

Scientific Learning.

RUTGERS
THE STATE UNIVERSITY OF NEW JERSEY

UCSD



VANDERBILT UNIVERSITY



SAN DIEGO STATE UNIVERSITY



BROWN



Temporal Dynamics of Learning Center

Colorado
University of Colorado at Boulder

The Preuss School
UCSD



SALK INSTITUTE
FOR BIOLOGICAL STUDIES

Berkeley
University of California

All Hands Meeting 2009

Carnegie Mellon



Penn
UNIVERSITY OF PENNSYLVANIA

UCSD Early Childhood Education Center



University of Pittsburgh



University of Victoria



THE UNIVERSITY OF QUEENSLAND
AUSTRALIA



reachfortomorrow



Jensen Learning
Practical, scientific teaching
www.jensenlearning.com

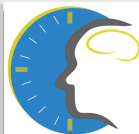
Temporal Dynamics of Learning Center



The State of the Center

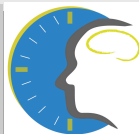
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- This is a number that will be important in your life soon....



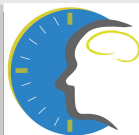
The State of the Center

- How we are perceived
- How we are
- What we would like to become



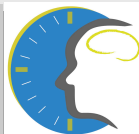
The State of the Center

- How we are perceived
 - We are now the “flagship” center in the SLC program
 - Other Centers are told to use our SIP as a model
 - The National Science Board was very enthusiastic about the Network of Research Networks concept
 - NSF started an SLC Network composed of all six centers
 - I am the current chair
 - Goal is to promote inter-center collaboration and activity
 - We in the process of trying to get a grant for The Science Network to promote the SLC program’s science through a “Science Roadshow”



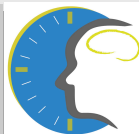
The State of the Center

- How we are:
 - Networks
 - Initiatives
 - Funding
 - External Funding



Reminder: Our Purpose

- No less than to develop a new **Science of the Temporal Dynamics of Learning**
- Change educational *practice* based on sound science.
- To do this by creating a new collaborative research structure, the *network of networks*, to transform the practice of science



What are the components of a science of the temporal dynamics of learning?

A complete science of temporal dynamics of learning would include how we learn:

- To adapt to the **input** (the temporal dynamics of the world)
- To adapt our **outputs** (the temporal dynamics of action)
- And how the brain in between these accomplishes this (**the temporal dynamics of the brain**)
- But a science requires formalism (**the theory of temporal learning**)

These, *mutatis mutandis*, are our four research initiatives.



TEMPORAL DYNAMICS OF THE WORLD

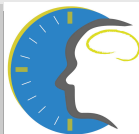
TEMPORAL
DYNAMICS OF
LEARNING

TDLIC
Initiatives

TEMPORAL
DYNAMICS OF
THE BRAIN

TEMPORAL DYNAMICS OF MOVEMENT
AND EXPLORATION

Temporal Dynamics of Learning Center

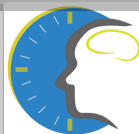


The State of the Center

Interweaving Initiatives & Networks


Each research network has a coherent focus; the initiatives weave them together:

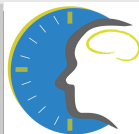
- **The goal of network meetings is to synchronize research *within networks***
- **Initiative meetings - here, at the All-Hands Meeting - will synchronize research *between networks*.**
- **This creates the coherence - the synergy - the *je ne sais quoi* - that makes the whole greater than the sum of its parts**



Networks and Initiatives: The weft and the warp of the Center

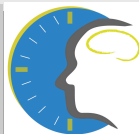
Research Networks

		Perceptual Expertise	Social Interaction	Sensory Motor	Memory Systems
		Research Initiatives	1. Input		
2. Brain					
3. Output					
4. Learning					



The State of the Center

- How we are:
 - **Networks**
 - Initiatives
 - Funding
 - External Funding



The Network-of-Networks

UC San Diego

Rutgers
University

Vanderbilt
University

UC Berkeley

University of
Colorado

The Salk Institute

Queensland
University

Victoria
University

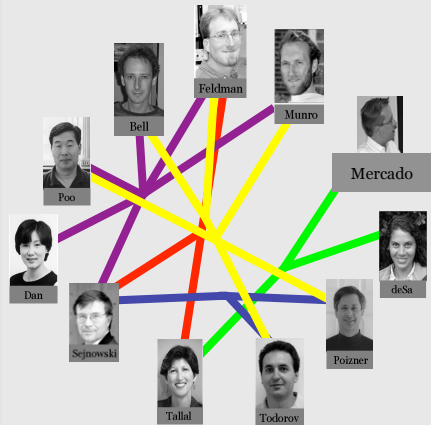
Brown
University

Carnegie-Melon
University

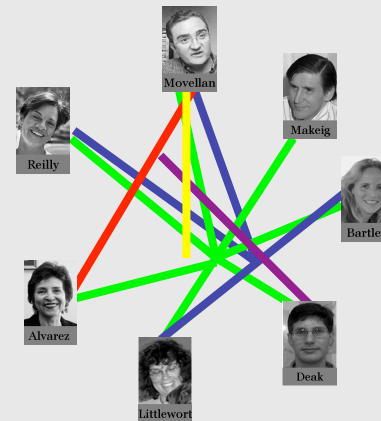
Yale University

San Diego State
University

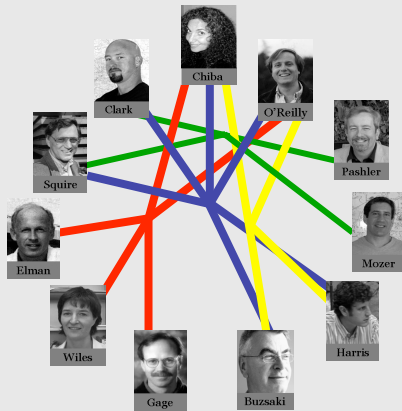
SensoriMotor Network



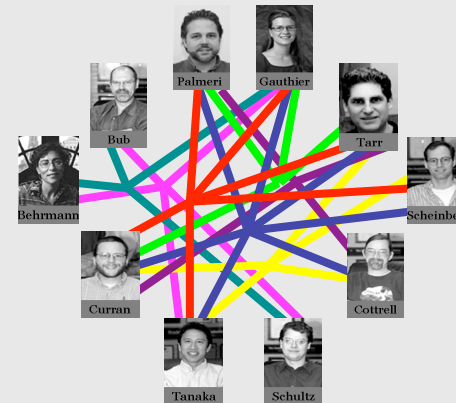
Social Interaction Network



Bridge
Members



Interacting Memory Systems



Perceptual Expertise Network

Mathematics

Physics

Machine
Learning

Robotics

Computer
Science

Computational
Neuroscience

Neuroscience

Cognitive Science

Linguistics

Neuropsychology

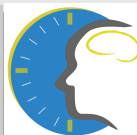
Cognitive
Psychology

Developmental
Psychology

Learning Theory

Education

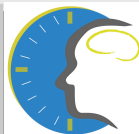
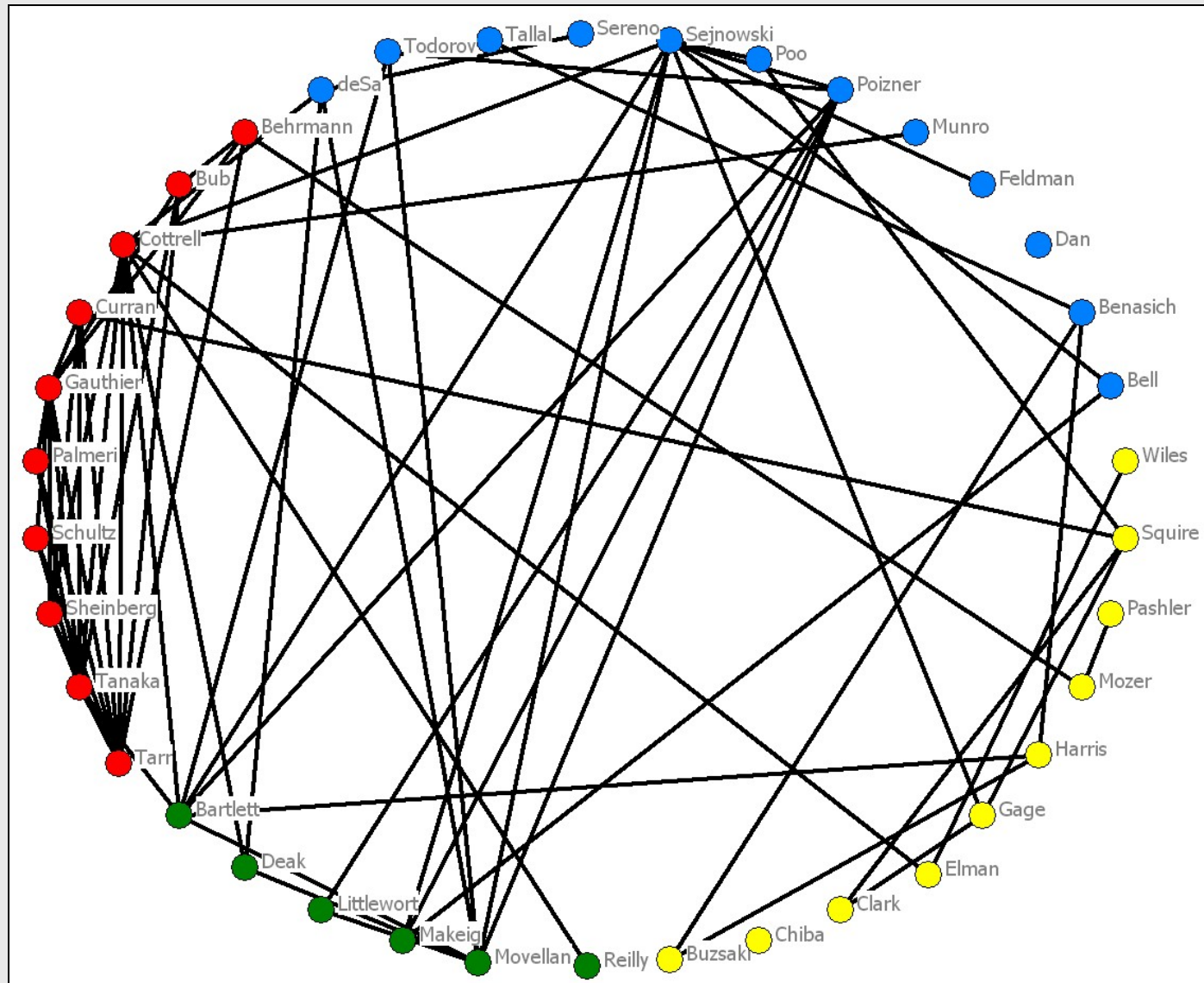
Temporal Dynamics of Learning Center



The State of the Center

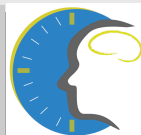
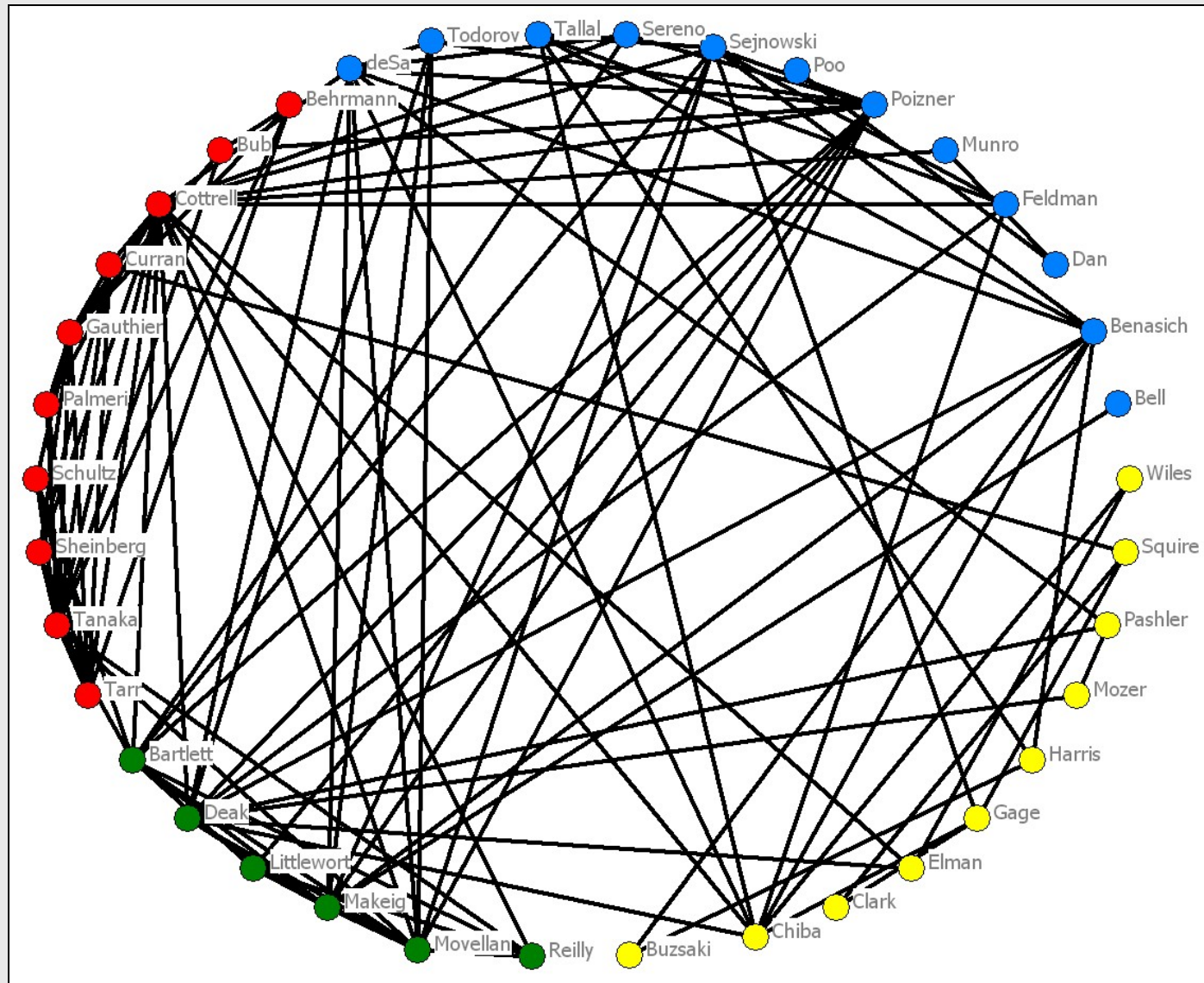
Collaborations, circa 2005

2005



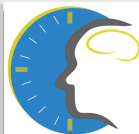
Collaborations, circa 2008

2008



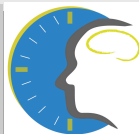
The State of the Center

- How we are:
 - Networks
 - **Initiatives**
 - Funding
 - External Funding



How are the Initiatives progressing?

- We'll find out tomorrow!
 - We have reorganized the Strategic and Implementation Plan (SIP) to better reflect the science
 - and as usual, NSF approved it right away (this NEVER happens to other centers...)
 - Initiative 1 has a new strand on spacing effects; Initiative 2 has a new strand on decision dynamics.
- ⇒ our science is becoming more focused.



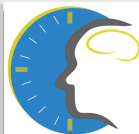
The State of the Center

- How we are:
 - Networks
 - Initiatives
 - **Funding**
 - External Funding



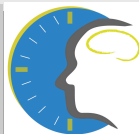
The State of the Center: Funding

- We achieved **full funding** this year!!
- (***Audience applauds***)
- Outside collaborators have received many supplements
- Remember, if you know someone you would like to collaborate with on Center science, *and* they have an NSF grant, they can get 20% more money from NSF to work with you!



The State of the Center

- How we are:
 - Networks
 - Initiatives
 - Funding
 - **External Funding**



The State of the Center: External Funding

- Equipment:

- MoCap (Howard) received **\$1M** from ONR
- SIN (Javier) received **\$.5M** from ONR

⇒ ONR seems to be our friend! If you have major equipment needs, and aren't like me (a leftover from the new left), consider ONR!

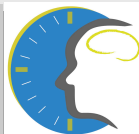
- Research:

- We received one NIH supplement this year (an infinity improvement from last year when we received zero).
- Many of us are applying for research grants based on Center Science.
- We have a 4/7 chance of putting in an IGERT this year
- We will apply for an REU site



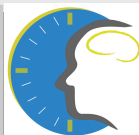
The State of the Center

- How we are perceived
- How we are
- **What we would like to become (from Gary's point of view)**



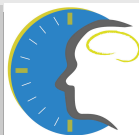
Synchronizing our Research

- We sold ourselves to NSF based on the Perceptual Expertise Network model
- In PEN, we started by learning each other's vocabulary and research perspectives
- Then we worked to *synchronize our research* to answer the questions of what constituted a perceptual expert and what the processes were that led to perceptual expertise



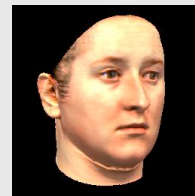
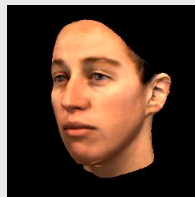
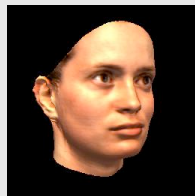
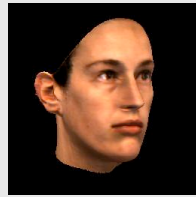
Synchronizing our Research

- For example, we tried to come up with an experimental paradigm that we could run *virtually unchanged* in humans, patients, monkeys and neural nets.
- We came up with the *two-button perceptual expertise task*, mostly limited by what we thought monkeys could do: Sort these two *arbitrary sets of exemplars* into two categories.
- In order to do so, we thought the monkeys *et al.* would have to pay attention to the exemplars - individuate them.

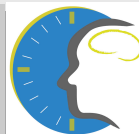


The two button task (example)

Category A



Category B



Synchronizing our Research

- Unfortunately, the task was ***too easy*** - neural networks and monkeys did not show any expertise effects from doing the task.
- In hindsight, we should have realized there was no ***generalizable knowledge*** in making arbitrary distinctions.
- But other attempts did work - e.g., we have made neurophysiological predictions about the response properties of neurons in the Fusiform Face Area based on our neural network model of expertise



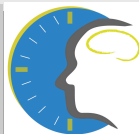
Synchronizing **Center** Research

- TDLC needs to make better attempts to synchronize our research
- It has been 4 years since we spent that long night at our first site visit coming up with **slow world/fast world**:
- A paradigm we can use in multiple preparations: Humans, monkeys, rats, neural nets, probabilistic models
- The world is a probabilistic environment with ***the time constant the primary experimental variable***



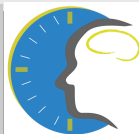
Slow World/Fast World

- Alter the time constants of experimental world.
- Find empirical curves relating time constants to performance and how these curves change throughout learning.
- Find general principles that explain these functional forms across domains.



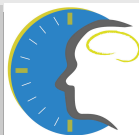
Slow World/Fast World (rat version)

- A statistical model (HMM) will be used to generate an operant world with changing temporal demands.
- The model will build spatial probability states.
- The rat's ability to abstract the regularities of the operant world will be examined under different temporal demands.
- These temporal demands will change with the state of the model.



Slow World/Fast World

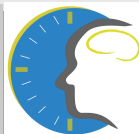
- If the same principle works across domains then the resultant research will have generated insights for thinking about how nature solves difficult prediction problems in different time scales on a wide range of domains.



My point

We should be thinking about experimental paradigms like this that we can ***all*** do...

And that are essentially the ***same*** experiment across multiple species.



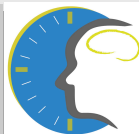
Fun

- We should be seeking **novelty** in our research -
- So I can't help but show off this cool demo of a novelty-seeking salience map
- Nick will explain how it works in his talk



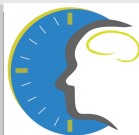
Schedule

- MEMORY
- 9:15--9:45 Mike Mozer and Hal Pashler: Mechanisms of the distributed practice effect
- 9:45-10:05 Tim Curran: Spaced learning enhances perceptual expertise training (Init 1, PEN)
- 10:05-10:25 Janet Wiles: What is the role of new neurons in DG? (Init 2, IMS)
- 10:30-10:45: Coffee break



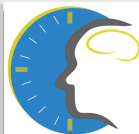
Schedule

- MEMORY, EYE MOVEMENTS, and the whole enchilada
- 10:45- 11:05: Christine Smith: Experience-dependent eye movements reflect hippocampus-dependent (aware) memory (Init 2, IMS)
- 11:05-11:35 Nick Butko: Models of salience and eye movements (Init 3, PEN, SIN)
- 11:35-11:55 Tony Bell: Towards a Cross-Level Theory of Neural Learning (Init 4, SMN)



Schedule

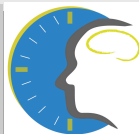
- 12:00-1:00 Lunch (Foyer outside auditorium)
- 1:00-1:30 Birds of a Feather 1: Time to meet with fellow collaborators to plan experiments (obviously, use lunch for this too!)



Schedule

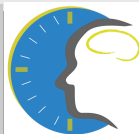
- BRAIN DYNAMICS
- 1:30-2:00 Dan Feldman: Precise spike timing and reliability in neural encoding of low-level sensory stimuli and sequences (Init 1, SMN)
- 2:05-2:25 Yang Dan: Burst spiking of a single cortical neuron modifies global brain state. (Init 2, SMN)
- MOTOR CONTROL
- 2:25-2:45 Emo Todorov: Optimal control (Init 3, SMN)
- 2:45-3:15 Dan Bub & Tim Curran, Grasping Beer Mugs: On the Dynamics of Alignment Effects Induced by Handled Objects (Init 3, PEN)

- 3:15-3:30: Coffee break

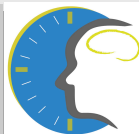


Schedule

- 3:30-4:30 Invited Speaker: George Alvarez: The Fidelity of Visual Long-term Memory
- 4:30-5:00 Discussion
- 5:00: return to La Jolla Shores (SHUTTLE)
- 6-7 Meeting between EC and AB (dinner, CSE Building room 4109)
- 6:15 SHUTTLE BRINGS YOU BACK HERE
- 6:30-9:00 Posters, heavy hors d'oeuvres FOURTH FLOOR



*Life passes in milliseconds,
but what we learn
in those milliseconds
changes us for life.*



happy new year

May 2008 bring you more -- TIME.

Obviously not jail time!

Prime time.

I'm alive time.

I'm just fine thank you time.

I'm really here time.

I'm dear (even to me) time.

More groovin' time.

Less provin' time.

More aah that's yummy time.

Less oy my tummy time.

More swayin' and movin' time.

Less sittin' in one and the same place time.

More croonin' time.

Less off key and out of sorts time.

More swoonin' time.

Less behoovin' time.

Occasional moonin' time.

Less where's my time gone to time.

More I'm in charge of my own time time.

Less serving time and more deserving time.

More rhyme time or non-rhyme time

Just more time time.

And, if not any of these types of time

then at least the perception of more time time.

-Marta Kutas

