying (Amabile et al, 1994).

Extrinsic Motivation (Primary) - the motivation to work primarily in response to something apart from the work itself, such as reward or recognition or the dictates of other people (Ibid).

Challenge (Secondary) - "People who score high on this orientation tend to enjoy solving new, difficult, complex problems. They are not satisfied by straightforward tasks, and they prefer work that stretches their abilities (Amabile, 1994, p.1)."

Enjoyment (Secondary) - "People who score high on this orientation tend to be strongly motivated by curiosity and self-expression in their work, and they can get so absorbed in their work the that they forget about everything else. They prefer to figure things out for themselves and set their own goals. High scorers want to learn from their work, and they feel it is very important to enjoy what they do (Amabile, 1994, p.1)."

Outward (Secondary) - "People who score high on this orientation tend to be motivated by recognition; they are sensitive to others' opinions of their work and ideas. They tend to judge their success relative to other people. In addition, high scorers prefer work with clear goals and procedures (Amabile, 1994, p. 2)."

Compensation (Secondary) - "People who score high on this orientation tend to be strongly motivated by the compensation they receive for their work. They are keenly aware of their income and promotion goals (Amabile, 1994, p. 2)."

Stage two

For Stage two of the study, Critical Incident Interview questions were adapted (see Appendix 4) in order to examine the conditions necessary for intrinsic motivation and creativity to occur for designers within BNR (Burnside et al, 1988). The Burnside et

al (1988) approach relates specifically to R&D employees' perceptions of environmental factors that either stimulate or obstruct creativity. Adaptations were made to the interview protocol's questions to include an item on how R&D designers viewed their ideal working conditions, and the kind of setting where they worked best. During the interviews, subjects were also asked for their own definition of creativity.

DATA COLLECTION METHOD

This investigation involved a quantitative and qualitative collection of data through the use of instruments, and in-depth interviews with a subset of the R&D designers. Collection of the data occurred in two stages. In the first stage subjects completed both the TTCT and WPI. The second stage involved using the results of stage one to divide subjects into two groups: (Group a) the top ten percent that score high on intrinsic motivation and creativity, and (Group b) the bottom ten percent that score low in both intrinsic motivation and creativity. This resulted in 12 full-scale interviews.

In stage one, subjects were contacted by phone to invite them to attend a 40 minute session to complete both the TTCT and the WPI. Subjects were asked to sign a consent form and informed both verbally and in writing of the confidentiality of the study. Subjects were informed that there were two groups under study, however, individual designation was not identified in order to reduce bias and not effect performance in the study. They were also informed they could drop out of the study at any time (see Appendix 1). In an effort to minimize social desirability, participants were

told that the study involved working styles, i.e., creativity and motivation, in a high technology organization. Once attendance at the session was confirmed, participants were sent the information sheet and consent form to sign and bring to the next session. Each session included collection of the signed information sheet and consent form, an explanation of what was to transpire, and the administration of each instrument (see Appendix 5). The administration of the TTCT was conducted as per instructions provided in the TTCT Directions Manual (Torrance, 1991b) with some adaptation for this study.

In stage two, thirty minute individual interviews were held with each subject of the 12 subjects from groups a and b using the set of questions based on Burns et al (1988) Critical Incidence Approach (see Appendix 4). The interview questions were distributed to participants before the interview so that subjects could prepare. All interviews were held in a closed office. All interviews were tape recorded to ensure accuracy. Participants were informed they could have the tape recorder turned off at anytime. They were also assured that all data would be held in confidence and that only pooled group data would be reported.

As stated earlier, this two stage approach of collecting data was deemed necessary in order to more thoroughly address the two research questions. Interview times ranged from 30 minutes to one and a half hours in length.

DATA ANALYSIS

Data were analyzed by first examining them quantitatively (stage one) and then qualitatively (stage two), and then conducting the process of triangulation for cross-checking and comparison. Each stage is described in detail below.

Stage one

In stage one the TTCT was scored by Scholastic Testing Services, and the WPI scored by the researcher. Data were analyzed using the MYSTAT Statistical Analysis package (Hale, 1992), and SAS (1989). The level of significance was set to $p < 0.10$. The TTCT and WPI scores, measuring creativity and motivational orientation, were the dependent variables while and the performance level of the R&D designer (Solid or High) were the independent variables. Summary statistics - Mean and standard deviation were determined, and Pearson product correlation was established to determine the relationship between intrinsic motivation and creativity, for both groups. Comparisons were made between the two groups of participants: High and Solid performers using t-tests. The results are presented and discussed in the following chapter.

Stage two

Each interview was tape-recorded with the permission of the subject. Following completion of all the interviews, typed verbatim interview transcripts were prepared for analysis, as in the procedures used by Burnside et all (1988). Content was analyzed by two coders, the principal investigator and an assistant, who read identical copies of the transcripts independently, looking for comments that they felt should be coded as examples of conditions that either stimulate or obstruct intrinsic motivation and creativity, and the characteristics of ideal working conditions. Stimulants and obstacles were color coded. The coders coded comments either by word, phrase or sentence. Similarities were highlighted and patterns were established.

When completed, the two coders compared transcripts and noted disagreements. Where disagreements existed, the two coders discussed them until agreements were reached (the two coders were in 98 percent agreement, and only needed to work through two percent of disagreements). From this, the researcher worked with the master set of transcripts marking the categorizations for each comment on separate coding sheets. The researcher then coded all comments related to obstacles into the subcategories and comments related to stimulants into the subcategories. Characteristics of the ideal work environment were also coded. These were reviewed independently and agreed upon by both the researcher and the research assistant. From this, a master subcategorization coding sheet with all the final agreed upon subcategories was prepared.

Data were compiled from the master data coding sheet by obtaining frequency counts of the number of the subcategories of stimulants and obstacles that were mentioned at least once. Repeated mentions of a subcategory within an interview were not counted. This approach was taken in order to reduce the effect of a talkative person making the same point a number of times. For each group of participants, the categories were ranked by the total number of mentions throughout the interviews. The inclusion of quotes from interviews was used to bring the content analysis data to life.

Triangulation was used comparing the participants' statements about when they felt most and least creative and their ideal work environment and cross-checking them with the results found in the TTCT and WPI. Results will be discussed in the next chapter.

In summary, the researcher chose a combined quantitative and qualitative approach because it provided data that are rich for interpretation and potential implications. The use of an independent coder served to validate the constructs, eliminate potential bias, and assist in formulating the final reduction of categories.

CONTROLLING RESEARCHER BIAS

Many precautions were built into the procedure in an attempt to control for bias. Some of these included:

1) Random selection of subjects was used. Subjects were not known well by the investigator.

2) All interview questions were treated in a standard way and in a particular order. Given the retrospective nature of the questions, the timeframe for subjects' recall was kept to a minimum (within the last year). Subjects were given the questions at least one day ahead of time for preparation.

3) The researcher clarified or paraphrased when necessary to check the clarity and understanding of the subjects' experience or perspective.

4) Data were categorized independently by both an assistant and the researcher. Comparisons of both individual's conclusions was found to be 98 percent.

This chapter has outlined in detail the methodology used in the research study. It was the intent of the researcher to provide adequate detail for potential replication. The next chapter will present and discuss the results of this study. These will be reported entirely but not judgmentally, and discussion of the implications will be reserved for Chapter V.

CHAPTER 4: RESULTS AND DISCUSSION

The material presented in the following chapter provides the results and discussion of both the quantitative analysis of the TTCT and WPI of 30 high and 30 solid performing R&D designers, and the qualitative analysis of critical incidence interview transcripts of 12 members of the sample population.

In the first section, R&D designers scores, as well as gender scores, on both the TTCT and WPI are quantitatively profiled, analyzed and discussed. In section 2, a detailed analysis of interview transcripts is presented and discussed using the specific methodology of critical incident interviews from Burnside et al (1988). Burnside et al (1988), at the Center for Creative Leadership (CCL), have used this methodological approach (combining content-analyzed critical incident interviews, questionnaires, and a battery of validation techniques) to study organizational effectiveness, specifically, creativity and innovation within large organizations.

Comparisons of the critical incidence interviews, content analysis between solid and high performing R&D designers, as well as gender comparisons are made. Representative interview quotes are presented throughout the results to illustrate the basis upon which statements or categories were formulated.

Each section ends with a discussion of the relevance of the findings to the research questions. Finally, a link between the quantitative results and the critical incidence interview findings is provided in a discussion summary. Chapter V offers conclusions, followed by limitations of the present study, and implication for managers and Human Resources (HR) professionals working in Research & Development (R&D) organizations.

SECTION 1: QUANTITATIVE RESULTS

Amabile & Hennessey (1992) hypothesized that "people will be most creative when they feel motivated by the interest, enjoyment, satisfaction and the challenge of the work itself - rather that by external pressures" (p. 55). In order to determine whether this positive relationship between intrinsic motivation and creativity was transferable to adults within a high technology organization, such as BNR, correlational analysis was conducted. Tests of significance were conducted to determine whether differences were evident between high and solid performers. As a result of this analysis, it was expected that Amabile and Hennessey's hypothesis would be confirmed in the sample population, and that significant differences would be evident between high and solid performers, and between both groups and the norm populations. To begin with, an overview of the sample population is provided showing both demographic data and summary statistics.

It was predicted that the sample population would be representative to the BNR population, meaning homogeneous in nature, i.e.; young in age and based on the influx of new graduates each year, having minimal years of experience. As seen in Table 3, a review of the demographic data of the sample population confirms this, showing little difference between high and solid performers in terms of age, experience, gender, and their background, be it hardware or software.

Table 3: Demographic data of Sample population

Variables	Solid Performers (N=30) Percentage	High Performers (N=30) Percentage	Total (N=60) Percentage
Age:			
25-29	33	40	37
30-34	33	37	35
35-39	17	17	17
40-44	3	3	3
45 +	13	3	8
Years Experience:			
0-4	20	13	17
5-9	33	57	45
10-14	30	20	25
15-19	10	10	10
20 +	7	0	3
Gender Ratio:			
Males	73	77	75
females	27	23	25
Area of Experience:			
Hardware	10	3	7
Software	90	97	93

Subjects seem to be at the beginning stages of their career with 52 percent having 9 years or less experience. Interestingly, 57 percent of high performers have 5-9 years experience versus solid performers at 33 percent. This could be attributed to the need to have more experience on the job before demonstrating a high level of performance to the organization. The gender split, with females representing 25 percent, is slightly higher than the BNR Ottawa population norm of 20 percent.

Table 4 provides overall means and standard deviations for solid and high performers, the total population, and norm populations for the measures. Information provided by Scholastic Testing Service on the norm population indicated that the

population consisted of college students up to adults age 65. The WPI norm population consists of over 1000 working adults who have filled out the WPI. In terms of the TTCT, standard scores are used to ensure uniform interpretation. Unfortunately, norm-reference standard scores are not available for fluency, originality, titles, elaboration, and resistance to closure. Definitions of each of the measures can be found in Chapter 3 (pp. 53-57).

Table 4: Summary Statistics - TTCT and WPI scores for Solid, high performers, the Total Population and Norm Populations

	Solid Performers		High Performers		Total Population		Norm Population	
Measures	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**
TTCT								
CRI	114.7	15.1	117.7	18.4	116.2	16.77	111.6	16.1
Fluency	91.7	15.0	97.9	16.6	94.77	16.28		
Originality	102.2	18.1	107.7	21.7	104.97	20.31		
Titles	112.6	23.6	108.8	23.4	110.7	23.77		
Elaboration	93.3	16.9	99.9	19.5	96.6	18.71		
Resistance to Closure	115.0	20.3	111.2	24.7	113	22.9		
WPI								
Primary Orientation								
Intrinsic Motivation	3.21	0.30	3.17	0.32	3.19	0.31	3.16	0.34
Extrinsic Motivation	2.40	0.47	2.44	0.40	2.41	0.43	2.42	0.39
Secondary Orientation								
Enjoyment	3.18	0.36	3.16	0.40	3.17	0.38	3.11	0.38
Challenge	3.27	0.43	3.16	0.51	3.21	0.47	3.26	0.50
Outward	2.26	0.50	2.35	0.44	2.3	0.47	2.29	0.40
Compensation	2.62	0.62	2.60	0.70.	2.60	0.65	2.67	0.63

Note. CRI = Creativity Index. Norm population for the TTCT consists of over 720 adults, grade 12+. Norm population for WPI consists of over 1000 working adults.

As anticipated, high performers tended to score higher on the TTCT measures. Surprisingly, high performers scored slightly lower in three of the orientations,

enjoyment, challenge, and compensation, than solid performers on the WPI scores. Both groups scored higher on the CRI than the Norm population. However, to determine whether these differences were significant t-tests were conducted.

Table 5 displays the results showing the comparison of high performers and solid performers on different variables using t-test.

Table 5: Comparison of high & solid performers on different variables using t-test

Measures	High Performers (N=30) Mean score	Solid Performers (N=30) Mean score	p values
TTCT:			
Creativity Index	117.73 (18.41)#	114.73 (15.12)	0.4931
Fluency	97.87 (16.88)	91.67 (15.30)	0.1415
Originality	107.7 (22.03)	102.23 (18.40)	0.3012
Titles	108.8 (23.77)	112.6 (24.03)	0.5405
Elaboration	99.87 (19.86)	93.33 (17.21)	0.1785
Resistance to Closure	111 (25.1)	115 (20.7)	0.26436
WPI:			
Intrinsic motivation	3.17 (0.32)	3.21 (0.30)	0.7316
Enjoyment orientation	3.16 (0.40)	3.18 (0.43)	0.8399
Challenge orientation	3.16 (0.50)	3.27 (0.43)	0.3553
Extrinsic motivation	2.44 (0.40)	2.40 (0.47)	0.8432
Outward orientation	2.34 (0.43)	2.26 (0.50)	0.4949
Compensation orientation	2.62 (0.69)	2.62 (0.62)	0.8303

Note. CRI = Creativity Index; # = Standard Deviation. * $p < .05$; ** $p < .10$. None of the results are statistically significant on this table.

It can be observed that although most of the high performers TTCT scores are higher than the solid performers, there is no significant difference from a statistical

standpoint. Although this was not anticipated there may be several reasons why significant differences did not occur. Perhaps the subjectivity of the selection process for high performers did not allow for enough differentiation between the two groups. The line between solid and high performers may be too arbitrary, and may not be discrete enough for differences to be seen. Finally, the sample size may be too small for differences to occur.

Table 6 displays the comparison on the different variables using t-test. Interestingly, significant differences occurred on the TTCT measures, but not on the WPI measures when comparing the two groups. In an effort to understand further the possible differences between high and solid performers, the researcher chose an arbitrary line between the two groups by selecting the top 50 percent of high performers who scored the highest on the CRI measure, and the bottom 50 percent of solid performers who scored the lowest on the CRI measure.[1] This decision was made in order to truly separate the high performers from the solid performers, and to determine what differentiated them from solid performers.

[1] The researcher recognizes that there is a risk in making this arbitrary split given that correlations between the TTCT and WPI measures were not found. However, given the homogeneous nature of the subjects (i.e.; socialized into the same behavior and attributes, working in same area and with same work ethic), it was deemed important to try and differentiate the group. It was determined that we were not measuring the same thing in a different way.

Table 6: Comparison of a subset of high & solid performers on different variables using t-test

Measures	High Performers - Top 50 percent on CRI measure (N=15) Mean score	Solid Performers - Bottom 50 percent on CRI measure (N=15) Mean score	p values
TTCT:			
Creativity Index	132.33 (12.25)#	101.73 (18.10)	0.000*
Fluency	106.4 (15.44)	86.07 (14.68)	0.001*
Originality	122.13 (17.61)	90.93 (12.58)	0.000*
Titles	123.00 (18.48)	92.2 (12.17)	0.000*
Elaboration	110.00 (20.78)	86.53 (17.16)	0.002*
Resistance to Closure	130.53 (16.86)	100.87 (16.78)	0.000*
WPI:			
Intrinsic motivation	3.20 (0.33)	3.21 (0.32)	0.929
Enjoyment orientation	3.13 (0.37)	3.17 (0.40)	0.777
Challenge orientation	3.26 (0.50)	3.30 (0.45)	0.766
Extrinsic motivation	2.39 (0.34)	2.37 (0.48)	0.882
Outward orientation	2.33 (0.42)	2.25 (0.52)	0.618
Compensation orientation	2.47 (0.55)	2.55 (0.61)	0.708

Note. CRI = Creativity Index; # = Standard Deviation. * $p \leq .05$; ** $p < .10$

Although one would expect significant differences on the CRI measure because that's where the arbitrary split was made, it was difficult to predict whether this same trend would occur on the other measures. This points to the creativity level acting as a differentiator between high and solid performers but does not differentiate in the same way the motivational orientation of the individual. It also suggests that there are other factors leading to high performance that are not dealt with in this study, such as personality type, self-confidence, personal history, to name a few.

Through ANOVA analysis, it was found that there were no significant differences between high and solid performers and the norm population scores on both TTCT and WPI. It was expected that significant differences would have occurred given BNR's goal to hire the top ten percent of the graduating class from the top engineering and computer science schools. Perhaps BNR's selection criteria of high academics is not for creativity. Or perhaps the university training has effectively suppressed or camouflaged the creativity. The nature of course work at engineering and computer science schools may be emphasizing left-brain thinking, leaving little room or reward for right brain creativity.

In order to determine if a relationship existed between creativity and intrinsic motivation, Pearson product-moment correlation coefficients were generated for both measures for both high and solid performers, and the total population. Correlation data are summarized in Tables 7, 8, and 9. Amabile et al (1994) predicted that WPI scores should be related to pencil-and-paper measures of creativity; and behavioural measures of product creativity, as assessed by the standard consensual assessment technique (Amabile, 1983a). More specifically, as predicted by the intrinsic motivation hypothesis

of creativity, "creativity should be positively related to intrinsic motivation scores on WPI, and negatively related to extrinsic scores" (p.963).

In terms of correlation analysis, it is important to note that weak associations are the rule in social science studies, 0.30 to 0.70, being the usual range for *r* (Freeman et al, 1991). Creativity correlated at 0.25 or less is common due to the magnitude of variables that could effect it's variability (Zumbo, 1993). Generally, in studies investigating relationships only, correlations as low as 0.30 or 0.40 are useful (McMillian & Schumacher, 1984). Finally, it is important to reiterate that correlation measures association, which is not the same as causation. However, a low correlation does not necessarily mean lack of association.

Correlations between TTCT and WPI measures for the total population seen in Table 7 are low overall.

Table 7: Correlations with TTCT scores for the total population

	Primary Orientation		Secondary Orientation			
Measures	Intrinsic Motivation	Extrinsic Motivation	Enjoy-ment (IM)	Challenge (IM)	Outward (EM)	Compensa-tion (EM)
Creativity Index	0.097	0.0005	0.11	0.01	0.04	-0.02
Fluency	0.15	-0.07	0.18	-0.06	-0.07	0.07
Originality	0.05	0.10	0.06	-0.02	-0.004	0.22
Titles	-0.03	0.07	0.04	-0.04	0.12	-0.05
Elaboration	0.19	-0.09	0.17	0.15	0.11	-0.25*
Resistance to Closure	0.03	-0.04	0.007	-0.05	-0.12	0.02

Note.. * $p < .05$; ** $p < .10$

Although they are weak it should be noted that there is an overall trend towards positive correlations for intrinsic motivation, enjoyment, and challenge scores and the creativity scores, and several negative correlations with the extrinsic scores and creativity. Thus supporting Amabile's (1983a, b, 1985) hypothesis that an intrinsically motivated state is conducive to creativity, and an extrinsically motivated state is detrimental.

The results of the correlation results for Solid performers seen in Table 8, shows correlations between fluency and enjoyment, .31 ($p < .10$), and originality and compensation, .36 ($p < .05$). Again, a similar trend is occurring towards positive correlations for intrinsic motivation, enjoyment, and challenge scores and the creativity scores, and several negative correlations with the extrinsic scores and creativity. Again this trend supports Amabile's hypothesis of intrinsic motivation on creativity. The positive correlation between originality and compensation may be attributed to the phenomenon that these solid performers are immunized to compensation effecting in a negative way their ability to create original ideas.

Table 8: WPI correlations with TTCT score for solid performers

	Primary Orientation		Secondary Orientation			
Measures	Intrinsic Motivation	Extrinsic Motivation	Enjoy-ment (IM)	Challenge (IM)	Outward (EM)	Compensa-tion (EM)
Creativity Index	0.14	0.01	0.23	-0.05	0.04	0.03
Fluency	0.18	- 0.19	0.31**	-0.02	-0.15	-0.09
Originality	0.10	0.17	0.10	0.11	0.06	0.36*
Titles	-0.14	0.15	-0.03	-0.24	0.13	0.10
Elaboration	0.23	-0.14	0.21	0.12	0.007	-0.27
Resistance to Closure	0.04	-0.02	0.23	-0.27	0.001	-0.02

Note. CRI = Creativity Index. * $p < .05$; ** $p < .10$

As can be seen in Table 9, significant correlation results for high performers were non-existent. However, correlations between WPI scores and creativity scores are moderately encouraging in terms of seeing a trend towards positive correlations with intrinsic motivation, enjoyment and challenge, and mostly negative correlations with extrinsic motivation, outward and compensation orientations with the creativity scores. The homogenous nature of the two groups may have had an effect on the results. Again, the sample size of both groups was small.

Table 9: WPI correlations with TTCT scores for high performers

	Primary Orientation		Secondary Orientation			
Measures	Intrinsic Motivation	Extrinsic Motivation	Enjoy-ment (IM)	Challenge (IM)	Outward (EM)	Compensa-tion (EM)
CRI	0.08	-0.01	0.02	0.07	-0.05	-0.05
Fluency	0.14	0.05	0.09	-0.05	-0.03	0.22
Originality	0.03	0.03	0.04	-0.08	-0.09	0.13
Titles	0.07	-0.01	0.10	0.11	0.13	-0.18
Elaboration	0.085	0.17	0.14	0.22	0.17	-0.24
Resistance to Closure	0.01	-0.06	-0.16	0.10	-0.22	0.03

Note. CRI = Creativity Index.. * $p < .05$; ** $p < .10$

Tables 10 and 11 display the WPI correlation with the TTCT scores for the subset of high performers (top 50 percent who scored high on the CRI measure) and solid performers (bottom 50 percent who scored low on the CRI measure). This arbitrary selection has lead to more significant correlations for both groups. Specifically, for the high performer group, originality is correlating significantly at $p < .05$ with challenge (-0.52) and compensation (0.53); and fluency with compensation at 0.49 ($p < .10$). For solid performers, CRI is correlating significantly at $p < .05$ with intrinsic motivation

(0.52) and enjoyment (0.66); and with elaboration and intrinsic motivation (0.50), and enjoyment (0.45) at $p < .10$. As seen earlier, a trend is occurring towards a positive correlations for intrinsic motivation, enjoyment, and challenge scores and the creativity scores, and several negative correlations with the extrinsic scores and creativity. Interesting however, is how these high performers had fewer negative correlations with the extrinsic scores and creativity, and showed mostly negative correlations between the creativity scores and challenge, suggesting that high performers may be more immune to extrinsic constraints or are able to work with them in a positive way.

Table 10: WPI correlations with TTCT scores for high performers (top 50 percent)

	Primary Orientation		Secondary Orientation			
Measures	Intrinsic Motivation	Extrinsic Motivation	Enjoy-ment (IM)	Challenge (IM)	Outward (EM)	Compensa-tion (EM)
CRI	0.15	0.28	0.36	-0.12	0.07	0.27
Fluency	0.20	0.28	0.36	-0.12	0.13	0.49**
Originality	-0.04	0.38	0.30	-0.52*	0.02	0.53*
Titles	0.11	0.05	0.29	-0.09	0.08	-0.15
Elaboration	0.27	-0.06	0.23	0.33	0.11	-0.02
Resistance to Closure	-0.09	0.02	0.09	-0.19	-0.34	0.20

Note. CRI = Creativity Index.. * $p < .05$; ** $p < .10$

Table 11: WPI Correlations with TTCT Scores for Solid Performers (bottom 50 percent)

	Primary Orientation		Secondary Orientation			
Measures	Intrinsic Motivation	Extrinsic Motivation	Enjoy-ment (IM)	Challenge (IM)	Outward (EM)	Compensa-tion (EM)
CRI	0.52*	--.21	0.66*	0.08	-0.03	-0.25
Fluency	0.11	-0.36	0.32	-0.17	-0.27	-0.23
Originality	0.34	-0.18	0.30	0.25	-0.22	-0.04
Titles	0.04	0.09	0.08	-0.03	0.31	-0.18
Elaboration	0.50**	0.04	0.45**	0.21	0.17	-0.13
Resistance to Closure	0.08	-0.31	0.25	-0.24	-0.19	-0.26

Note. CRI = Creativity Index.. * $p < .05$; ** $p < .10$

Gender Differences

Table 12 compares TTCT scores with WPI scores for males and female using t-test analysis.

Table 12: Comparison of Males and females on different variables using t-test

Measures	Males (N=45) Mean score	females (N=15) Mean score	p values
TTCT:			
CRI	116.51 (16.81)#	115.40 (17.22)	0.8263
Fluency	95.87 (15.75)	91.47 (17.91)	0.3690
Originality	105.42 (19.60)	103.60 (23.00)	0.7663
Titles	109.78 (23.20)	113.60 (26.06)	0.5940
Elaboration	95.04 (19.38)	101.27 (16.25)	0.2683
Resistance to Closure	114.09 (22.40)	110.20 (24.91)	0.5733
WPI:			
Intrinsic Motivation	3.19 (0.31)	3.21 (0.30)	0.8133
Enjoyment orientation	3.15 (0.38)	3.25 (0.37)	0.3490
Challenge orientation	3.24 (0.45)	3.15 (0.52)	0.5060
Extrinsic Motivation	2.37 (0.43)	2.56 (0.42)	0.1414
Outward orientation	2.24 (0.43)	2.50 (0.54)	0.0617**
Compensation orientation	2.58 (0.68)	2.68 (0.58)	0.5966

Note. CRI = Creativity Index. # = Standard Deviation. * $p < .05$; ** $p < .10$

Again, it is interesting to see that when discrete are used the results are more favorable. Results pointed to a significant difference in the outward orientation for females at $p < .10$. No significant differences were found in the other scores. The need to be recognized, and having a sensitivity to the opinions of others is supported by Keown & Keown (1985) who found that females discussed recognition, surprising men 'that a women could do it', and interaction with people as motivations found in their work.

Tables 13 and 14 display correlation results for males and females. As specified earlier, it was anticipated that creativity would be positively related to intrinsic motivation scores on the WPI and negatively related to extrinsic scores for both males and females. Results for both males and females are more encouraging in this regard. Specifically, as seen in Table 13, the results of the correlations for males show significant correlations of .24 ($p < .10$) for fluency and intrinsic motivation; .25 ($p < .10$) for titles and outward orientation, and .27 ($p < .10$) for originality and compensation orientation. All creativity scores correlated positively with intrinsic motivation scores except for titles. Interestingly, all creativity scores yielded a positive correlation with extrinsic motivation except for elaboration, and with the secondary scales yielded mostly positive correlations all around. Although it is recognized that these correlations are weak the trend is encouraging in support of the hypothesis that "people will be most creative when they feel motivated by the interest, enjoyment, satisfaction and the challenge of the work itself - rather that by external pressures" (Amabile & Hennessey, 1992, p. 55)..

Table 13: WPI correlations with TTCT scores for Males

Measures	Primary Orientation		Secondary Orientation			
	Intrinsic Motivation	Extrinsic Motivation	Enjoy-ment (IM)	Challenge (IM)	Outward (EM)	Compensa-tion (EM)
CRI	0.13	0.14	0.06	0.14	0.20	0.03
Fluency	0.24**	0.05	0.24	-0.03	0.08	0.10
Originality	0.19	0.23	0.12	0.15	0.12	0.27**
Titles	-0.05	0.20	-0.10	0.12	0.25**	0.02
Elaboration	0.11	-0.10	0.08	0.15	0.09	-0.24
Resistance to Closure	0.08	0.12	-0.01	0.08	0.08	0.08

Note. CRI = Creativity Index. * $p < .05$; ** $p < .10$

The results of the correlations for females (Table 14) produced significant correlations for elaboration and intrinsic motivation, .49 ($p < .10$), resistance to closure and extrinsic motivation, -.47 ($p < .10$), originality and challenge, -.44 ($p < .10$), and resistance to closure and outward, -.51 ($p < .10$). Surprisingly, most creativity scores correlated negatively with intrinsic motivation, yet, all correlated negatively with extrinsic motivation. On secondary scales mostly negative correlations were found. Again this trend supports Amabile's hypothesis of intrinsic motivation on creativity, and the possibility that females may be more immune to extrinsic constraints or are able to work with them in a positive way.

Table 14: WPI correlations with TTCT scores for females

Measures	Primary Orientation		Secondary Orientation			
	Intrinsic Motivation	Extrinsic Motivation	Enjoy-ment (IM)	Challenge (IM)	Outward (EM)	Compensa-tion (EM)
CRI	0.003	-0.42	0.29	-0.33	-0.32	-0.22
Fluency	-0.12	-0.32	0.06	-0.20	-0.31	0.04
Originality	-0.32	-0.20	-0.06	-0.44**	-0.25	0.07
Titles	0.02	-0.34	0.42	-0.41	-0.20	-0.28
Elaboration	0.49**	-0.23	0.42	0.25	0.04	-0.38
Resistance to Closure	-0.12	-0.47**	0.10	-0.39	-0.51*	-0.18

Note. CRI = Creativity Index. *p < .05; ** p < .10

DISCUSSION

Several interesting findings may be drawn from the data presented. First, we predicted that creativity would be positively related to intrinsic motivation scores on the WPI, and negatively related to extrinsic scores. This was substantiated by several measures (see Tables 9 - 11, 13, and 14). Although many of the correlations are not statistically significant (because of the small sample size), an overall pattern is quite consistent. The results appear to support the hypothesis of a positive relationship between intrinsic motivation and creativity in adults in a high technology organization. A trend seems to be evident in the tables in terms of a significant correlation between the compensation orientation and the creativity scores of fluency, originality and elaboration; the creativity index with intrinsic motivation; originality with the challenge orientation; elaboration with intrinsic motivation; and fluency with enjoyment and intrinsic motivation. The areas where positive correlations for extrinsic motivation occurred may be attributed to the ability of many highly creative people to continue being creative in

despite numerous extrinsic constraints. One type of motivation does not necessarily undermine the other. Some highly autonomous individuals, while retaining high levels of intrinsic motivation toward their work, might also be highly motivated to achieve compensation for their work (Amabile et al, 1994).

Secondly, more significant correlations seem to appear when males and females were compared. Particularly, the females' scores of originality and the challenge orientation, elaboration and the intrinsic motivation orientation, and resistance to closure and the outward orientation correlated strongly. Keown & Keown (1985) found that while the main motivation for women in their study appeared to be a sense of accomplishment or achievement, the women also expected to be compensated in the marketplace with competitive rewards or money, power and recognition.

Significant correlations were also evident when the researcher drew an arbitrary line between high and solid performers (the top 50 percent of high performers who scored high on the creativity index and the bottom 50 percent of solid performers who scored low on the creativity index). This not only supported the trend mentioned earlier, but seems to support the notion that high performers seem to either immunize themselves from extrinsic constraints or remain creative despite them.

Thirdly, the t-test results showed no significant differences between solid and high performers on all of the TTCT and WPI measures. These results could be attributed to the hiring practices mentioned earlier, meaning that since BNR hires the top 10 percent of the university graduates, once they become employed by BNR it may be difficult to

differentiate the solid from the high performers. Other contributors to this occurrence could be that the definitions of high and solid performers are not specific enough, or were applied too loosely by management, for differentiation to be seen between the two groups. Although criteria are established and expected to be followed in selecting key resources (high performers), there is still much subjectivity. Finally, the sample size was relatively small and could have influenced the results.

In order to differentiate high from solid performers as a way of understanding what differentiates the two, an arbitrary line was drawn by the researcher. When the top 50 percent of high performers who scored high on the creativity index and the bottom 50 percent of solid performers who scored low on the creativity index were compared significant differences were seen on all TTCT measures but not on the motivational measures. This suggests that within this study the creativity level seems to be acting as the differentiator between the two. The fact that the motivational orientation did not differ significantly could be attributed to the fact that all subjects are deemed good performers and are hired from the top of their class, therefore it could be expected that motivation would be similar. Further investigation of these individuals would help identify what other attributes are contributing to higher levels of creativity and performance.

Also, ANOVA results showed no significant differences between high and solid performers and the norm populations on the TTCT and WPI. It was expected the BNR designers, hired based on supposedly stringent selection criteria, would score significantly higher in the area of creativity and motivation towards work. Perhaps high marks are not an adequate predictor of creativity. Also, the norm populations includes a

variety of disciplines versus the specific two selected in this study, engineering and computer science. As mentioned earlier, the designers within this study came from engineering and computer science areas. One could suggest that the training that an individual gets in engineering and computer science would be more rational, logical, and using left-brain thinking with minimal training in creativity and interpersonal skills. This specialized training, while a strength on one hand, may pose as a weakness to individuals in high technology organizations where creativity and innovation is needed.

Lastly, it was interesting to see significant differences between males and females on the outward orientation. The males tended to score closer to the norm population, while the females scored significantly higher. Given that there are very few women in Science, Engineering and Technology in Canada (Shenin, 1981), women may feel that they need to judge their success relative to other people, and may be more sensitive to others' opinions of their work and ideas. Evidence of this was seen in the Keown and Keown (1985) study where women discussed rewards such as recognition, money and power more of a measure of self-worth rather than personal values. It is questionable whether women scientists received the support or mentors needed to be successful, as do the men, in an R&D organization, like BNR. In addition, although BNR has aggressive goals to bring more women scientists into the organization, the stereotyping still found in most engineering schools today, may still be prevalent in BNR, potentially influencing female scientist's sense of self-worth.

In summary, in response to research question 1, the data do show evidence of the Intrinsic Motivation Principle of Creativity in adults in BNR. However, no significant

difference was seen between the level of intrinsic motivation and creativity between high and solid performers. Only when the top 50 percent of high performing having high scores on the CRI, and the bottom 50 percent of solid performers having low scores on the CRI were compared did differences occur on the creativity measures. Further research would be required to determine what other factors contribute to high performance in designers within BNR.

SECTION 2: INTERVIEW FINDINGS

This section will present the perceptions of a sub-set of the designers, and will address research question 2. Results of the quantitative analysis were used to select interviewees. Specifically, the top ten percent who scored high in both the CRI and intrinsic motivation score (Group A), and the bottom ten percent who scored low in both the CRI and intrinsic motivation score (Group B) were selected resulting in 12 full-scale interviews. Each group consisted of six subjects. Group A included three high performers and three solid performers (of which 5 were male and 1 female), while Group B included two high performers and four solid performers (of which 4 were male and 2 female).

The areas interviewees talked about fell into four major themes (specific interview questions can be found in Appendix 4). Ranked-ordered by frequency, they included: 1) stimulants to creativity, 2) obstacles to creativity, 3) characteristics of an ideal work environment, and 4) definitions of creativity. In this study, stimulants or obstacles included any condition outside (i.e.; other people, the environment), or within (i.e., self-esteem, individual beliefs) the subjects themselves, that seem to consistently influence creativity positively, as in the high creativity stories, or negatively, as in the low creativity stories. This is somewhat different from Burnside et al's (1988) definition which only considered factors outside the problem solver(s), including other people, that served to stimulate or obstruct creativity. Since the focus of this study is on intrinsic motivation and its interaction with creativity it was deemed important to look for those internal conditions that promote or have a negative effect on creativity.

Both stimulants to creativity, which were present in the high creativity events, and the obstacles, which were present in the low creativity events, are summarized into eight subcategories as outlined in Table 15. Tables 16, 17, and 18 display the rankings of the subcategories by all 12 interviewees, Group A and B, and high and solid performers. Although most subcategories replicate the factors seen in other studies related to this area (Amabile & Gryskiewicz, 1987; Burnside et al, 1988) some differences in subcategories occurred. Specifically, competition was seen as an obstacle in Burnside et al's (1988) study, but in BNR's case because the environment does not lend itself to or encourage competition, it was not evident. In most cases the same definitions, or slight modifications of subcategories were used as in Burnside et al (1988). To substantiate the rankings, the findings will also be reported in paraphrase form, but will use many direct quotations in order to express the respondent's feelings and points of view.

Table 15: Critical incident interviews - stimulants & obstacles to creativity

Subcategory: Stimulants
1. **Freedom and control.** Freedom to decide what to do or how to do it; a sense of control over ones' work; taking initiative to be creative.
2. **Good management.** Manager sets clear direction without managing too tightly, providing support when needed. Hands-off management.
3. **Interesting and challenging work.** Challenging work, need for solution, solving problems, "ground up" work, work feels important.
4. **Sufficient resources.** Access to appropriate resources, including equipment, people, facilities, information.
5. **Recognition and encouragement.** General sense that creative work will receive appropriate feedback, recognition, and reward.
6. **Pressure.** Positive feelings of pressure from high expectations and time deadlines.
7. **Various organizational characteristics.** Aspects of the overall organization that do not fit the above categories - e.g. cooperative and collaborative atmosphere, good communication, valuing of creativity, open atmosphere.
8. **Miscellaneous other.** Any stimulants that didn't fit above.

Subcategory: Obstacles
1. **Constraint.** Lack of freedom to decide what to do or how to do it, lack of control over ones' work or ideas; lack of initiative, feeling constrained.
2. **Poor management.** Managers who are intrusive, have unclear goals, poor communication and interpersonal skills.
3. **Boring, non-challenging, uninteresting work.** Emphasis on keeping things the same. Repetitive tasks, routine work; difficult to be creative.
4. **Inappropriate or no evaluation.** Lack of or poor feedback on work. Little recognition. Not enough feedback on the value of the work itself.
5. **Insufficient time.** Unrealistic deadlines. Too much workload in too little time.
6. **Individual does not see self as being creative.** Negative self-talk, lack of self-esteem, external locus of control.
7. **Various organizational characteristics.** Aspects of the overall organization that do not fit the above categories - e.g. lack of support from other areas, overly formal and bureaucratic procedures, working environment, i.e.; space, lighting, colors.
8. **Miscellaneous other.** Any stimulants that didn't fit above.

Stimulants to Creativity

Content analysis identified eight subcategories within this theme. They are listed in order of relative frequency[2]:

Table 16: Critical incident interviews - rankings of subcategories by all interviewees (Of the total comments made, what percentage fell into each subcategory?)

Stimulants Subcategories (Condition)	% of total	Obstacles Subcategories (Condition)	% of total
Freedom & Control (Ext./Int.)	22	Boring, non challenging, uninteresting work (Ext.)	25
Interesting & challenging work (Ext.)	20	Individual does not see self as being creative (Int.)	20
Various organizational characteristics (Ext.)	16	Constraint (Ext./Int.)	15
Good management (Ext.)	13	Insufficient time (Ext.)	15
Pressure (Int.)	13	Various organizational characteristics (Ext.)	13
Recognition & encouragement (Ext.)	9	Inappropriate or no evaluation (Ext.)	8
Sufficient resources (Ext.)	4	Poor management (Ext.)	5
Miscellaneous other (Ext.)	4	Miscellaneous other (Ext.)	0
	100.0 (n=12)		100 (n=12)

Note: Ext. = external condition affecting the individual. Int. = internal condition affecting the individual.

1) Freedom and Control. The most frequently mentioned stimulant surrounding the high creativity events was freedom, freedom to decide what to do or how to do it; a sense of

[2] Note: We are using percentages in the qualitative section as a more objective way of showing the rankings. However, all factors identified are deemed important by interviewees. Numbers have been rounded off.

control over ones work; taking initiative to be creative. All subjects mentioned freedom or control at least once.

> It was a project where we basically had to start to design from the ground up. So there weren't a lot of framework in place to work in. We basically had to start from scratch. Analyze what our requirements are and come up with an appropriate high level design to accommodate that. And I guess I would say I felt quite creative, there was an opportunity for a lot of creativity there, because there weren't a lot of restrictions or, nothing in place that would, you know, block you from going in one direction or another. I would've had a lot of freedom to explore the design and its possibilities. And, once you've done that initial exploration, you could, you know, dive further into the design, again and work on a preconception as to how it should work. There was quite a lot of flexibility in that situation. (high performer, male)

> I felt the most creative in doing was like when I'm solving my own problems. Like, I do a lot of work in a lab. ... It's like a blank sheet, And I can take any approach I want and come up with several ways I can do it. (solid performer, male)

> There were not firm guidelines as to say: "Well, you have to do it this way." or "There's this convention that must be followed." It was more of less an open ended type of thing. So, at that point, I guess I felt creative because I took a very small piece of specification and was able to, without too many constraints it terms

> of what can and can't be done from the customer point of view, I developed something in conjunction with my thoughts and his thoughts. (high performer, male)

The last quote illustrates an important aspect concerning the role of freedom in promoting R & D creativity. Many researchers have found that freedom generally does promote creativity (Amabile & Gryskiewicz, 1987; Kanter, 1983). However, many have also found that complete freedom can be detrimental to creativity (Bailyn, 1984, as quoted in Amabile & Gryskiewicz, 1987). There seems to be a fine line between how best to balance the freedom of individuals with the organizational needs for structure, meeting deadlines, and consistent processes.

Finally, three of the interviewees in Group A versus one in Group B spoke about taking initiative in an effort to turn low creativity events into high creativity events.

> I was able to make up questions that would be frequently asked and then provide the answers. From the perspective of an end user, this part would be very beneficial to them. But, it was not part of the original package that I was asked to provide. It was something I did to try to make this more interesting for myself to work on. It helped. (solid performer, male)

These results are supported by Kelly and Chaplan (1993) who found that self-management and taking initiative made up the real difference between star and average performers.

2) Interesting and challenging work. Ninety percent of the interviewees made comments that fell into the subcategory of interesting and challenging work -- Challenging work, need for solution, solving problems, ground up work, work feels important.

> Solving problems. That is the kind of work that I like. I think I find it very self-motivating. I mean, in the sense I have control. (solid performer, male)

> I was really interested in the product. That was one thing, I think that helped me out. If I wasn't that interested, I don't think I would've come up with something like that. (high performer, male)

> What again was interesting was the digging out the data. That's what we do but in this case what's interesting is the fact that it really came together as a puzzle in a sense. The relevant, the supportive information, we really had to piece together as the trends, from various areas around the world, guided us. (high performer, female)

One individual spoke to "a private challenge that made it interesting as well" pointing to internal motivation leading to high creativity. Amabile & Gryskiewicz (1988) proposed that "a sense of challenge fuels creativity -- often coming from intriguing nature of the problem itself." (p. 509) This was certainly evident by those who commented on this. Many interviewees, specifically in Group A, used the words "interesting" and "challenging" abundantly.

3) Various organizational characteristics. This subcategory captured comments about the organizations as a whole, often referred to as the organization climate. "The optimal organization might be described as having a collaborative atmosphere, a high expectation of creativity, an acceptance of failure, and/or a non-bureaucratic structure" (Amabile & Sensabaugh, 1986, p. 46). Seventy-five percent of interviewees mentioned some organizational factors as positive in their high creativity stories that were different from the other categories within the organization, such as, freedom, sufficient resources and time, recognition and encouragement, and positive pressure. Although no one single factor stands out with a particularly high frequency, some are more noticeable than others. One crucial point, for example, was the importance of a generally collaborative and cooperative atmosphere, as well as a level of mutual trust:

> But the whole creativity thing was being able to be in a relaxed atmosphere to me, and I think that's because of the management style and bringing together the same type of people together. That are willing to laugh at themselves, argue with themselves and argue with them and others but not, when it's over with go and have a coffee and it's done with. Because it if your ego gets tromped on, no matter what way you go, and really , that was about it for me. ... relaxed atmosphere. being able to just show your dumbness, I guess if there's such a word. But being able to just express your opinion. And yell, if you have to, whatever. (solid performer, male)

> Like four people in a room, with the door shut, and a white board, and people just throwing ideas around. We had to expand an idea we'd go and draw it on the white board. If we didn't like it, we'd just start over again. (high performer, male)

Several researchers have cited the importance of collaboration and mutual trust as important to organizational creativity (Amabile & Gryskiewicz, 1987; Kanter, 1983). Co-location was also mentioned several times. Co-location was defined by interviewees "as the ability for members of a team to work in the same location and within a short distance of each other." Often, teams in BNR are spread out on different floors or buildings.

> I think one of the key factors in our group being able to produce what we did, was that we were co-located. An it was easy for us to interact with each other. ... And, that made it easy for us, to exchange ideas quickly and with minimum interaction., or minimum interruption with our own work. (solid performer, male)

4) Good management tied with pressure as important stimulants to creativity. Fifty-eight percent of interviewees commented at least once on the factors of good management and pressure as conditions leading to creativity. The good management subcategory is defined as: Manager sets clear direction without managing too tightly, providing support when needed; hands-off management.

> So, basically, I was given a blank cheque from the management. I had a lot of guidance, I had a lot of mentoring from my management which has been constructive and very useful. But, not in any way cramping my space. So, that's why I consider this very creative. (solid performer, male)

Table 17: Critical incident interviews - rankings of subcategories by Group A and B (Of the total comments made, what percentage fell into each subcategory?)

Stimulants			Obstacles		
	% of Total			% of Total	
Subcategories	Group A	Group B	Subcategories	Group A	Group B
Freedom & Control	19	25.0	Boring, non challenging, uninteresting work	26	24
Interesting & challenging work	19	20.8	Individual does not see self as being creative	13	29
Various organizational characteristics	16	16.7	Insufficient time	13	18
Pressure	10	16.7	Constraint	17	12
Good management	16	8.3	Various organizational characteristics	13	12
Recognition & encouragement	13	4.2	Inappropriate or no evaluation	9	6
Sufficient resources	3	4.2	Poor Management	9	0
Miscellaneous other	3	4.2	Miscellaneous other	0	0
	100 (n=6)	100 (n=6)		100 (n=6)	100 (n=6)

Note: Group A = the top ten percent of the total sample group who scored high both on their Creativity index score (CRI) and intrinsic motivation score. Group B = the bottom ten percent who scored low both on their CRI and intrinsic motivation score.

Many researchers proposed that a "loose-rein" management style is most conducive to a creative work environment (Himes, 1987; Lewis & Delaney, 1991). In many of the high creativity stories, the manager served a valuable resource in terms of experience, and technical and morale support.

> My manager was very supportive ... not hovering over my shoulder every ten minutes saying: "how's it going? even though it was really under quite a tight deadline. (high performer, female)

> I think what really helped was that when, one Friday when everything was really getting bad, the managers all took us out for a beer. Sat us around the table, and that what really helped. The next Monday things got better, and we started 'anew' to a certain extent. (high performer, female)

Out of the total comments made, Group A commented on this subcategory nearly twice as often than Group B as having a positive influence on creativity. These results point to hands-off management being instrumental in ensuring employees have freedom and control to do their work.

5) Pressure is defined as positive feelings of pressure from high expectations and time deadlines. The importance of deadlines and working within them was mentioned in many of the high creativity stories. This conducive type of pressure was most often generated internally, not by some external force, but where the individuals felt driven to prove that they could succeed. It has often been suggested that creativity results when a certain kind of tension is felt within the individual (Amabile & Gryskiewicz, 1987). Certainly the most notable type of pressure is a sense of challenge, however, working to meet the urgent demands of the organization can also serve as a positive influence on creativity. This certainly seemed to be the case for 13 percent of interviewees.

> And what I found interesting is that it was a fairly tight deadline. Which is something we've seen, we tend to deal with a lot. That's not so much an issue for me. I tend to work quite well under deadlines. If, as a matter of fact, as the deadline approaches, It can sometimes be a little close for comfort as the deadline

approaches, but I'll make the deadline. And, if there isn't a deadline, there's not really that sense of urgency or that sense of "You've got to get it done!". (high performer, female)

On the negative side, deadlines can often serve as a constraint undermining creativity (Amabile, Dejong & Lepper, 1976). Evidence of this will be seen later under the theme of obstacles.

6) Recognition and encouragement. A general sense that creative work will receive appropriate feedback, recognition and reward was deemed a positive factor towards creativity by 42 percent of interviewees. This factor was commented upon nearly three times more often by Group A compared to Group B as a positive influence on creativity.

I guess, partly, what made it interesting was the fact that it was quite visible. That's the persons who were requesting it, there was one V.P. that I'd worked with before. Well, I worked with him when he was just a C level and now he's way up there in the hierarchy, so that's quite nice, just to be with him again. Also, the fact, the sense that, really my recommendation was, it would be the one to tilt the balance one way or the other, was a very motivating factor. (high performer, female)

They felt that it filled a need that they didn't have then. So, that find of feedback also was important to get the feeling that I had created something. I had solved a problem on one hand, but also it provided a way of being able to define for yourself the 'how' of something will work. And what is useful and not useful.

> And, then take the feedback, when the people say, 'Well yea, I agree with you.' I like this .... (high performer, male)

7) Sufficient resources. Access to appropriate resources, including equipment, facilities, and information was seen as vital to high creativity. Seventeen percent of interviewees mentioned at least once this factor in their description of high creativity stories.

Referring to equipment, adding colors, and rearranging furniture:

> If you're going to spend three weeks, and if you're going to be spending a lot of your time there, eight hours a week, you want to make it a comfortable place to be. (solid performer, female)

> We had quite a range of experience in other areas of software development.(solid performer, male)

8) Miscellaneous other. Some comments were difficult to categorize as they concerned not the environment or the organization but of the field itself:

> . . . You really have to keep that global view in order to really understand what the overall effect is. ... Because I find that it really helps you understand what you're working on, and what you're doing, and what the overall effect is. (high performer, female)

Amabile (1983a) refers to this as domain relevant skills which include knowledge about and experience in the task domain, special technical skills, and domain specific talents. Domain relevant skills is an important component of creativity.

Rankings of the stimulant subcategories by both Group A and B (Table 17). and high and solid performers (Table 18) followed the same order of frequency as the total group of interviewees. Only in three cases, good management, and recognition and encouragement, between Group A and B; and sufficient resources, between females and males, were there large differences in terms of the percentage of comments that fell into that subcategory of the total comments made.

For group A, those top 10 percent who scored high on both the CRI and intrinsic motivation measure, hands-off management and recognition and encouragement may be crucial elements supporting high creativity and performance.

Table 18: Critical incident interviews - rankings of subcategories by high performers (HP)and solid performers (SP) (Of the total comments made, what percentage fell into each subcategory?)

Stimulants			Obstacles		
	% of Total			% of Total	
Subcategories	HP	SP	Subcategories	HP	SP
Freedom & Control	19	24	Boring, non challenging, uninteresting work	33	20
Interesting & challenging work	19	21	Individual does not see self as being creative	13	24
Various organizational characteristics	19	14	Insufficient time	13	16
Pressure	16	10	Constraint	13	16
Good management	12	14	Various organizational characteristics	13	12
Recognition & encouragement	8	10	Inappropriate or no evaluation	7	8
Sufficient resources	0	7	Poor Management	7	4
Miscellaneous other	8	0	Miscellaneous other	0	0
	100 (n=5)	100 (n=7)		100 (n=5)	100 (n=7)

Note: HP = high performers. SP = solid performers.

Obstacles to Creativity

Content analysis identified eight subscategories ranked in order of relative frequency:

1) Boring, non challenging, uninteresting work. Emphasis on keeping things the same, repetitive tasks, routine work where it is difficult to be creative, was mentioned at least once by eighty-three percent of interviewees in their stories of low creativity events.

Other studies cited a similar subcategory, status quo, which was defined as "emphasis on keeping things the same; avoiding risks, avoiding controversy, taking a conservative view" as a environmental obstacle to creativity (Amabile & Gryskiewicz, 1988; Burnside et al, 1988, p. 177). However, this subtheme did not rank as highly in their studies (eighth out of ten) as an obstacle to creativity.

> Probably shortly after I first started BNR, just got out of university all raring to go, and the first assignment I was given was to data fill the switch. And it was not exactly what I was looking for in a job. It was really tough at first. So, it was impossible to be creative because you were so locked into what you were doing. And it was, you know, filling in tables and that kind of thing. And it wasn't something that really interested me at all. So there was absolutely no chance to be creative at all in that job. (high performer, male)

> I was locked into what I could, or could not do. There was no possibility for me to be creative. Because I simply had to document what was in place. And in one sense, it frustrated me. Because it was just a straight linear approach. (solid performer, male)

> Least creative when my work was exactly cut out for me. For three weeks, the only thing I did was cut and paste every automatic test case, and just changed the two numbers. That was probably the most boring task I've ever had to do. It was so boring! (solid performer, female)

Out of the total comments made, high performers commented on this subcategory significantly more than solid performers. This subcategory parallels with the subcategory cited under stimulants to creativity, interesting and challenging work.

2) Individual does not see self as being creative. Sixty-seven percent of interviews made comments that pointed to negative self-talk, lack of self-esteem or an external locus of control as having a negative effect on their own creativity. Two individuals had difficulty coming up with a high creativity story, indicating that they didn't believe themselves to be creative individuals. Others talked about their work not being creative, or that their ability to be creative or not was subject to other people or the environment. One individual indicated that creativity could only occur when working on new products, and that because her work was maintaining products and fixing problems she deemed it not to be creative. This certainly was a different perspective than that shared in Group A, where they saw opportunities to be creative when fixing problems. Perhaps these individuals were too rigid about, or unsure of the concept of creativity, or that they had an external locus of control. This subcategory did not seem to surface in other studies investigating stimulants and obstacles to creativity in a R&D setting (Amabile & Sensabaugh, 1986; Amabile & Gryskiewicz, 1987; Amabile & Gryskiewicz, 1988; Burnside et al, 1988). Some of the comments made were:

> To begin with, I don't really consider myself a very creative person. I always have problem when asked to create something. Like I, associate maybe creativity, maybe be something hard. I work, what we do here, I don't really find it creative. The reason is, I think the environment that

> we're in, and I can't really give you a specific event. I don't want to associate productivity with creativity, that's why I can't come up with something. ... I don't think that I'm creative in a sense to create something new from nothing. That's how I feel. (solid performer, male)

> First of all I would like to tell you that, in general my work is not creative. That's my feeling. (solid performer, female)

Interestingly, out of the total comments they made Group B, solid performers, and males made comments related to this subcategory significantly more than Group A, high performers, and females. Two of the interviewees referred to their not being creative within the first minute of the interview.

3) Insufficient time. This tied with the next subcategories as having a negative effect on creativity. Here, again, there is a parallel between the stimulants and obstacles to creativity. Just as fifty-eight percent of interviewees mentioned positive feelings of pressure from time deadlines, fifty percent mentioned unrealistic deadlines and too much workload in too little time as a hindrance. Out of their total comments they made, females seem to comment on insufficient time significantly more than males.

> You have the schedules to meet. So sometimes you don't have the chance to be creative. Because, to be creative, sometimes you need more time to do it. Because you try to do things differently. (solid performer, female)

4) Constraint. Opposite to freedom and control, constraint is defined as the lack of freedom to decide what to do or how to do it, lack of control over ones work or ideas; lack of initiative, feeling constrained. Half of the interviewees mentioned constraint as a negative influence on creativity. Although previous researchers have not found explicit evidence of the detrimental effects that constraint, or lack of freedom, can have on R & D creativity, this result and the results of several studies by Amabile and Gryskiewicz (1987, 1988) seem to provide some evidence towards this factor.

> However, the creativity level was pretty much carved out by mandates set by other members of the team, those being, you know, the managers. (solid performer, male)

> It was all predetermined what I had to do. And exactly how it had to be. I had specific formats I had to follow. The information I had to present was very specific. And it frustrated me. I didn't really enjoy that part. (solid performer, male)

This last quote points to the negative effect of constraint on this individual's intrinsic motivation to do creative work.

5) Various organizational characteristics. Forty-two percent of interviewees mentioned organizational characteristics such as lack of support from others, overly formal and bureaucratic procedures, the working environment such as colors, space, as a hindrance to their creativity. Typical of their comments were:

> I think that, you know, being in an environment where you just, you're not allowed to speak, or you're not allow to promote your ideas effects creativity.(solid performer, female)

> The Japan lab was the worst possible lab you could work in terms of seating arrangements, and no colors, no, very dry, dirty, messy. (solid performer, female)

Strained relationships or tension amongst the group was also mentioned as having a negative effect on creativity.

6) Inappropriate or no evaluation. Twenty-five percent of interviewees commented on lack of or poor feedback on work, little recognition; not enough feedback on the value of the work itself as detrimental to creativity. Just as recognition and encouragement were seen as a important stimulants to creativity, inappropriate or no evaluation is a obstacle.

> What I found difficult about that one, was being involved quite late in the cycle. Where I really wasn't aware of the history of it. Well, for one thing, it took a little while to start to know all about it. I wasn't aware of the history of it and I can't count the number of meetings where I raised a point or an objection, or question, or whatever, and I'd be told, " Oh, well, we already discussed it at another meeting". (high performer, female)

There was also reference to lack of management and team leader support.

> Very unsupportive in terms of guidance. Expectations that I should've been able to know certain things. And basically, you know, feeling that I was failing badly. (solid performer, male)

7) Poor management. Opposite to good managers, these managers are seen as intrusive, having unclear goals, poor communication and interpersonal skills. Approximately seventeen percent of interviewees commented on the effect of a poor manager on creativity.

> So, in terms of management, again, the ones I've had problems with were the ones where they're on my back all the time. Seeming to provide really challenging things to do, and in actually they're the ones who've just kept me in the plateau stage where I wanted to move on but I just wasn't allowed to. (high performer, female)

Interestingly, comments regarding poor management were not made by interviewees within Group B, the group that scored low both on their creativity index and intrinsic motivation scores.

8) Miscellaneous other. There were no comments that were eligible for this subcategory.

The next section deals with the interview question regarding the characteristics of an ideal working environment.

Characteristics of the Ideal Working Environment

Interviewees were also asked to comment on what they saw as the ideal working environment. Specifically, if they were given a blank slate and could create the ideal work environment what would it look like, what would it include, how would they describe the kind of setting where they would work best. Although the process of content analysis was used to analyze the comments, this particular aspect of the study did not replicate the work of Burnside et al (1988) or other researchers in this area. It was expected, however, that there would be duplication with what was identified earlier as stimulants to creativity.

Content analysis identified ten subcategories under this theme. Tables 19, 20, and 21 display the rankings of the subcategories by frequency of all 12 interviewees, Group A and B, and high and solid performers. Again, parallelism was seen between the subcategories identified here and the stimulants to creativity discussed earlier. Also, rankings of the subcategories were seen as similar for the total group of interviewees, Group A and B, high and solid performers. Some differences occurred in terms of the number of comments made by one group compared to another. These will be highlighted under the respective subcategory.

Table 19: Critical incident interviews - rankings of characteristics of ideal work environment (Of the total comments made, what percentage fell into each subcategory?)

Contributors to Ideal Work Environment:	Total Responses (ranked percent)
External environment. Noise level, quiet area, space.	13
Good management. Manager sets clear direction without managing too tightly, providing support when needed. Hands-off management.	13
Interaction with others. Like people working with, can throw ideas around, cross section of experience.	11
Interesting, challenging work. Challenging work, need for solution, solving problems, ground up work, work feels important	11
Freedom and control. Freedom to decide what to do or how to do it; a sense of control over ones work.	11
Recognition and rewards. General sense that creative work will receive appropriate feedback, recognition, and reward.	10
Adequate resources. Equipment, people, money	10
Good working environment. Open, informal, team atmosphere.	8
Sufficient time. Realistic deadlines; manageable workload given schedule, deadlines	8
Miscellaneous Other. Any characteristics that didn't fit above.	5
	100 (n=12)

External environment. This category included those aspects of the work environment surrounding the individual, such as, the noise level, space, lighting, colors, having a quiet area to work in. Sixty-seven percent of interviewees saw this as an important

characteristic of the ideal working environment. Bright lighting, colors, window seats, private places to think, minimal interruptions were mentioned often.

> I like to have long periods where I'm not interrupted. If there was a place of if my own office, or whatever, was quiet and uninterruptable for, not forever, not a whole day, but just for a couple of hours at a time if you needed to do these kinds of things. (high performer, male)

> . . . air in the place, colors, reasonable noise level. I wish I had a window seat, of course, like everybody, where you can look outside from time to time. (solid performer, female)

> We used to have the old thing of about four desks in a room, and we had great big walls, went up to the ceiling, and you were locked, you had a door and you could close it. But that's where you could sit down and talk, and argue, or whatever. (solid performer, male)

Good Management. Tied in importance with the subcategory of the external environment was good management. A good manager was seen as a manager who sets clear direction without managing too tightly, providing support when needed, a hands-off management style.

> Someone who gives you direction when you need it and doesn't when you don't. And is willing to give you constructive criticism when you need it

> and praise when you deserve it. And someone who respects you. And then, someone who you respect as well. (solid performer, male)

> Let's see, the good managers, they trust me. They know, they're not on my back all the time. They know what I can and can't do and at the same time will challenge me to do things that they feel I can do. (high performer, male)

Interaction with others; interesting, challenging, work; and freedom and control, all tied for third overall by fifty-eight percent of interviewees, but when analyzed by group the following order occurred.

Interaction with others. Described as the ability to throw ideas around and work with other people and having a cross section of expertise, this category was seen as important for an ideal work environment by all interviewees. This high performers sums up the thoughts of those who commented on this category.

> I really need to be able to draw on other people's opinions and advice and just be able to pop my head around the corner and say, 'How are things?" Or just get someone's opinion. (high performer, male)

Interesting, challenging work. This subcategory parallels with the subcategory under stimulants of interesting and challenging work, and uses the same definition.

> The kind of work that I have found I enjoy doing, has to do with presenting information to end users, using either graphics or pictures, or images of some sort.. The work tends to be visually oriented. (solid performer, male)

I think if you're learning something, it's a good day, you know? ... I was thinking something with more design type work. To have more of a open slate just to do, go whichever way you wanted to go. (solid performer, male)

There's got to be a challenge. .... And it's got to make you stretch. (high performer, female)

Table 20: Critical incident interviews - rankings of characteristics of ideal work environment by Group A and B (Of the total comments made, what percentage fell into each subcategory?)

Contributors to Ideal Work Environment:	Total Responses (percentage)	
	Group A	Group B
External environment	9	17
Good management	13	13
Interaction with others.	9	13
Interesting, challenging work	13	10
Freedom and control	16	7
Recognition and rewards	9	10
Adequate resources.	13	7
Good working environment.	6	10
Sufficient time	9	7
Miscellaneous Other	3	7
	100 (n=6)	100 (n=6)

Freedom and control. Again, paralleling with freedom and control as a stimulant to creativity, interviewees saw this subcategory as an important factor towards an ideal work environment.

> Well I think from an environment perspective I almost need the freedom to explore ideas. I need the freedom to be able to go off and present something I mean, I'm not really building on anything here. ... So, nobody is second guessing me. Again, I've been sort of given a broad description of a task and told: "Do it. Have fun. Do it". (solid performer, male)

> I guess it would be a situation where you've got a lot of flexibility to make decisions. You get, you're in power to make decisions. You have probably a situation where you may not be, probably not a large project but something where you can focus in on one area and you can, basically start from scratch. Your won't have a lot of restrictions imposed on you. You can come up with decisions and carry them out all the way through, I guess. (high performer, male)

Interestingly, out of the total comments made Group A commented significantly more often than Group B on this subcategory. In addition, out of the total comments made, males commented almost three times more often than females on this subcategory.

Table 21: Critical incident interviews - rankings of characteristics of ideal work environment by high and solid performers (Of the total comments made, what percentage fell into each subcategory?)

Contributors to Ideal Work Environment:	Total Responses (percentage)	
	High performers	Solid performers
External environment	14	12
Good management	14	12
Interaction with others.	14	9
Interesting, challenging work	11	12
Freedom and control	11	12
Recognition and rewards	7	12
Adequate resources.	11	9
Good working environment.	14	9
Sufficient time	7	9
Miscellaneous Other	4	6
	100 (n=5)	100 (n=7)

Adequate resources. Equipment, people, and money were commented upon by fifty percent of interviewees as a contributor to an ideal work environment. This parallels with the subcategory of sufficient resources raised as a stimulant to creativity. Tied with this was recognition and rewards, defined as a general sense that creative work will receive appropriate feedback, recognition, and reward.

Having the right tools was mentioned often by interviewees.

> Well, having all the right tools, I guess. Like the work station working perfectly all the time you know. (solid performer, male)

Availability of resources such as "industry information, research papers, legitimate documentation, and opportunity to participate in an industry forum" was also seen as important. (high performer, male)

> ... equipment wise it would be the type of equipment you're working with that is very important. I'm quite lucky in that I've got some of the top of the line equipment. (high performer, female)

Out of the total comments they made, Group A commented on this subcategory almost twice as often as Group B.

Recognition and rewards. This category was described as a general sense that creative work will receive appropriate feedback, recognition and reward.

> Recognition by the manager, just a little thank you. I'm not saying thank you on everything. That's silly. What you do is your job and you're not going to ask for a pat on the back for every single thing you do. But, for things where, you've made an effort above and beyond the call, where you've done something new and innovative and just so on. (high performer, female)

> The management always encourage people to be creative. If people are really creative, I think they are rewarded. So, I got the message of that. Why you are encouraged to be creative. (solid performer, female)

One individual talked about the importance of paying attention to recognition and salary to maintain motivation saying, "I know, we would be doing better work if the motivation through recognition and salary were there" (solid performer, male). This points to how extrinsic constraints can be detrimental to creativity for individuals who are unable to immunize themselves from them or put them in a positive light.

Females commented significantly more often than males on this subcategory. This seems to reflect the findings in Section 1 of this report where females scored significantly higher on the Outward orientation of the Work Preference Inventory (WPI). Recognition and the opinions of other seem to be important to females in doing their work.

Good working environment. Forty-two percent of interviewees commented on positive aspects of the working environment, such as, openness, informality, and a team atmosphere contributing to an ideal work environment. This subcategory also paralleled with the stimulant to creativity of various organizational characteristics. Tied with this was the subcategory of sufficient time -- realistic deadlines, manageable workload given schedule and deadlines. Again, this subcategory was seen as opposite to the obstacle raised earlier of insufficient time.

Comments related to a good work environment included:

> An environment where you're mixed in with peers who are familiar with the technology you're using or familiar with the overall system you're working on. So that you can chat with them and you can, formally, or informally, as the case may be. ... So, having that sort of environment where there's sort of a team spirit. A

mutual involvement in each other's project and the ability to bounce ideas off people. (high performer, male)

So I would fight for a more Tom Peter's type organization. A very flat, more team oriented one. And in that area, it's working quite well where I am because I am prime and I've gotten kind of dotted line into all key areas. (solid performer, male)

Sufficient time. This subcategory, described as realistic deadlines, manageable workload given schedule and deadlines, was commented on by eight percent of interviewees.

I always felt that sort of a start and stop time is important because that often adds fuel to the way you approach something. You think of a hundred ways to do something. And you know ninety of them are way out. And, you get a lot of creative thinking." (high performer, male)

No, I think the key, the key part is, I've been given a broad description of a task. Some kind of deadline. And the ability to use whatever tools are available or I'm aware of to accomplish that. (solid performer, male)

Females did not comment on this subcategory.

Miscellaneous other. This subcategory included any characteristics which didn't fit into the above nine categories. One individual spoke of "smaller projects, that are more self-contained as opposed to bigger projects being more conducive to an ideal work environment as you get more immediate feedback" (high performer, male). Again, as

raised earlier the issue of competence was mentioned along with the importance of knowing what you are doing. Finally, one individual spoke to "the importance of maintaining balance between pleasure and work" (solid performer, female).

Finally, interviewees were asked to define creativity in their own words. What follows provides the rankings of their definitions of creativity, along with a few of their direct quotes to support these rankings.

Definitions of Creativity

At the end of the interview participants were asked to provide their own definition of creativity. At no point before or during the interview was a definition provided by the researcher. Rankings of definitions of creativity are displayed in Table 22. The majority of interviewees saw creativity as doing something new or differently, and as something abstract, not the obvious.

Table 22: Critical iIncident interviews - rankings of definitions of creativity by all 12 interviewees

Definition	Total Responses (ranked percent)
Doing something new or differently	41.6
Abstract, not the obvious	25.0
Internally focused, i.e.; love what you're doing, personal, thought process	16.7
Flexibility	16.7
	100
	(n=12)

Definitely the word "new" comes in. Doing something new where in the process of the creation, there's a spark. There's an "ah, hah!" that takes place. Yet the

word that comes to mind as well is, "elegant, an elegant design means it's efficient ... elegant is very pure of form. (high performer, female)

Doing thing in like different ways. Like lateral thinking as opposed to linear. And sometimes you have to be, like a little bit crazy or whatever, you know, just completely ... an inventiveness. (solid performer, male)

I think a lot it is being able to see something differently. Being able to look at something and not to see the obvious. Being able to see things that other people might not. (high performer, male)

Two of the interviewees talked about creativity as a personal, inner process. This high performer, who was in the top ten percent group, quote showed an intrinsic motivational orientation.

I'd say it's a journey, I guess. Or a process that is personal. In that it comes from within. It can be validated externally but it's a process that changes every time. It's often dependent on a particular challenge or problem that you're facing. But. it's the process that you learn, that is initiated, initiates internally .. by doing, kind of like an approach you would take, I guess, finding your way through a maze. ... Key words are try to process, trial and error, thought process, feedback, succeeding in a goal. (high performer, male)

I think that's the basic thing. If you really love what you are doing. You cannot explain your emotions through a program, you can explain your emotions through

> a poem or through art, ... I think that to me the definition of creativity is, I don't think I can say it in words, but I know what it is, and I know where I can see it. I see it in art. I see it in ballet. I see it in poetry. Theater. Creativity at the work place I think is more, I don't know maybe, it's more to make you feel more, you have an incentive, which is to make you, you've got an incentive from a corporation point of view sometimes. Like, really you want to make your design faster because you will have a better design. Which is better for the customer. (solid performer, female)

Finally, several behaviours were observed by the researcher during the interview stage that are worth noting. These highlight some of the differences seen between Group A and Group B interviewees. Specifically, those interviewees in Group A tended to be more confident and more verbal. They were able to give lots of examples and antidotes when talking about their high and low creative activities. They also tended to be more excited about their work, speaking often about the challenges they enjoyed and how having interest in what they were doing was important. They also talked about the times where they took the initiative to turn uncreative work into more interesting and challenging work. These observations are supported by the literature which describes positive personal characteristics of high creativity producers as having: "persistence, curiosity, energy and intellectual honesty; self-motivation, the intrinsic motivation of being excited in the work itself; special cognitive abilities; risk orientation; social skill; and brilliance (Amabile, 1990, p. 75)." They also can be compared to Torrance's (1991a) identification of "beyonders" who demonstrated characteristics such as, "delight in deep

thinking, tolerance of mistakes, love of one's work, clear purpose, enjoying one's work, feeling comfortable as a minority of one, being different, not being well-rounded, sense of mission, and courage to be creative" (Torrance, 1991a, p. 74).

The interview results point to many stimulants and obstacles to creativity. Many of these parallel the work of other researchers in this area. The next section provides a discussion of the key points to be drawn from these results. Finally, a discussion summary will be provided summarizing the key elements from both the quantitative and qualitative results.

DISCUSSION

The data from the interviews confirmed many of the findings of other researchers regarding those stimulants and obstacles that influence creativity. In addition, identification of the most important factors was supported by the parallelism between stimulants and obstacles. Specifically, freedom and control versus constraint; challenge and interest in the work versus the lack of challenge or keeping things the same; various organizational characteristics such as collaboration and cooperation versus the organizational characteristics of lack of support from others; good versus poor management or supervision; pressure versus insufficient time; and recognition and encouragement versus inappropriate or no evaluation.

As expected the data collected from interviewees on the characteristics of an ideal working environment supported the factors identified as stimulants to creativity. Specifically, described by interviewees in order of frequency were the need for freedom and control; good management, interesting and challenging work; a good working environment supported by having proper equipment, lighting, space; and sufficient time. All of this suggests a central theme, one found in previous studies, that R & D designers who feel motivated primarily by their own interest in and sense of challenge toward their work are more likely to produce creative work than those who feel they are working primarily to meet to constraints placed on them by either their work environment or by they themselves (Amabile & Gryskiewicz, 1987, 1988; Amabile & Sensabaugh, 1986; Burnside et al, 1988). This is congruent with the intrinsic motivation principle of

creativity which states "people will be most creative when they feel motivated by the interest, enjoyment, satisfaction and the challenge of the work itself - rather that by external pressures" (Amabile & Hennessey, 1992, p. 55). These results are also encouraging given that social factors as these indicated above, although they only account for a small part of the total variance in creative behaviour, may account for the lion's share of the variance managers and professionals can control (Amabile, 1990).

The data revealed some interesting divisions not only along gender lines, but between Group A and B, and high and solid performers. For example, the obstacle of "individual does not see self as being creative" was expressed more often by Group B interviewees and solid performers. Interestingly, four out of six of the interviewees who commented on this had low scores on the Creativity Index and on intrinsic motivation. Creativity is by no means confined to the group of people referred to as being "creative". Most, if not all, people are capable of creativity and most people's creative abilities can be enhanced (Fernald, 1989; Pierson, 1983; Torrance, 1979). Perhaps the differentiator in this case was the motivational orientation of the individual, meaning those who are intrinsically motivated will not see themselves as not being creative. Another factor may be that those with individuals with an internal perceived locus of control will look for opportunities to be creative, as opposed to being defeated by work that seems to be uncreative. The capacity to choose and to have choices also fits the definition of self-determination, and is primary to intrinsic motivation (Deci & Ryan et al, 1975; 1978; 1985a). Finally, creativity is not only something we are born with, but creativity can be enhanced through a positive state of mind.

In terms of gender, males tended to make more comments about not seeing self as being creative than females. Although women scientists are often stereotyped as being less creative than male scientists, there seems to be conflicting empirical evidence to confirm this (Frieze & Hanusa, 1984). Women tend to be more holistic in their thinking, thus having a better chance of being creative. Often they have more connections in their lives than just work which would allow them to tap into different sources to support their creativity (Gilligan, 1982). More research is needed in this area.

Females tended to comment at least three times more often than males on the subcategory of sufficient resources as a stimulant to creativity, and saw insufficient time as an obstacle to creativity. Also raised in Amabile and Gryskiewicz's (1987) study, a lack of resources and a lack of sufficient time were seen as important factors in the low creativity events. Perhaps because males consider time and resources to be obvious prerequisites for creative work, they did not highlight these factors as often in their comments. Females, on the other hand, may feel the pressure of balancing work with the demands of their personal life more then the men. They may feel the strain that a lack of resources puts on a project in terms of meeting the schedule or deadline. On the other hand, they may feel they have to perform perfectly or better than men in a predominantly male environment. Again, this would need to be explored further.

Differences that appeared between Group A and B, and high and solid performers, begin to point to the characteristics or attributes that differentiate the two. One that was already mentioned was how individuals who are creative and motivated perceived themselves to be creative, and/or seemed to have the self-determination and motivation to

look for ways to be creative. These individuals seem to replicate Torrance's (1991a) group of "beyonders" who have characteristics of loving their work and the courage to be creative. The researcher's observation of this group was that they had a belief in their effort and effectiveness, having a sense of self-efficacy. Self-efficacy is a combination of one's self-esteem, skills and resources, and much like Amabile (1983a, b) definition of creativity, it is task specific (Pacific Institute Resource Manual, p. G-10).

Recognition, encouragement and good management also seemed to be more important for interviewees from Group A then those in Group B. These factors are seen as extrinsic in nature, and known to be detrimental to creativity, specifically when they are lacking. However, although overjustification studies have generally shown decreases in creativity under reward conditions (Deci & Ryan, 1985a; Lepper & Greene, 1978), Amabile found that while we expect that some professionals will succumb to the overjustification effect, many highly creative people go on being creative in light of extrinsic constraints (Amabile, 1979). This seems to be the case with Group A interviewees who had high scores on both the Creativity Index and the Intrinsic Motivation measure. These designers are either getting adequate support in these areas or may be immune to these factors when they are not there. Their internal states appear to be nonambiguous or salient

Also evident between Group A and Group B interviewees is how often they spoke about taking initiative in their work. They often took advantage of opportunities where the work started out mundane to make it more interesting, and in turn contributed more to the organization then expected. Taking initiative was not only found in Kelly and

Chaplan's (1993) study of star performers, but was also included as a component to creative performance (Amabile, 1983a, b) called task motivation. The attitude towards the task, and the individual's perceptions of his/her own motivation for undertaking the task will lead to higher creativity.

Finally, high performers commented more often on the effect of boring, non-challenging, uninteresting work as an obstacle to creativity. Given that these individuals are selected because they have demonstrated exceptional ability and performance, one would suspect that they would not only be given more interesting and challenging work, but would have an expectation to only do that kind of work. This finding points to the importance for managers to ensure that interesting challenges are maintained if they wish to keep their high performers motivated and satisfied.

The last theme presented dealt with the definitions of creativity. The definitions provided by interviewees not only emulated definitions found in Amabile and Gryskiewicz's (1987) study, but also paralleled the definition provided earlier by the researcher as including "the production of novel and useful ideas, and is dependent upon specific processes, creative abilities and motivation towards the task (Chapter 2, p. 21)."

This was encouraging as it is important for professionals to have a clear concept of creativity if they are going to use it in any way. It was also encouraging to see that most individuals did not see creativity as something that occurs only for artists and musicians, and that they could relate it to themselves.

In summary, in response to research question 2, the interview findings pointed to the conditions necessary to bring out intrinsic motivation and creativity in adults in BNR as: 1) freedom and control versus constraint; 2) challenge and interest in the work versus the lack of challenge or keeping things the same; 3) various organizational characteristics such as collaboration and cooperation versus the organizational characteristics of lack of support from others; 4) good versus poor management or supervision; 5) pressure versus insufficient time; and 6) recognition and encouragement versus inappropriate or no evaluation. These results replicate the results of previous studies. Those factors which seem to begin to differentiate high performers from solid performers were: taking initiative - being able to turn uncreative situations into interesting and challenging ones, the importance of hands-off management and recognition and encouragement, and the need for interesting and challenging work. The definitions provided by interviewees fit well with the research definition of creativity. Finally, a new element discovered was the aspect of individuals' not seeing themselves as being creative as potentially having a negative influence on creativity. This parallels somewhat with the work of Amabile (1990) and Kelly and Chaplin (1993) on high versus low creativity and performance, and may be a key differentiator between high and solid performers. It remains for further research to determine this cause and effect. If someone's motivational orientation and perception of their creative ability could change would this effect their creativity level and performance.

DISCUSSION SUMMARY

Several links can be made between the quantitative and the qualitative results. In both, males and females differed on the outward/extrinsic orientation (females scored significantly higher). Females referred to recognition and rewards more often than males. People who score high on the outward orientation "tend to be motivated by recognition; they are sensitive to others' opinions of their work and ideas; and they tend to judge their success relative to other people" (Amabile, 1994). Although there is limited empirical evidence, Frieze & Hanusa (1984) found that women who become scientists must be highly motivated, very self-assured, and/or have a good deal of support from people both in and outside of their chosen field of science. Keown and Keown (1985) found that 11 of 21 women reported recognition as giving them pleasure in their work life. Certainly, there was evidence in this study to show that support and recognition from others was important for females in influencing creativity and working in the ideal work environment. Their task mastery, when recognized by others, appeared to engender more pleasure and satisfaction in the women participants than in the men.

Secondly, both in the quantitative results and interview findings there was no significant difference between high and solid performers in terms of their creativity and motivational scores, and on how they perceived stimulants and obstacles to creativity, or the ideal work environment. The only noticeable difference was that high performers tended to comment more frequently on boring, non-challenging work as being an obstacle to creativity. Again, the lack of significant difference may be attributed to hiring practices that do not differentiate between solid and high performers. Perhaps the definitions for

high and solid performers are not specific enough, or are being applied too loosely by management for differentiation to be seen between the two groups. As well, the criteria to select high performers may be too subjective. Finally, the sample size for interviews may have been too small.

Although significant differences did not occur from a statistical standpoint, there are trends. When the researcher chose to select the top 50 percent of high performers who scored high on the creativity index and the bottom 50 percent who scored low on the creativity index, significant differences were found in the creativity scores of the top 50 percent, yet not on the motivational scores. Behavioural differences were also evident during interviews with interviewees who scored high on both the CRI and intrinsic motivation score compared to those who had low scores on both (i.e., those with high scores spoke often of interest and challenge being important in the work they do). Given that Group B included more solid performers that Group A, one could suggest that intrinsic motivation can make a difference between high and solid performers. What a person can do and what he or she chooses to do depends on an individual's self-esteem, and belief system. What seemed evident in this study was that those individuals who capitalized on their sense of efficacy (self-esteem and self-image), their belief in their abilities (taking initiative), and their ability to be motivated from within (intrinsically motivated) tended to be more creative. Also key to these individuals was the perceptions of the environment in which they worked (the factors contributing to creativity mentioned earlier). All this supports the model presented in Chapter 2 (p. 21), suggesting that an intrinsic motivational orientation lies as the foundation, along with creative abilities and

specific processes, to the production and implementation of new and useful ideas. More research is needed, using a larger sample group, in order to confirm this.

In summary, the researcher started off suggesting that the key success factor for organizations operating in the new economy will be their ability to effectively utilize their human capital. Although there are many ways that this can be achieved the results of this study suggests that high levels of intrinsic motivation in employees may be the leverage point to high creativity and job satisfaction. Also identified were those factors (taking initiative (being able to turn uncreative situations into interesting and challenging ones), the importance of hands-off management and recognition and encouragement, and the need for interesting and challenging work) which seem differentiate high performers from solid performers. To substantiate this, interviewees provided their perceptions of factors that act as stimulants to creativity and promote the ideal work environment, specifically, freedom and control; challenge and interest in the work; various organizational characteristics such as collaboration and cooperation; good management or supervision; pressure; and recognition and encouragement. Finally, a new element discovered was the role of self-evaluation on individuals who did not see themselves as being creative, in creating a negative influence on creativity. This links with the concept of the self-fulfilling prophecy, if one does not see themselves as being creative, they will not be creative. Organizations, like NT/BNR, may want to consider these findings when looking for ways to increase employee morale and at the same time unleash creativity within their employees leading them to global competitiveness and profitability in the 21st century.

The next chapter provides conclusions based on these results, followed by the limitations of the study, implications for professionals and high technology organizations, and recommendations for future research.

CHAPTER 5: CONCLUSIONS

The following conclusions may be drawn from an integration of the quantitative and qualitative findings of this study. This study provides clear support for the intrinsic motivation principle of creativity, meaning that high creativity in high technology organizations will most likely occur in an atmosphere of freedom rather than constraint, and where the work is challenging and interesting. Individuals will be most creative when they feel motivated by the interest, enjoyment, satisfaction, and challenge in the work itself, rather than by external pressures. Organizations and managers should look for ways to foster this within the work environment.

Following on this, when hiring designers and when assigning them to tasks, it is important to look not only at skills and knowledge but also at intrinsic motivation. "Qualified people who are personally intrigued and challenged by the task with be more likely to produce creative work than qualified people who are not so motivated." (Amabile, 1988, p. 163) High technology organizations need to ensure that their selection criteria expands further than academics. Perhaps BNR's history of hiring from the same engineering and computer science schools on the basis of high academics has contributed to the lack of differentiation on the creativity and motivational measures between designers and the norm populations used in this study. These hiring practices may need to be extended further than the Faculties of Engineering and Computer Science, where emphasis on creative thinking and interpersonal skills are generally lacking.

It is important for the organization to keep intrinsic motivation, and therefore creativity alive by fortifying and expanding those factors identified as stimulates creativity and eliminating or reducing those factors that serve as obstacles to creativity. These include freedom and control versus constraint; challenge and interest in the work versus the lack of challenge or keeping things the same; various organizational characteristics such as collaboration and cooperation versus the organizational characteristics of lack of support from others; good versus poor management or supervision; pressure versus insufficient time; and recognition and encouragement versus inappropriate or no evaluation. This will contribute to a high technology organization's success in the new economy allowing them to more effectively utilize their intellectual and creative capital.

The characteristics that seem to emerge from this study that differentiate high performing designers from solid were: taking initiative - being able to turn uncreative situations into interesting and challenging ones, the importance of hands-off management and recognition and encouragement, and the need for interesting and challenging work. All of these characteristics will lead to high creativity. In addition, Amabile et al (1994) found that compared with individuals who score low in intrinsic motivation, individuals who score high should be more likely to voluntarily undertake challenging assignments that will allow them autonomy; and will choose professions that will allow them, active, self-reliant involvement in their work. These types of knowledge workers within a high technology organization will lead them to competitiveness and profitability.

Finally, the research has confirmed many of the findings in the literature creativity and intrinsic motivation. In particular, this research has added to our knowledge of what conditions are necessary to bring out intrinsic motivation, therefore creativity, in adults in a high technology organization. It has also helped identify what are some characteristics that differentiate high performing designers from solid performing designers within a high technology organization.

LIMITATIONS OF THE STUDY

The study's design is not without its limitations. Although I consistently strived to refrain from intervention during the interview sessions, the nature of her role was to guide discussion, and to probe for greater depth and breadth wherever possible. Sometimes the interviewer would interrupt to search for reasons behind a statement or to clarify what had been said. Some participants would stray off-topic or become hooked on one particular area. Also, the interviewer was bound to influence the situation simply by her presence and manner.

Use of the tape recorder might have influenced the participants' responses. Although they knew that it was only being used for completeness and not to influence their thinking, its lack of inpact can not be proven.

Unlike, Burnside et al (1988) I did not use independent coders in stage one and two to analyze the verbatim transcripts. The same coders were maintained for both stages of the study, I and an assistant. This may have an effect on the accuracy of the data presented and may have included some bias.

I recognizes that she needed to be more dogmatic in the selection of high and solid performing designers. Perhaps, a better definition of each category could have been developed by interviewing a random sample of both managers and peers from the Switching Networks Division. Once the definition of each was formed, the list of designers could have been reviewed against the definitions to select each sample group.

I achnowledges that the study would probably be richer and more varied if more that one business unit had been involved. Although the Switching Networks Division is the largest BNR division, differences may have occurred between different business units. Finally, this study does not provide a longitudinal perspective.

IMPLICATIONS FOR MANAGERS AND HUMAN RESOURCES PROFESSIONALS IN HIGH TECHNOLOGY ORGANIZATIONS

Although it was not the purpose of I to provide sweeping generalizations on the basis of a small sample size and twelve interviews, several repetitive themes both from the results and well-documented research are worth noting.

It is important that high technology organizations hire their R&D designers with not only domain-relevant skills and knowledge, but also with creativity skills, abilities, and an intrinsic motivational orientation. Human Resources (HR) professionals must work with management to ensure that future designers hired into the organizations have more diverse skills and knowledge to bring to the organization.

Managers should identify and foster those factors that were brought out in this study as stimulants to creativity within their organizations, and identify and eliminate those factors perceived to be obstacles to creativity within their organizations. Not only will individual motivation and creativity increase, but also as a consequence, organizational innovation will flourish.

Designers, currently working within high technology organizations, must not only develop and keep up-to-date their technical skills and knowledge, but also must look for ways to develop themselves personally. This not only includes their creativity and interpersonal skills, but keeping on top of what career interests and aspirations, balance and stress managment, and sense of self-worth and motivation. Many organizations have

career development and planning programs and/or Training department that could offer assistance in this area.

Faculties of Engineering and Computer science, within universities, should consider offering courses in creativity and interpersonal skills. There needs to be more emphasis on these elements if we are expecting individuals to be creative and innovative in the workplace. The time will come when large organizations, such as BNR and NT, whose success depend on the effectiveness of their knowledge workers, will count on universities and colleges to provide training in this area.

RECOMMENDATIONS FOR FUTURE RESEARCH

Using this study as a pilot, it would be valuable to expand this to a larger study incorporating a comparison group of designers and/or non-designers from another division and/or another high technology organizations, and a larger sample size. This replication would add a different perspective to research in the area.

Researchers could conduct a longitudinal study tracking the 60 designers in this study. The goal would be to determine if they experience changes in their creativity and motivational orientation as they progress in their careers, and to determine what factors could be effecting any changes that may occur. We may learn from this type of study how best to meet the needs of designers in BNR.

In an effort to understand what are the differences between high and solid performers, a future study could investigate those high performers from this study, who were in the top 50 percent who scored high on the Creativity Index, further to determine what other factors could be contributing their high creativity scores, and their high performance. These results would assist organizations as to what is needed to turn a solid performer into a high performer.

Hennesey and Amabile's (1988) work with children in the area of creativity and intrinsic motivation could be used as a foundation to further study adults creativity and intrinsic motivational orientations based on professional development training. Specific programs could provide special training to those designers who had both low intrinsic

motivation and creativity scores with the goal of increasing their intrinsic motivational orientation or immunizing them from extrinsic constraints, in an effort to increase their creativity.

R&D organizations would benefit greatly by the knowledge resulting from further studies in the area of intrinsic motivation and creativity within adults. Given that intellectual capital will be the economic currency in the 21st century, high technology organizations, such as BNR, are positioned well. However, their leverage point will be their ability to stimulate and harness their existing creativity. As mentioned earlier, creativity is a complex concept that has been of interest to researchers and organizations in the past, but more investigation is still needed. The findings of this study point to future work that could be done in this area.

REFERENCES

Albrecht, K, & Albrecht, S. (1987). The Creative Corporation. Homewood, Illinois: Dow Jones-Irwin.

Alderfer, C. P., (1972). Existence, Relatedness, and Growth. New York: The Free Press.

Amabile, T.M., (1979). Effects of external evaluation on artisitc creativity. Journal of Personality and Social Psychology, 37, 221-233.

Amabile, T.M., (1982). Social psychology of creativity: A consensual assessment technique. Journal of Personality and Social Psychology, 43, 997-1013.

Amabile, T.M., (1983a). The Social Psychology of Creativity. New York: Springer-Verlag.

Amabile, T.M., (1983b). Social psychology of creativity: A componential conceptualization. Journal of Personality and Social Psychology, 45, 357-377.

Amabile, T. M., (1985). Motivation and creativity: effects of motivational orientation on creative writers. Journal of Personality and Social Psychology, 48, 2, 393-399.

Amabile, T.M. (1987). The Work Preference Inventory. Unpublished Instrument., Brandeis University, Waltham, MA.

Amabile, T.M. (1988). A model of creativity and innovation in organizations. Research in Organizational Behaviour, 10, 123-167.

Amabile, T.M. (1990). Within you, without you: The social psychology of creativity, and beyond. In M.A. Runco and R.S. Albert (eds), Theories of Creativity. Newbury Park, CA: Sage Publications, 61-91.

Amabile, T.M., (1994) Brief Scoring Guide for the Work Preference Inventory (WPI). Unpublished document, Brandeis University, Waltham, MA.

Amabile, T.M., DeJong, W., & Lepper, M. (1976). Effects of externally imposed deadlines on subsequent intrinsic motivation. Journal of Personality and Social Psychology, 34, 92-98.

Amabile, T.M., & Gryskiewicz, S.S. (1985). Creativity in research and development, Technical Report, Center of Creative Leadership, Greensboro, NC.

Amabile, T.M., & Gryskiewicz, S.S. (1987). Creativity in the R&D laboratory. Technical Report Number 30, Greensboro, North Carolina: Center for Creative Leadership, 1-31.

Amabile, T.M., & Gryskiewicz, S.S. (1988). Creative human resources in the R&D laboratory: How environment and personality affect innovation. In R.L. Kuhn, Handbook for Creative and Innovative Managers, 501-525. McGraw-Hill Book Company.

Amabile, T.M., & Hennessey, B.A. (1992). The motivation for creativity in children. In A.K. Boggiano, T.S. Pittman, & S. Thane (Eds), Achievement and Motivation: A Social-developmental Perspective. Cambridge: University Press.

Amabile, T.M., Hill, K.G., Hennessey, B.A., & Tighe, E.M. (1994). The work preference inventory: Assessing intrinsic and extrinsic motivational orientations, Journal of Personality and Social Psychology. 66, 5, 950-967.

Amabile, T.M. & Sensabaugh, S.J. (1986). High creativity vs. low creativity: What makes the difference? In S.S. Gryskiewicz, and R. Burnside (Eds), Creativity Week 8, 1986 Proceedings, Greensboro, NC: Center for Creative Leadership, 43-45.

Bailyn, L., (1984). Autonomy in the industrial R&D lab. Paper #1592-84, Alfred P. Sloan School of Management, Massachussetts Institute of Technology.

Bailey, R.L. (1978). Disciplined Creativity for Engineers. Ann Arbour, Michigan: Ann Arbour Science publishers inc.

Beck, N. (1993). Shifting Gears: Triving in the New Economy. Toronto,Canada: Harper Perennical/Harper Collins Publishers Ltd.

Becker, G.S. (1976). The economic approach to human behaviour. Chicago: University of Chicago Press.

Bem, D. (1972). Self-perception theory. In L. Berkowitz (Ed), Advances in Experimental Social Psychology (6). New York: Academic press.

Bell-Northern Research (BNR) Switching Networks Division, 1994 KRD Presentation, Internal Document, Ottawa, Canada.

Besemer, S.P. & Treffinger, D.J. (1976). Analysis of creative products: Review and synthesis. Journal of Creative Behaviour, 15, 158-178.

Brewer, G., (1992). The Peters principle. Incentive, 166 (10), 32-36.

Brown, R.T., (1989). Creativity: What are we to measure. In J.A. Glove, R.R. Ronning, and C.R. Reynolds, Handbook of Creativity. New York: Plenum Press.

Burnside, R.M., Amabile, T.M., and Gryskiewicz, S.G., (1988). Assessing Organizational Climates for Creativity and Innovation: Methodological review of large company audits. In Y. Ijiri, & R.L. Kuhn (Eds.) New Directions in Research for Creative and Innovative Managers. Cambridge, Ma: Ballinger. 169-185.

Crutchfield, R.S. (1962). Conformity and creative thinking. In H. Gruber, G. Terrell, & M. Wertheimer (Eds), Contemporary Approaches to Creative Thinking. New York: Atherton Press.

Csikszentmihalyi, M. (1975). Beyond Bordom and Anxiety. San Francisco: Jossey-Bass.

Davis, G.A., (1992). Creativity is Forever. Dubuque, Iowa: Kendall/Hunt Publishing, 3rd Edition.

deCharms, R., (1968). Personal Causation: The Internal Affective Determinants of Behaviour. San Diego, CA: Academic Press.

Deci, E. L. (1972). Intrinsic motivation, extrinsic reinforcement, and inequity. Journal of Personality and Social Psychology, 22, 113-120.

Deci, E. L. (1975). Intrinsic Motivation. New York: Plenum Press.

Deci, E.L., & Porac, J. (1978). Cognitive evaluation theory and the study of human motivation. In M.R. Lepper, & D. Greene, (1978). The Hidden Costs of Reward: New Perspectives on the Psychology of Human Motivation. Hillsdale, NJ: Lawrence Erlbaum Associates.

Deci, E.L., & Ryan, R.M. (1985a). Intrinsic motivation and self-determination in human behaviour. New York: Plenum.

Deci, E.L., & Ryan, R.M. (1985b). The general causality orientations scale: self-determination in personality. Journal of Research in Personality, 19, 109-134.

Denzin, N., (1978). The Research Act. (2nd ed.). New York: McGraw-Hill.

Drucker, P.F., (1986). Innovation and Entrepreneurship. NewYork: Harper and Row; London: Wm. Heinemann.

Drucker, P.F., (1993). Post-Capitalist Society. New York: HarperCollins Publishers.

Fernald Jr., L.W., (1989). A new trend: creative and innovative corportation environments. Journal of Creative Behaviour, 3 (3), 178-184.

Freedman, D., Pisani, R., Purves, R., & Adhikari, A., ((1991). Statistics (Second Edition). New York: Norton & Company.

Freeman, S. J. M., (1990). Managing lives: Corporate women and social change. Amherst: The University of Massachusetts Press.

Frieze, I.H., & Hanusa, B. H., (1984) Women scientists: overcoming barriers. In M.W. Steinkemp & M.L. Maehr (Eds.) Advances in Motivation and achievement: Women in Science. New York: JAI Press, 139-163.

Garvin, D., (1993). Building a learning organization. Harvard Business Review, 71, July-August, 78-91.

Gilligan, C., (1982). In a different voice: Psychological theory and women's development. Cambridge, MA: Harvard University Press.

Hale, R.I., (1992). Mystat Statistical Applications, DOS Edition. Cambridge: Course Technology, Inc

Hayes, R.H., Wheelwright, S.C., & Clark, K.B., (1988). Dynamic Manufacturing: Creating the Learning Organiation. New York: The Free Press.

Harter, S.A., (1978). Effectance motivation reconsidered: Toward a developmental model. Human Development, 21, 34-64.

Hennessey, B.A., & Amabile, T.M., (1988). The conditions of creativity. In R.J. Sternberg (Ed). The Nature of Creativity. New York: Cambridge University Press.

Herzberg, F., (1959). The motivation to work. New York: Wiley.

Himes, G. K. (1987). Stimulating Creativity: Encouraging Creative Ideas. In A. Dale Timpe (Ed.) Creativity. New York: Kend Publishing.

Kanter, R.M., (1983) The Change Masters. New York: Simon & Schuster Publishers.

Kanter R.M. (1995). Constructing the Future. In NT 1994 Annual Report: A world of Networks (.27-29).

Kelly, R., & Caplan, J. (1993). How Bell Labs creates star performers, Harvard Business Review. July/August, 128-139.

Keown, A.L., & Keown, C.F., (1985). Factors of success for women in business. International Journal of Women's Studies, 8 (3), 278-285.

Khatena, J. (1982). Myth: Creativity is too difficult to measure. Gifted Child Quarterly, 26, 1, 21-23.

Lepper, M., Greene, D., & Nisbet, R. (1973). Undermining children's intrinsic interest with extrinsic rewards: A test of the "overjustification" hypothesis. Journal of Personality and Social Psychology, 28, 129-137.

Lepper, M.R., & Greene, D. (1975). Turning play into work: Effects of adult surveillance and extrinsic rewards on children's intrinsic motivation. Journal of Personality and Social Psychology, 31, 479-486.

Lepper, M.R., & Greene, D., (1978). The Hidden Costs of Reward: New Perspectives on the Psychology of Human Motivation. Hillsdale, NJ: Lawrence Erlbaum Associates.

Lewis, R. & Delaney, W.F. (1991). Promoting innovation and creativity. Research Technology Management, vo.34, no. 3, p. 21-25.

Lincoln, Y.S. and Guba, E.G., (1985). Naturalistic Inquiry. Newbury Park, California: Sage Publications.

MacKinnon, D.W. (1975). IPAR's contribution to the conceptualization and study of creativity. In I. Taylor & J. Getzels (Eds.), Perspectives in Creativity. Chicago: Aldine.

MacKinnon, D.W. (1978). In Search of Human Effectiveness: Identifying and Developing Creativity. Buffalo: Bearly Limited.

Maslow, A.H., (1943). A theory of human motivation. Psychological Review, 50, 370-396.

Maslow, A.H., (1971). The Farther Reaches of Human Nature. New York: Viking.

McClelland, D.C. (1961). The Achieving Society. Princeton, NJ: Van Nostrand.

McGregor, D. (1960). The Human Side of Enterprise. New York: McGraw Hill.

McMillian, J.H., and Schumacher, S., (1984). Research in Education: A Conceptual Introduction. Glenview, Illinois: Scott, Foresman and Company.

Mincer, J., (1979). Human capital and earnings. In D. Windham (Ed) Economic Dimensions of Education. New York: National Academey of Education, 1-21.

Morgan, G., (1988). Riding the Waves of Change: Developing Managerial Competencies for a Turbulent World. San Francisco: Jossey-Bass Publishers.

Nolan, T.N., & Nolan, S.J., (1988). A model for innovation. In The 1988 Annual: Developing Human Resources. University Associates, Inc.

NT 1993 Managing for Achievement (MFA) Guide. Published by the Human Resources Department.

NT Quarterly Report. (1994). First Quarter results.

NT Universe Magazine. (1994). Publishes internally for NT employees and customers.

Ohmae, K. (1995). Competitive advantage in the information age. In NT 1994 Annual Report: A world of Networks, (19-21).

Perkins, D.N., (1981). The Minds Best Work. Cambridge: Harvard University Press.

Perkins, D.N., (1984). Creativity by design. Educational Leadership, 42, 1, 18-25.

Pearlman, C. (1983). Teachers as an informational resource in identifying and rating student creativity. Education, 103, 215-222.

Pierson, D.A., (1983). A technique for managing creative people. Personnel, 60 (1), 12-26.

Ramo, S. (1988) Creativity in Business Management. In R.L. Kuhn, Handbook for Creative and Innovative Managers, (p 3-10). New York McGraw Hill Book Company.

Roe, A., (1952). A psychologist examines sixty-four eminent scientists. Scientific American, 187, 21-25.

Roe, A., (1972). Maintenance of creative output through the years. In C. W. Taylor (Ed.), Climate for Creativity, (. 167-191). New York: Pergamon Press.

SAS, (1989). SAS Institute Inc., Cary, NC USA.

Shaughnessy, M.J., Mentoring and E. Paul Torrance: his creative contributions. The Creative Child and Adult Quarterly, 16, 2, 95-97.

Shenin, R. (1981). The rearing of women in science, engineering and technology. International Journal of Women's Studies, 4, 339-347.

Senge, P., (1990). The Fifth Discipline. New York: DoubleDay Dell Publishing Inc.

Strata, R., (1989). Organizational learning the key to management innovation. Sloan Management Review, Spring.

Tapscot, D., & Caston, A., (1993). Paradigm Shift: The New Promise of Information Technology. New York: McGraw Hill Inc.

Tardif, T.Z. & Sternberg, R.J. (1988) What do we Know About Creativity? In R. J. Sternberg (ED), The Nature of Creativity, Cambridge, MA: Cambridge University Press.

Taylor, C.W. (1972). Can organizations be creative, too? In C.W. Taylor (Ed.), Climate for Creativity, (1-22). New York: Pergamon Press.

The Conference Board of Canada, (1992). Employability Skills Profile. Published by The Conference Board of Canada, Ottawa, Ontario, Canada.

The Pacific Institute, (1994). Investment in Excellence for the 90's, Personal Resource Manual, Video Phase 2.

Torrance, E.P., (1966). Torrance Tests for Creative Thinking, Thinking Creatively with Pictures - Figural Booklet B. Scholastic Testing Service Inc.

Torrance, E.P. (1979). Search for Satori and Creativity. Buffalo, NY: Bearly Limited.

Torrance, E.P. (1988) The Nature of Creativity as Manifest in its Testing. In R.J. Sternberg (ED), The Nature of Creativity, 43-75, Cambridge, MA: Cambridge University Press.

Torrance, E. P. (1990). Torrance Tests for Creative Thinking, Norms-Technical Manual, Figural (Streamlined) Forms A&B. Scholastic Testing Service Inc.

Torrance, E.P., (1991). Torrance Tests for Creative Thinking, Test user booklet. Scholastic Testing Service Inc.

Torrance, E.P., (1991a). The beyonders and their characteristics. The Creative Child and Adult Quarterly, 16, 2, 69-79.

Torrance, E.P., (1991b). Torrance Tests for Creative Thinking, Directions Manual, Figural Forms A and B. Scholastic Testing Service Inc.

Van Gundy, A.B. (1987). Organizational creativity and innovation. In S.G. Isaksen (Ed.), Frontiers of creativity research, (358-379). Buffalo,NY : Bearly Limited.

Walberg, H.J. (1988). Creativity and talent as learning. In R.J. Sternberg (ED), The Nature of Creativity, 340-361. Cambridge, MA: Cambridge University Press.

White, R., (1959). Motivation reconsidered: The concept of competence. Psychological Review, 66, 297-323.

Yong, L.M., (1994). Managing creative people. The Journal of Creative Behaviour, 28, 1, 16-20.

Zumbo, B., (1993). Class notes from Methods and Interpretation in Quantitative Research 1 (EDU 5191), University of Ottawa, Ottawa, Ontario, Canada.

Appendix 1: Information sheet and consent form for participants of the study

Appendix 2: Torrance's (1966) Thinking Creatively With Pictures - Figural Booklet B instrument

BNR

Information Sheet for Informed Consent of Research Participant

Research: An Examination of the interaction between intrinsic motivation and the fostering of creativity within a High Technology organization.

When a research project that studies individuals is undertaken by a member of the University of Ottawa, the Ethics Committee of the University requires the written consent of the participants. This does not imply that the project is risky; the intention is simply to assure the respect and confidentiality of the individuals concerned.

This research project directed by Masters candidate, Judy Laws, is under the supervision of Dr. Janice Leroux, Faculty of Education, and Jules Meunier, Vice President, DMS Evolution, Bell-Northern Research (BNR). It examines the working styles (i.e.; motivation and creativity) of R&D Designers within BNR . Conclusions drawn from the data will be helpful in providing some valid recommendations and actions that both individuals of the study and the organization could take towards incorporating conditions necessary for increasing intrinsic motivation and creativity.

In order to do a comparative analysis of different working styles, the researcher will gather data through a two stage approach. The first stage will involve subjects completing both a Torrance Test for Creative Thinking (TTCT) and Work Preference Inventory (WPI). Both the TTCT and WPI will be completed in group sessions of 40 minutes.

In stage two, individuals will be selected for thirty minute one-on-one interviews. The interview questions will be distributed to subjects one week before the interview so that they can prepare. All interviews will be tape recorded to ensure accuracy. Subjects can ask to have the tape recorder turned off at anytime. To ensure confidentiality, only group data will be reported, no names will be used and it will be impossible to link participants to the data. Tapes will be destroyed after analysis.

Consent Form for Participants

I have read the information sheet and have understood the request to participate in the study of working styles of R&D Designers within Bell-Northern Research (BNR). I understand that I may withdraw from the study at any time without business repercussions. All information is confidential and is protected under the Freedom of Information and Protection of Privacy Act, 1989 (Bill 49). Since all individual instruments and interview transcripts will be destroyed after analysis and only group data will be available, it will not be possible to link any of this data with individuals.

_____ I give permission to participant in the research and for previous records to be examined.

_____ I do not give permission to participate in the research or for previous records to be used in the study.

NAME OF PARTICIPANT: _____

COMPANY: _____

COMPANY ADDRESS: _____

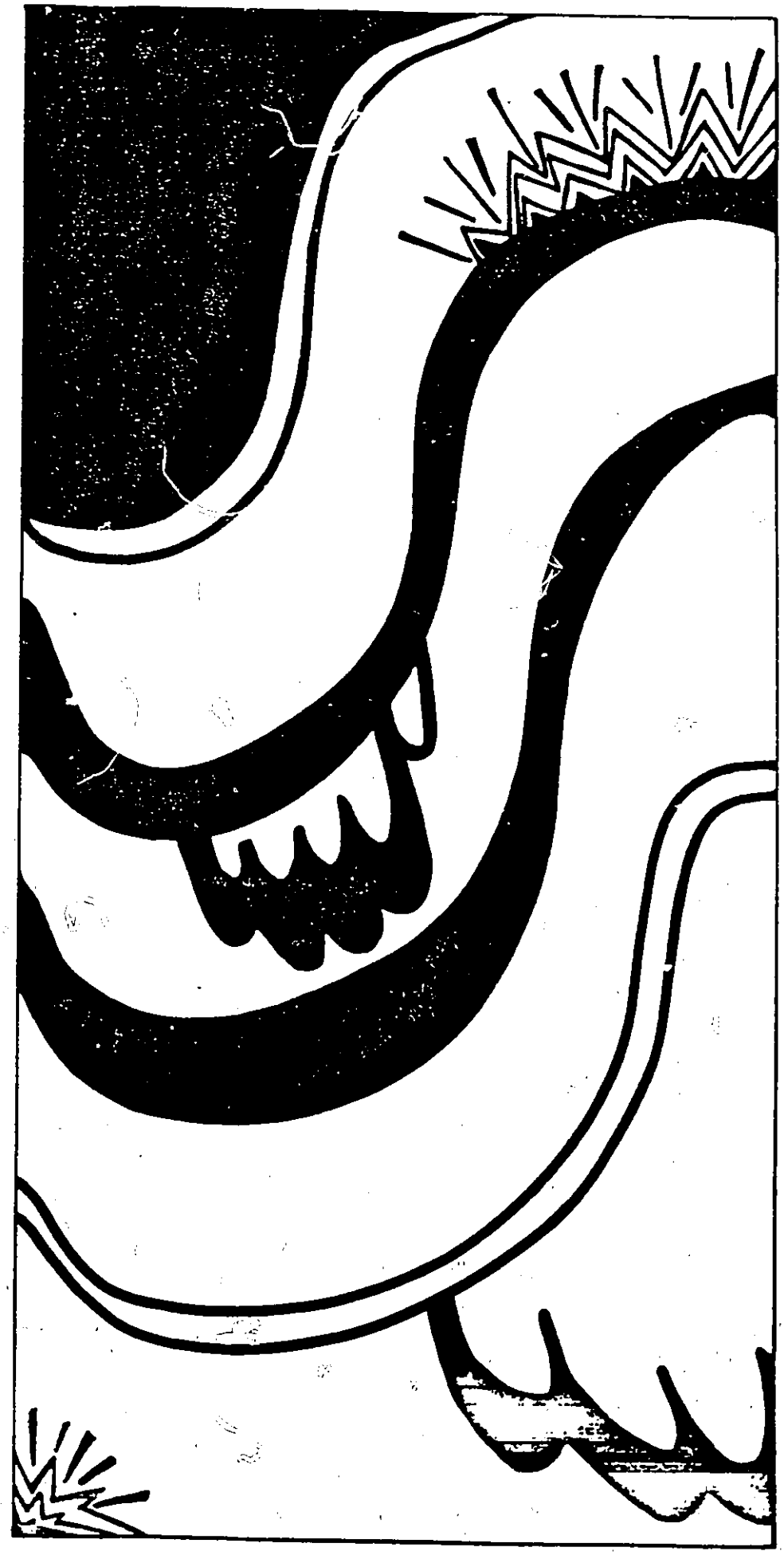
DATE: _____

SIGNATURE: _____

Please return this consent form to Judy Laws, Dept. 1471, Carling, Stop 158 by _____. My intent is to plan our meetings well in advance so as to be as convenient to you as possible. Thank you for your interest in this project. An executive summary of the study will be available to participants upon request.

Researcher (Masters candidate)
Judy Laws
Dept. 1471
BNR Carling
Stop 158
(613) 765-2564

Faculty Advisor
Dr. Janice Leroux
Faculty of Education
University of Ottawa
145 Jean Jacques Lussier
Ottawa, Ontario
KIN 6N5
(613) 564-7711



THINKING CREATIVELY WITH PICTURES

By E. Paul Torrance

FIGURAL BOOKLET B

NAME _____

AGE _____ SEX _____

SCHOOL _____

GRADE _____

CITY _____

DATE _____

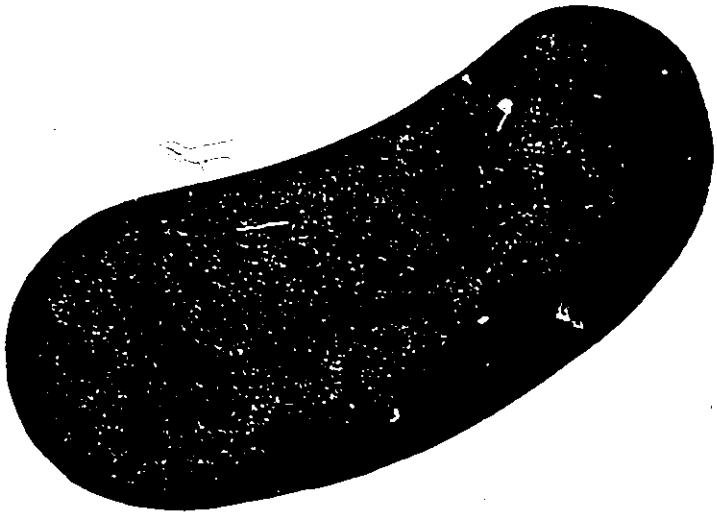
SCHOLASTIC TESTING SERVICE, INC
480 [illegible] Rd., P.O. Box 1056
Bensenville, IL 60106-2056

Activity 1. PICTURE CONSTRUCTION

On the opposite page is a curved shape. Think of a picture or an object which you can draw with this shape as a part.

Try to think of a picture that no one else will think of. Keep adding new ideas to your first idea to make it tell as interesting and as exciting a story as you can.

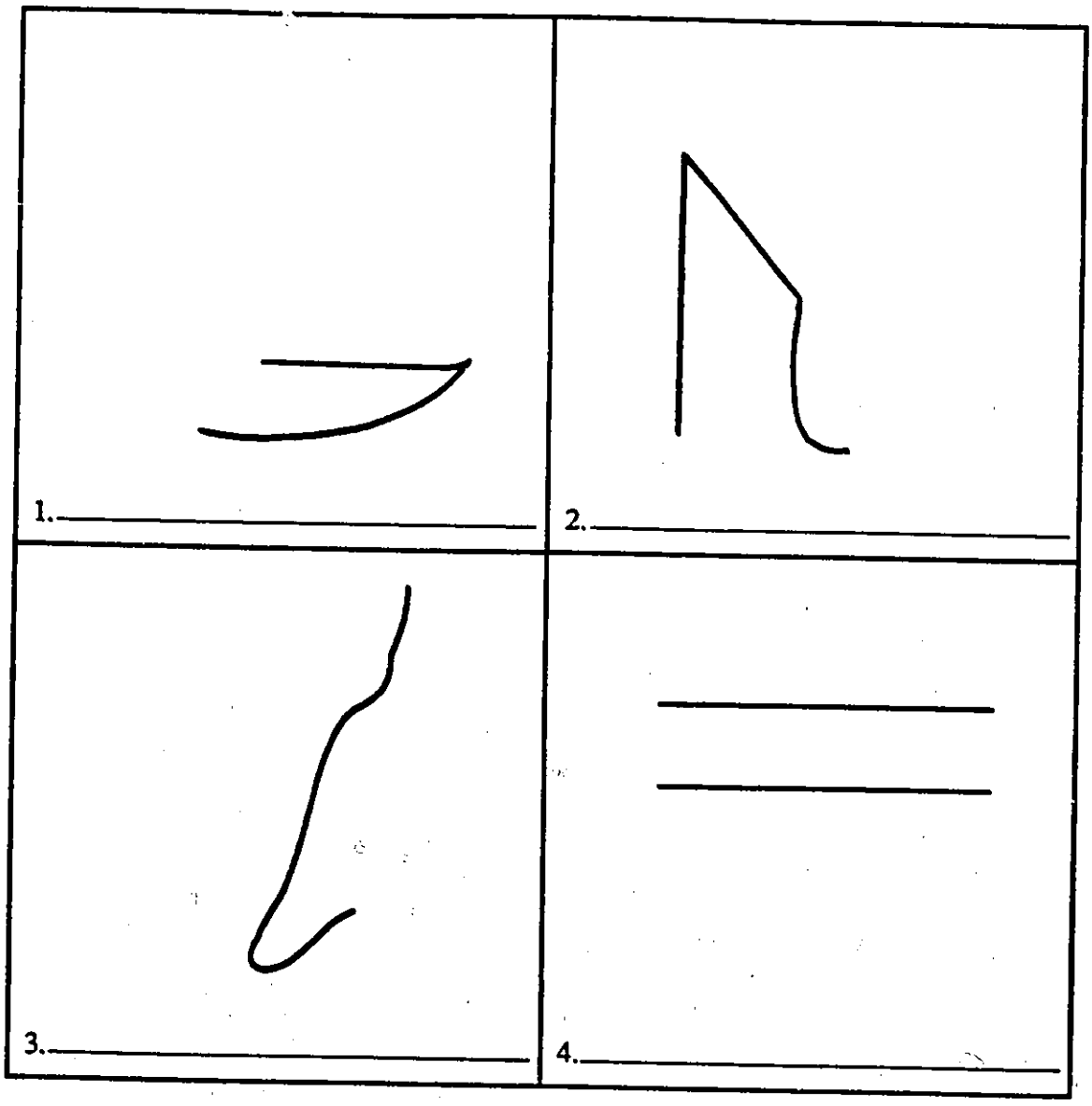
When you have completed your picture, think up a name or title for it and write it at the bottom of the page in the space provided. Make your title as clever and unusual as possible. Use it to help tell your story.

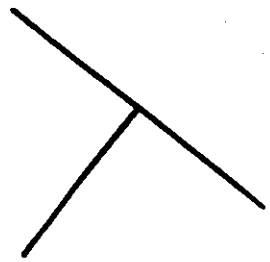
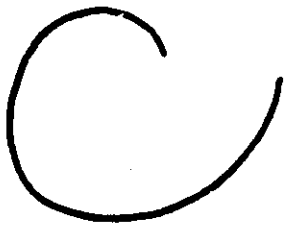
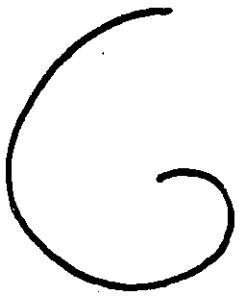
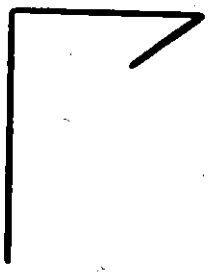


YOUR TITLE: _____

Activity 2. PICTURE COMPLETION

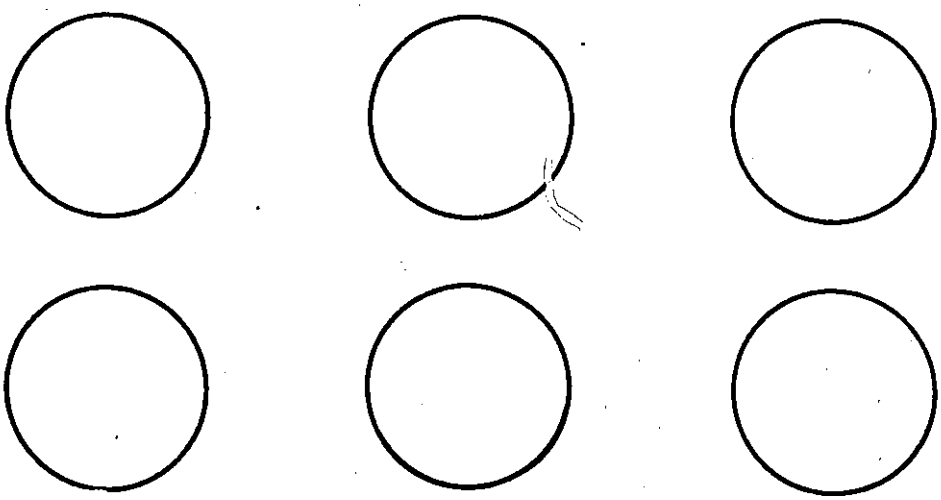
By adding lines to the incomplete figures on this and the next page, you can sketch some interesting objects or pictures. Again, try to think of some picture or object that no one else will think of. Try to make it tell as complete and as interesting a story as you can by adding to and building up your first idea. Make up an interesting title for each of your drawings and write it at the bottom of each block next to the number of the figure.

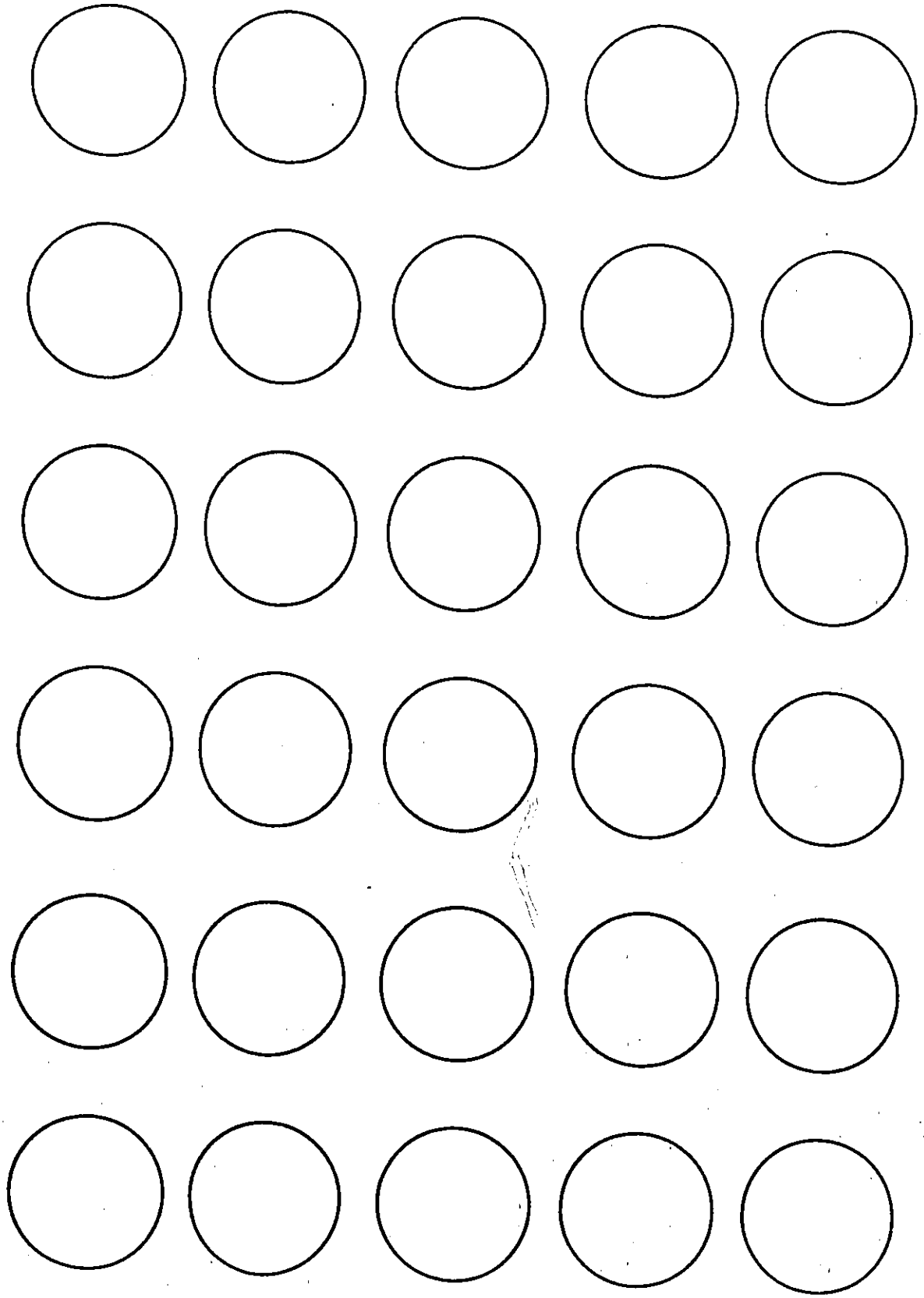


 5._____	 6._____
 7._____	 8._____
 9._____	 10._____

Activity 3. CIRCLES

In ten minutes see how many objects or pictures you can make from the circles below and on the next page. The circles should be the main part of whatever you make. With pencil or crayon add lines to the circles to complete your picture. You can place marks inside the circles, outside the circles, or both inside and outside the circles—wherever you want to in order to make your picture. Try to think of things that no one else will think of. Make as many different pictures or objects as you can and put as many ideas as you can in each one. Make them tell as complete and as interesting a story as you can. Add names or titles below the objects.





Appendix 3: Amabile's (1985) Work Preference Inventory - Working Adult Version

#_____

7:10/07/86

Work Preference Inventory
Working Adult Version

Teresa M. Amabile, Ph.D.
Department of Psychology
Brandeis University

Please rate each item in terms of how true it is of you. Please circle one and only one letter for each question according to the following scale:

N = **Never** or almost never true of you
S = **Sometimes** true of you
O = **Often** true of you
A = **Always** or almost always true of you

N S O A	1. I am not that concerned about what other people think of my work.
N S O A	2. I prefer having someone set clear goals for me in my work.
N S O A	3. The more difficult the problem, the more I enjoy trying to solve it.
N S O A	4. I am keenly aware of the income goals I have for myself.
N S O A	5. I want my work to provide me with opportunities for increasing my knowledge and skills.
N S O A	6. To me, success means doing better than other people.
N S O A	7. I prefer to figure things out for myself.
N S O A	8. No matter what the outcome of a project, I am satisfied if I feel I gained a new experience.
N S O A	9. I enjoy relatively simple, straightforward tasks.
N S O A	10. I am keenly aware of the promotion goals I have for myself.
N S O A	11. Curiosity is the driving force behind much of what I do.
N S O A	12. I'm less concerned with what work I do than what I get for it.
N S O A	13. I enjoy tackling problems that are completely new to me.
N S O A	14. I prefer work I know I can do well over work that stretches my abilities.
N S O A	15. I'm concerned about how other people are going to react to my ideas.
N S O A	16. I seldom think about salary and promotions.
N S O A	17. I'm more comfortable when I can set my own goals.
N S O A	18. I believe that there is no point in doing a good job if nobody else knows about it.
N S O A	19. I am strongly motivated by the money I can earn.
N S O A	20. It is important for me to be able to do what I most enjoy.
N S O A	21. I prefer working on projects with clearly specified procedures.
N S O A	22. As long as I can do what I enjoy, I'm not that concerned about exactly what I'm paid.
N S O A	23. I enjoy doing work that is so absorbing that I forget about everything else.
N S O A	24. I am strongly motivated by the recognition I can earn from other people.
N S O A	25. I have to feel that I'm earning something for what I do.
N S O A	26. I enjoy trying to solve complex problems.
N S O A	27. It is important for me to have an outlet for self-expression.
N S O A	28. I want to find out how good I really can be at my work.
N S O A	29. I want other people to find out how good I really can be at my work.
N S O A	30. What matters most to me is enjoying what I do.

Please also complete the following. This information is essential for our statistical records.

Name _____ Age_____ Sex_____

Occupation _____ # years in occupation _____

Highest educational degree _____ Today's date _____

Appendix 4: One-on One interview Memo and Questions

Dear _____,

Once again thank-you for agreeing to take the time to participate in my research study on different working styles in Bell Northern Research (BNR). As discussed on the telephone you have been selected to participate in stage two of the study involving a 30 minute one-on-one interview. Hence, your interview is scheduled for __*(date)*_____, at ___*(time)*____, and in room _____. Come prepared to describe an event that has occurred in your work in the last twelve months that you consider to have been highly creative; and a separate event that you consider to have been low in creativity. In this case, creative is whatever you judge to be creative.

Interview Questions:

1) Describe a time in your work when you felt most creative? Be specific, providing as many details as you can about what you thought, felt, and about the work environment surrounding the event.

2) Describe a time in your work when you felt least creative? Again, Be specific, providing as many details as you can about what you thought, felt, and about the work environment surrounding the event.

3) What would be your ideal working conditions? Describe the kind of setting where you could work best?

Appendix 5: Instructions for Administering Torrance's Thinking Creatively with Picture (TTCT) and Amabile's Work Preference Inventory (WPI)

1. Introduction:

- Introduce yourself and reiterate the purpose of the study is "to examine the working styles (i.e. creativity and motivation) of R&D designers within Division 7", and that comparisons will be made between the two groups of participants - high and solid performing.
- indicate that today's session satisfies Stage 1 of the study. Based on our analysis, about 20 percent of the sixty participants will be contacted to set up 30 minute one-on-one interviews during the last week in October/first week in November. Interviews will be set up at their convenience.
- **Ensure that you get all signed consent forms before your begin.** Bring extras for those who forgot theirs.

2. Administering TTCT:

- Say: "I believe you will have a lot of fun doing the activities in this session. Working through the activities in the TTCT will give you a chance to see how good you are at thinking up new ideas and solving problems. They will call for all of your imagination and thinking ability you have. So I hope that you will relax, put on your best thinking cap and enjoy yourself."
- Distribute the booklet with a pencil. Ask them to print their name on the front and the date (that is all that is needed). Tell them not to open the booklet until you tell them to. They should stay focused on what they are doing and not look at their colleagues' booklet.
- **Section 1 of TTCT:** Read out loud first bold print, page 4 in TTCT Directions Manual. If there are no questions proceed with first activity. Tell them to open to the first page. Read out loud second bold print on page 4, Directions Manual. Once questions are answered instruct them to begin. Using time allow for TEN MINUTES before calling time. **Don't forget to begin timer!**
- **Section 2 of TTCT:** Read out loud third bold print, page 5 of TTCT Directions Manual. Once questions are answered instruct them to begin. Using timer allow for TEN MINUTES before calling time. **Don't forget to begin timer!**
- **Section 3 of TTCT:** Read out loud forth bold print, pages 5&6 of TTCT Directions Manual. Once questions are answered instruct them to begin. Using timer allow for TEN MINUTES before calling time. **Don't forget to begin timer!** Collect booklets

3. **Administering the WPI:**

- Say: "The WPI consists of 30 questions designed to assess your overall intrinsic and extrinsic motivational orientations toward your work."
- Read them the instructions at the top of the page. Remind them to fill in their name and today's date on the bottom. There is no time limit for this instrument.
- Before they begin, thank them for their time and indicate that you will stay to answer any questions or that they can contact you at anytime if they have questions. Put your phone number on the whiteboard for them. Ask those who finish early to leave quietly so as not to disturb those who are not finished. Tell them to begin.