What Inspires Leisure Time Invention?

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Motivation

- We all know **success stories** about leisure time inventors:
  e.g., Wozniak and Jobs: Apple Computer
  the Wright brothers: airplane.
- Many scholars have examined the **economic value of unpaid work**, e.g., volunteer work (Beneria 1999).
- Leisure time inventions have so far been neglected in the literature – leisure time inventors are dispatched as "**hobbyists**".
- R&D literature focuses on inventions that are the result of a **group endeavor.**
- Literature on creativity finds a negative relationship between **workload pressure** and productivity
- **Research question:** Under which conditions is leisure time likely to arise?

Leisure time invention

- Generally, a “leisure time invention” may be defined as …

  … an invention made during a worker’s unpaid time.

- We define leisure time invention more strictly:

  … as an invention for which the inventor got the idea during his leisure time;

  - possibly, the resulting invention was further developed in the inventor’s leisure time but more likely, it was further developed during work time;
  - status of the inventors: 92% of the inventors in the sample are employee-inventors, the remaining 8% are free inventors;
  - at least an EP patent was granted to each invention.

► The data do not contain pure hobbyists.

PatVal Data

- **Sample** – stratified random sample of 10,500 granted EP patents
  - inventors living in Germany at the time of the invention
  - priority date between 1993 and 1997

- **Unit of observation** – first inventor listed on the patent document

- **Survey** – paper / online questionnaire
  - 3 pre-tests: Mai 02 – Feb. 03
  - full scale survey: Mai – Oct. 03 (response rate 33%)

- **Dataset** – PatVal/EPO
  - questionnaire - answers from 3,049 inventors
  - EPOLINE database - bibliographic and procedural information

Theoretical background – Leisure time invention

The **creative process** …

- involves the **novel combination of ideas** or prior technologies (Gilfillan 1935);
- typically is a **group endeavour** (Hargadon 1999);
- is characterized by the tension between **conscious and unconscious forces** (*Kris 1952; Noy 1969)*;
- requires a mind that is receptive to intrusive ideas and that is able to **suppress fixated subconscious thoughts** which interfere with creativity (*Kris 1952; Kubie 1958)*.

Hypotheses - Leisure time invention

H1: *The incidence of leisure time invention will be positively related to the quality of prior inventive output of the inventor.*

operationalization: share of received x-type citations of the inventor's patent applications within one year before the application of the underlying patent

H2a: *The incidence of leisure time invention will be negatively related to interactions with people from the inventor's own workplace.*

H2b: *The incidence of leisure time invention will be positively related to interactions with people outside the inventor's own workplace.*

operationalization: interactions with fellow employees or people outside the own workplace

Hypotheses - Leisure time invention

H3: *Leisure time invention occurs more frequently in conceptual-based (CB) technologies than science-based (SB) technologies*

operationalization: main technological areas: electricity/electronics, instruments (CB), chemicals/pharmaceuticals (SB), process engineering (CB), mechanical engineering, and consumer goods/civil engineering (CB)

H4: *The incidence of leisure time invention will be negatively related to the project size.*

operationalization: number of man-months invested in research leading to the patented invention

Descriptive statistics

	leisure time invention (N=149)				work time invention (N=2393)			
variable	mean	S.D.	min	max	mean	S.D.	min	max
quality of prior inventive output	1.50	2.99	0	17	1.73	3.31	0	28
interactions with fellow employees								
same organization (≤ 1 hour) *	0.46		0	1	0.68		0	1
same organization (> 1 hour)	0.17		0	1	0.22		0	1
other organization (≤ 1 hour) *	0.17		0	1	0.13		0	1
other organization (> 1 hour)	0.30		0	1	0.25		0	1
type of problem								
science based problem *	0.12		0	1	0.26		0	1
medium science based problem	0.40		0	1	0.38		0	1
conceptual based problem *	0.48		0	1	0.35		0	1
project size (man months)♦ *	2		1	5	3		1	5
idea further developed in R&D project *	0.64		0	1	0.83		0	1
age at the time of the survey **	51.42	9.12	31	72	49.20	9.71	24	83
education (terminal degree) *								
high school diploma or less	0.17		0	1	0.11		0	1
university studies	0.59		0	1	0.52		0	1
doctoral/postdoctoral studies	0.24		0	1	0.37		0	1
high intrinsic motivation	0.47		0	1	0.45		0	1
employee mobility	0.30		0	1	0.32		0	1
type of the organization: firm *	0.91		0	1	0.96		0	1
size of the inventor team **	2.41	1.75	1	10	2.98	1.97	1	16
status employee-inventor *	0.85		0	1	0.96		0	1
financial resources: internal funds *	0.89		0	1	0.95		0	1
no. of patent applications (1 year prior)	3.36	4.74	1	30	3.28	3.81	1	58

♦ median

* in a Chi2-Test, the difference between leisure time and work time invention turned out to be significant

**** in a t-test, the difference between leisure time and work time invention turned out to be significant**

	Model (1)		Model (2)		
Dependent variable	leisure time invention				
quality of prior inventive output	-0.0001	[0.001]	-0.00004	[0.001]	**H.1**
type of interaction					
own organization (distance <= 1 hour)	-0.031***	[0.010]	-0.030***	[0.010]	**H.2**
own organization (distance > 1 hour)	-0.002	[0.010]	-0.001	[0.010]	
other organization (distance <= 1 hour)	0.027*	[0.016]	0.028*	[0.016]	
other organization (distance > 1 hour)	0.024**	[0.011]	0.024**	[0.011]	
type of problem (reference group: science based problem)					
medium science based problem	0.010	[0.014]	0.010	[0.013]	**H.3**
conceptual based problem	0.022*	[0.014]	0.022*	[0.014]	
project size (reference group: labor input 'less than 1 man month')					
1 to 3 man months (mm)	-0.022**	[0.009]	-0.039***	[0.012]	**H.4**
4 to 6 men-months	-0.028***	[0.008]	-0.043**	[0.013]	
7 to 12 man months	-0.022**	[0.010]	-0.056**	[0.012]	
more than 13 man months	-0.039***	[0.008]	-0.042	[0.020]	
idea further developed in R&D project	-0.032***	[0.012]	-0.073***	[0.026]	
1 to 3 mm * further developed			0.049*	[0.033]	
4 to 6 mm * further developed			0.050	[0.044]	
7 to 12 mm * further developed			0.185**	[0.130]	
> 12 mm * further developed			0.017	[0.047]	
number of inventions (1 year prior)	0.002*	[0.001]	0.002*	[0.001]	
constant	-2.399**	[1.174]	-2.340**	[1.179]	
Pseudo R2	0.106		0.113		
Chi2-test	120.2; p = 0.00		128.2; p = 0.00		

Standard errors in brackets / * significant at 10%; ** significant at 5%; *** significant at 1%

Table 2: Probit model (marginal effects) (N = 2,542) (additional control variables included)

Summary of the results

- **Leisure time inventions**
  - \+ interactions with people outside the own organization
  - \- interactions with people from the same organization
  - \- science-based problems
  - \- project size

- **Implication:**
  - Design corporate programs to give employees unstructured "free" time during working hours?