Tasks and Skills:

Meaning, Measurement, and Policy

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The issues

A. Timeless

1. **What skills do jobs require currently, i.e., what is the real labor input generating current output?**

2. **Are the education and job training systems well adapted to meeting those needs (e.g., mismatch)?**

3. **What are (previous and) likely future trends in job requirements?**

B. More recent

1. **Inequality growth often attributed to changes in jobs and tasks due to computers, i.e., SBTC**

2. **Related issues: job stress/workload, job displacement, precarity, mobility/ILM, social exclusion**

But data scarcity and drawbacks remain barriers—toward a program

What kind of data are needed?

1. Systematic conception of tasks and related job requirements, i.e., what to measure?

2. Measurement approach, i.e., how to measure (operationalize)?

3. Clear relationship to key explanatory and other issues, i.e., research and policy relevance

4. Internationally comparable (?)

Systematic conception—what

Domains

1. **Data—cognitive, mental power**
2. **People—interpersonal**
3. **Things—physical, muscle power**
4. **Technology use**
5. **Management duties**
6. **Work organization, worker autonomy**

Cognitive tasks/skills the focus here

- **Focus of most study and policy (e.g., education) interest**
- **High impact, especially on wages**
- **Among the easier to measure**

Measurement approach—how

1. **Item generality**
   - **Highly general questions**
     - **Pro—apply to wide variety of jobs**
     - **Cons—lacks specific content, too holistic, no frame of reference for respondents, i.e., <u>abstraction → subjective responses</u>**

   - **Highly specific questions**
     - **Pro—relatively unambiguous meaning**
     - **Con—too many occupations (ca. 500) to support items with such narrow scope**

   - **Moderately general items strike right balance**
     - **transversal skills**
     - **broadly applicable to diverse occupations**
     - **concrete meaning, absolute referent rather than arbitrary rating → low ambiguity, <u>more objective</u> (less error variance?)**

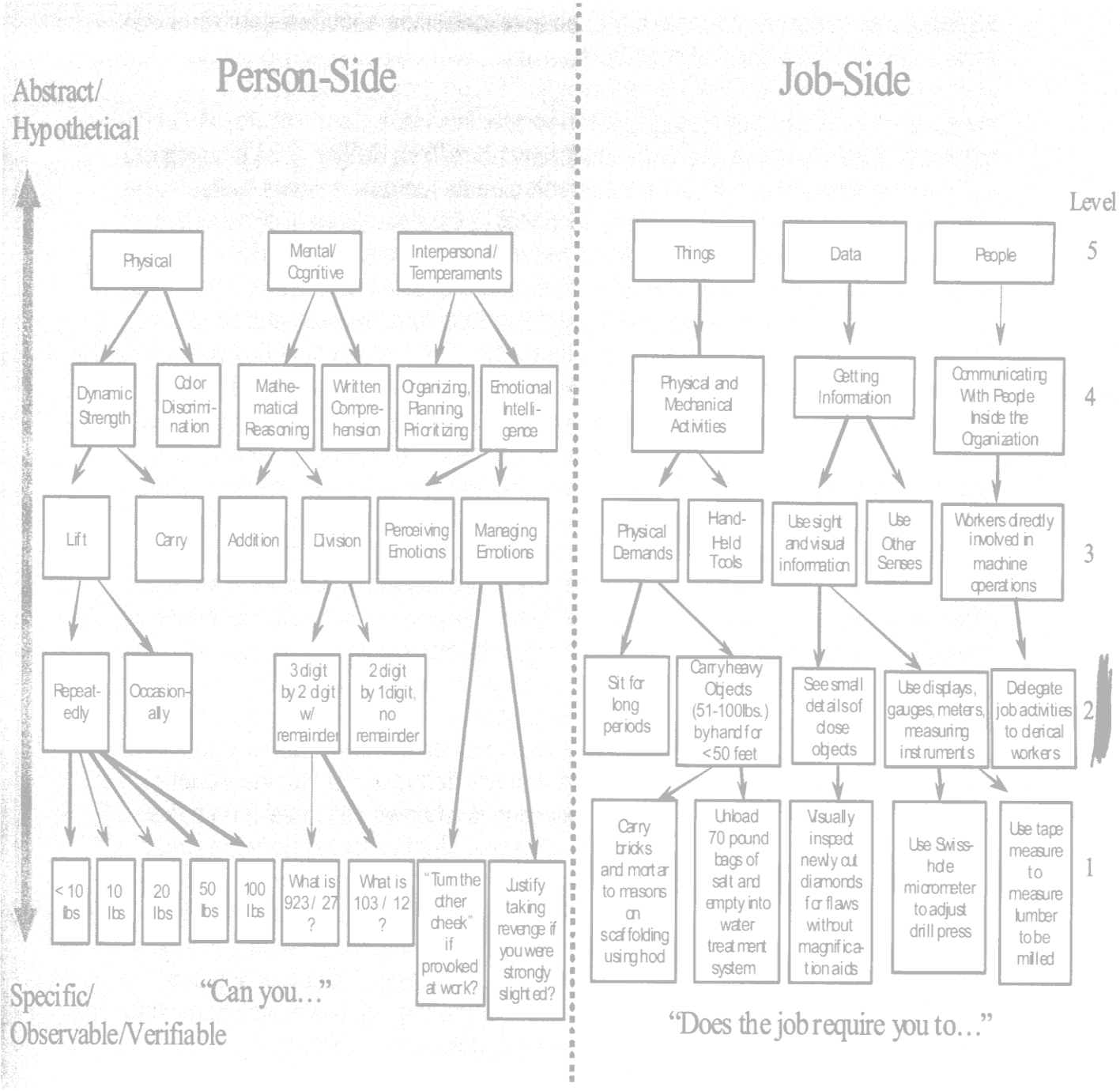
2. **Measure job task on same scale as person competencies—otherwise comparison impossible, (e.g., mismatch?), policy relevance limited**

3. **Ideally, hierarchy of items along clear complexity/ difficulty gradient (but sometimes variables are qualitative, e.g., interpersonal tasks)**

Occupational Information Development Advisory Panel

Content Model and Classification Recommendations

Figure 1. Levels of data specificity within the "person side" and "work side" domains of the "world of work"



Measurement—explicit scaling

1. **Measure facts, events, and behaviors of moderate to high generality**
2. **Avoid evaluations and holistic judgments**
3. **Use concrete response scales (e.g., frequency, time spent)**
4. **Avoid vague quantifiers and rating scales whenever possible**
5. **Measure hierarchy of complexity, avoid floor and ceiling effects**
6. **Cover domain as fully as possible**

But survey time and resource constraints never fully overcome

- **Some job functions too subtle/multi-faceted to specify concretely**
- **E.g., workload and autonomy concepts are generic but operational measures are occupation-specific**

Example—Cognitive skills

Measures should cover domain

	Source of skills		
	Education	Work	Other
General	Required ed.		
	Read, write, math		
	Prob. solving		Prob. solving
	Training		
Occptn-	Field of study	reqd. exp.	
specific	Training	Learning time	

Hierarchy of objective (factual) items

Policy relevant

Job measures comparable to person measures, e.g. covers key school subjects, focus of testing

Captures diverse occupation-specific skills

Table 2. Math, Reading, Writing, and Document Use (percentage)

	All	Hi WC	Lo WC	Upper BC	Low BC	Service
Percentage (weight)	100	36.1	25.4	10.3	13.0	15.1
N (unweighted)	2,304	1,010	569	161	271	291
Math (α=0.81)						
1. Any math	0.94	0.95	0.97	0.94	0.91	0.88
2. Add/subtract	0.86	0.93	0.90	0.87	0.78	0.73
3. Multiply/divide	0.78	0.89	0.82	0.81	0.65	0.57
4. Fractions	0.68	0.82	0.68	0.70	0.58	0.40
Any more advanced	0.22	0.35	0.09	0.41	0.19	0.04
5. Algebra (basic)	0.19	0.30	0.08	0.36	0.16	0.04
6. Geometry/trig	0.14	0.20	0.05	0.29	0.15	0.02
7. Statistics	0.11	0.22	0.05	0.10	0.06	0.02
8. Algebra (complex)	0.09	0.14	0.03	0.16	0.08	0.02
9. Calculus	0.05	0.08	0.01	0.08	0.05	0.01
Reading (α=0.80)						
1. Any reading	0.96	0.99	0.97	0.91	0.91	0.95
2. One page	0.82	0.96	0.86	0.72	0.57	0.67
3. Five pages	0.54	0.81	0.47	0.46	0.26	0.32
4. News articles	0.42	0.64	0.37	0.27	0.21	0.24
5. Prof'l articles	0.38	0.65	0.26	0.24	0.15	0.23
6. Books	0.53	0.76	0.40	0.53	0.35	0.38
Writing (α=0.64)						
1. Any writing	0.91	0.99	0.93	0.83	0.80	0.83
2. One page	0.61	0.86	0.56	0.46	0.36	0.41
3. Five pages	0.24	0.47	0.13	0.12	0.07	0.09
4. News articles	0.09	0.20	0.04	0.01	0.04	0.03
5. Books/prof'l arts	0.03	0.07	0.00	0.00	0.00	0.02

Items generally in a hierarchy of difficulty—values decline as one reads down and across

Substantively, occupations shown how they differ in their cognitive task complexity

How do the academic skills relate to levels of required and personal education?

Correlations of required and attained education with skill scales and wages

	Required	Attained	Difference
Math	0.42	0.32	0.10
Reading	0.64	0.51	0.13
Writing	0.61	0.51	0.10
Problem	0.45	0.36	0.09
IT use (users)	0.43	0.31	0.12
IT use (all)	0.56	0.45	0.11
EI	0.10	0.13	-0.03
Wages	0.59	0.45	0.14
Interpersonal	0.48	0.39	0.09

Correlation between the education measures: 0.72

Required education is

- **generally good measure of the skills people use on their jobs**
- **always better than personal education**
- **much better measure of job rewards**

Math, Reading, Writing, and Problem solving on job by required education
(percentages, except problem solving)

	All	<HS	HS	HS + voc	<BA	BA	Grad
Math							
1. Add/subtract	86	60	85	87	91	95	94
2. Multiply/divide	78	43	74	80	84	93	93
3. Fractions, decimals	68	22	58	81	76	87	90
Any more advanced	22	2	11	37	21	43	47
4. Algebra (basic)	19	2	10	30	17	37	42
5. Geometry/trig	14	2	7	27	12	24	25
6. Statistics	11	1	2	9	10	26	41
7. Algebra (complex)	9	2	4	14	6	18	23
8. Calculus	5	0	2	1	3	9	16
Reading							
1. Any reading	96	80	96	97	99	100	100
2. One page	82	35	75	85	95	99	99
3. Five pages	54	13	35	55	67	86	97
4. News articles, et al.	42	8	25	37	49	72	87
5. Professional articles	38	7	18	33	49	70	91
6. Books	53	11	38	55	64	82	85
Writing							
1. Any writing	91	62	88	92	98	100	100
2. One page	61	15	44	54	76	92	97
3. Five pages	24	3	9	13	22	54	72
4. News articles, et al.	9	3	3	2	6	22	40
5. Books/prof'l arts	3	3	0	1	1	5	24
Problem solving							
Easy (1=never, 4=often)	3.5	2.9	3.3	3.6	3.7	3.8	3.8
Hard (1=never, 4=often)	2.9	2.0	2.5	2.8	3.1	3.3	3.4
No. of hard problems	4.8	1.2	3.9	3.9	5.8	6.1	7.5

Table 4. Trends in education required by job 1969-2005
(percentage)

	SWC/QES			PSID		STAMP
	1969	1972	1977	1976	1985	2005
< HS	36.1	24.3	21.4	27.0	13.2	6.0
HS	25.6	43.7	43.9	42.5	40.0	39.3
HS+Voc	12.6	--	--	--	6.1	6.3
< BA	9.0	14.4	17.1	7.9	10.2	17.1
BA	10.2	9.8	10.6	17.1	23.4	23.8
Grad	6.6	7.8	7.0	5.5	7.1	7.5
N	1,033	982	861	3,250	4,509	1,885

Samples restricted to workers over 25 working at least 20 hours per week for comparability. All figures use sample weights.

Sources: Survey of Working Conditions (1969), Quality of Employment Surveys (1972, 1977), and Panel Study of Income Dynamics (1976, 1985), Survey of Skills, Technology, and Management Practices (2005)

Trend toward jobs requiring more education, but

- **not more rapid in recent era**
- **lots of non-college jobs remain**
- **little change in Grad degree category**
- **educational requirements track trends in attainment, may be partly endogenous to supply**

Table 3. Distributions of Educational Attainment and Required Education, and Rates of Mismatch (percentage)

Aggregate distribution	Attained	Required	A – R
<HS	9.0	7.6	1.4
HS	25.9	42.6	-16.7
HS+voc	5.7	6.3	-0.6
<BA	29.1	16.5	12.6
BA	20.0	20.8	-0.8
Grad	10.3	6.3	4.0
Individual matches	**All**	**30≤Age≤59**	
Under-educated	13.2	14.1	
Matched	55.3	57.4	
Over-educated	31.5	28.6	

This suggests:

1. **Lots of people have HS, <BA, BA**
2. **Jobs similar, tilted more to HS level**
3. **Lots of people with some college in HS jobs**
4. **Sig. fraction of Grad deg. holders consider jobs don't require them**
5. **Apparent mismatches not due to age**

Required vs. Actual Education

	Required						
Actual	< HS	HS	HS + voc	< BA	BA	Grad	**Total**
< HS	53	9	6	0	1	0	9
HS	25	47	25	11	3	0	26
HS + voc	1	5	37	5	1	0	6
< BA	21	29	29	66	13	1	29
BA	1	8	4	16	62	15	20
Grad	0	1	1	2	21	83	10
Total	100	100	100	100	100	100	100

	Required						
Actual	< HS	HS	HS + voc	< BA	BA	Grad	**Total**
< HS	47	45	4	1	3	0	100
HS	7	78	6	7	2	0	100
HS + voc	1	40	40	15	4	0	100
< BA	5	42	6	37	9	0	100
BA	0	17	1	13	63	5	100
Grad	0	5	0	3	41	50	100
Total	8	43	6	16	21	6	100

	Required						
Actual	< HS	HS	HS + voc	< BA	BA	Grad	**Total**
< HS	4	4	0	0	0	0	9
HS	2	20	2	2	1	0	26
HS + voc	0	2	2	1	0	0	6
< BA	2	12	2	11	3	0	29
BA	0	3	0	3	13	1	20
Grad	0	1	0	0	4	5	10
Total	8	43	6	16	21	6	100

Bottom lines

Where do people go?

1. **Those with <HS are in jobs at <HS or HS level**
2. **HS grads usually well-matched**

3. **Over half with <BA in jobs below that level**
4. **Some BA holders in HS jobs (18%)**
5. **Only half of Grad holders in Grad jobs**

Where are people drawn from?

1. **Many <HS and HS jobs filled by people 1 or 2 levels up (40%)—over-education?**

2. **Higher-level jobs draw mostly from expected attainment groups—people saying their jobs require high education usually have it, but we still don't know what they are doing on the job**

Biggest anomalies are those with <BA in HS jobs and those with Grad degrees in BA-level jobs

Required education and occupation

	Required						
	< HS	HS	HS + voc	< BA	BA	Grad	**Total**
High WC	7	13	13	40	81	97	36
Low WC	19	35	18	34	12	1	26
High BC	10	12	36	9	2	0	10
Low BC	29	19	17	6	2	1	13
Service	35	21	16	10	3	1	15
Total	100	100	100	100	100	100	100

	Required						
	< HS	HS	HS + voc	< BA	BA	Grad	**Total**
High WC	1	16	2	18	46	17	100
Low WC	6	58	4	22	10	0	100
High BC	8	51	22	15	3	0	100
Low BC	17	63	8	8	3	0	100
Service	18	59	7	12	5	0	100
Total	8	43	6	17	21	6	100

	Required						
	< HS	HS	HS + voc	< BA	BA	Grad	**Total**
High WC	1	6	1	7	17	6	36
Low WC	1	15	1	6	3	0	26
High BC	1	5	2	2	0	0	10
Low BC	2	8	1	1	0	0	13
Service	3	9	1	2	1	0	15
Total	8	43	6	17	21	6	100

Bottom lines

- College-level jobs are overwhelmingly upper white collar—self-reported required education fits the occupation report

- No basis to believe that many blue-collar jobs require college education

- Some craft jobs require some college, but more require HS+voc or below, as is traditional

- For all occupations below upper white-collar, HS is clearly the dominant required education level

➢ Nothing looks too surprising in terms of education requirements within occupations

but

➢ occupational composition of employment more consistent with Knowledge Society

36% high WC, 26% lo WC, 38% BC + service

Bottom lines

- Required education tells us a lot about the academic skills used on the job
  - When people say jobs only require HS or don't require a Grad degree, probably reasonable assessment
- Task-level skill measures get us inside the black box

Generally speaking,

- jobs requiring HS and below don't require any HS math on the job, or reading 5-page or writing 1-page documents, and only sometimes have to solve easy problems
- jobs requiring some college usually don't require any HS math on the job or writing 5-page documents, but more often require college-level reading and hard problem solving
- jobs requiring a BA usually require college-level reading but only half require writing 5-page documents and <10% require calculus or similar math

- Need to specify concepts like "Knowledge Economy" to be meaningful

So, education and academic skills matter for work, but

- **many people are in jobs that don't require their education level, even at the Graduate degree level**

- **the level of foundation skills used is often not high**

<u>Caveats</u>: This covers only foundation skills, not field of study, which may show much higher use on the job

It doesn't cover training, when use of reading and problem solving might be more important.

Broader implications

Objective, policy-relevant measures of job requirements are feasible and meaningful

An international time series of job requirements should be part of an agenda for an expanded set of economic and social indicators, including such things as precarity, mobility, etc.

Broader cautions

- Solid general education widens range of occupational choices open to students, even if skills never used again

- Benefits of general education go beyond work
  - socio-emotional and general cognitive development
  - appreciation of knowledge
  - effective citizenship
  - social cohesion

➢ And possible that if jobs were upgraded in general literacy skills in future, productivity and wage growth would result

➢ Still, current U.S. standard of living results from jobs performed as portrayed