Walking and Talking: Dual Task Effects on Neurogenic Disfluency

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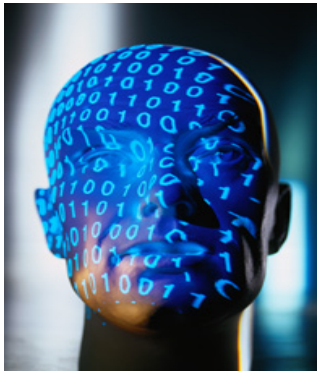
Distribution of Duties in this Tag Team Match

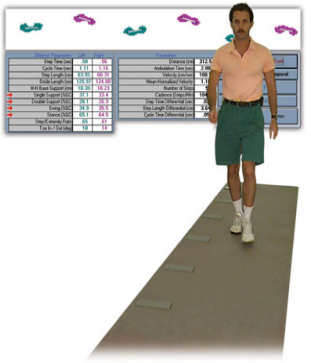
- LaPointe – Intro and setup
- Scott – Neurogenic stuttering and basal ganglia
- Stierwalt – Methods of measuring effects of cognitive load on gait and balance in PD
- Holt – Case example of disrupted fluency and respiration during cognitive load demands

Tallahassee Memorial HealthCare - Florida State University

Neurolinguistic - Neurocognitive

Rehabilitation Research Center





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Cognitive-Linguistic Interactions in Neurological Disease

New Directions in Cognitive Assessment

Distraction, Competition, Interference

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Specific Focus

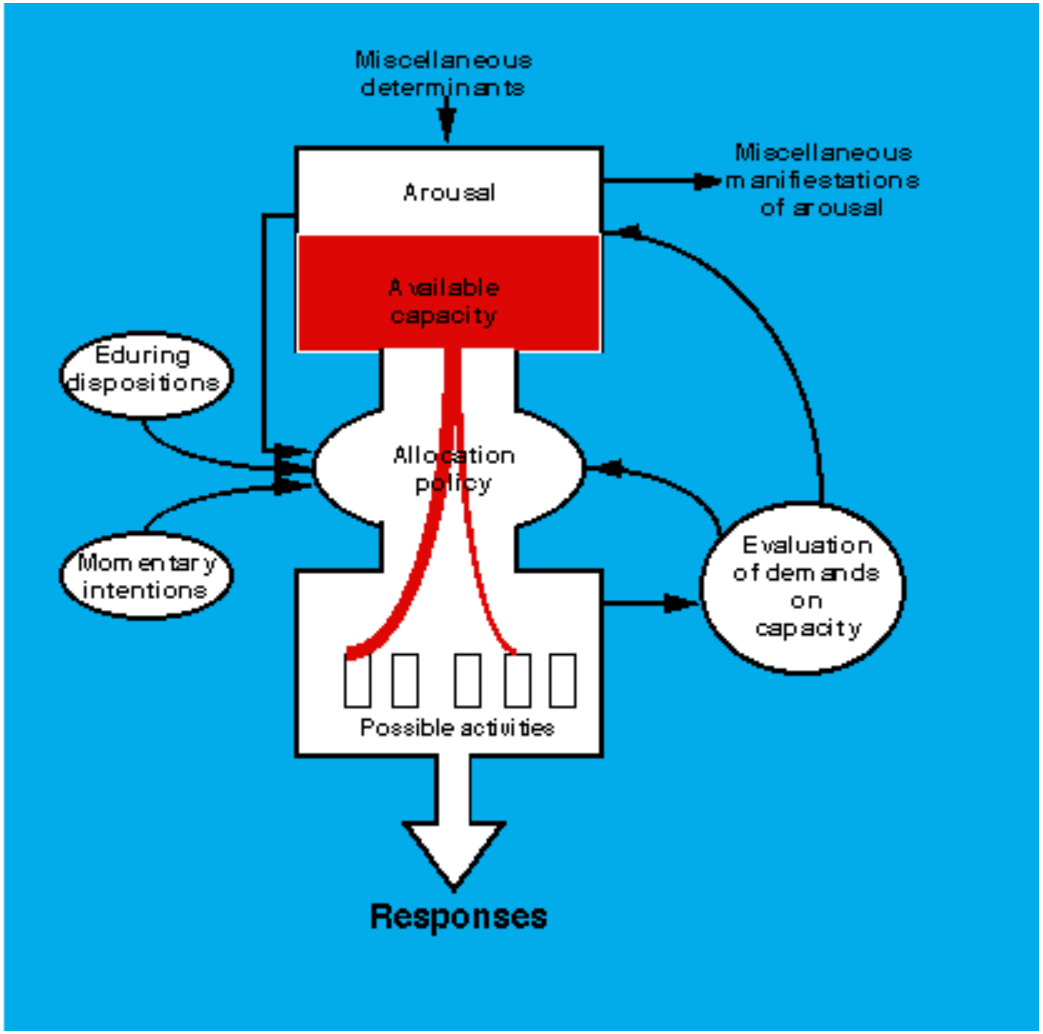
- Effects of distraction, interference, competition on cognitive and linguistic performance

- Examples of distraction in our research
  - Cafeteria noise
  - 4-talker babble

Theoretic Groundings

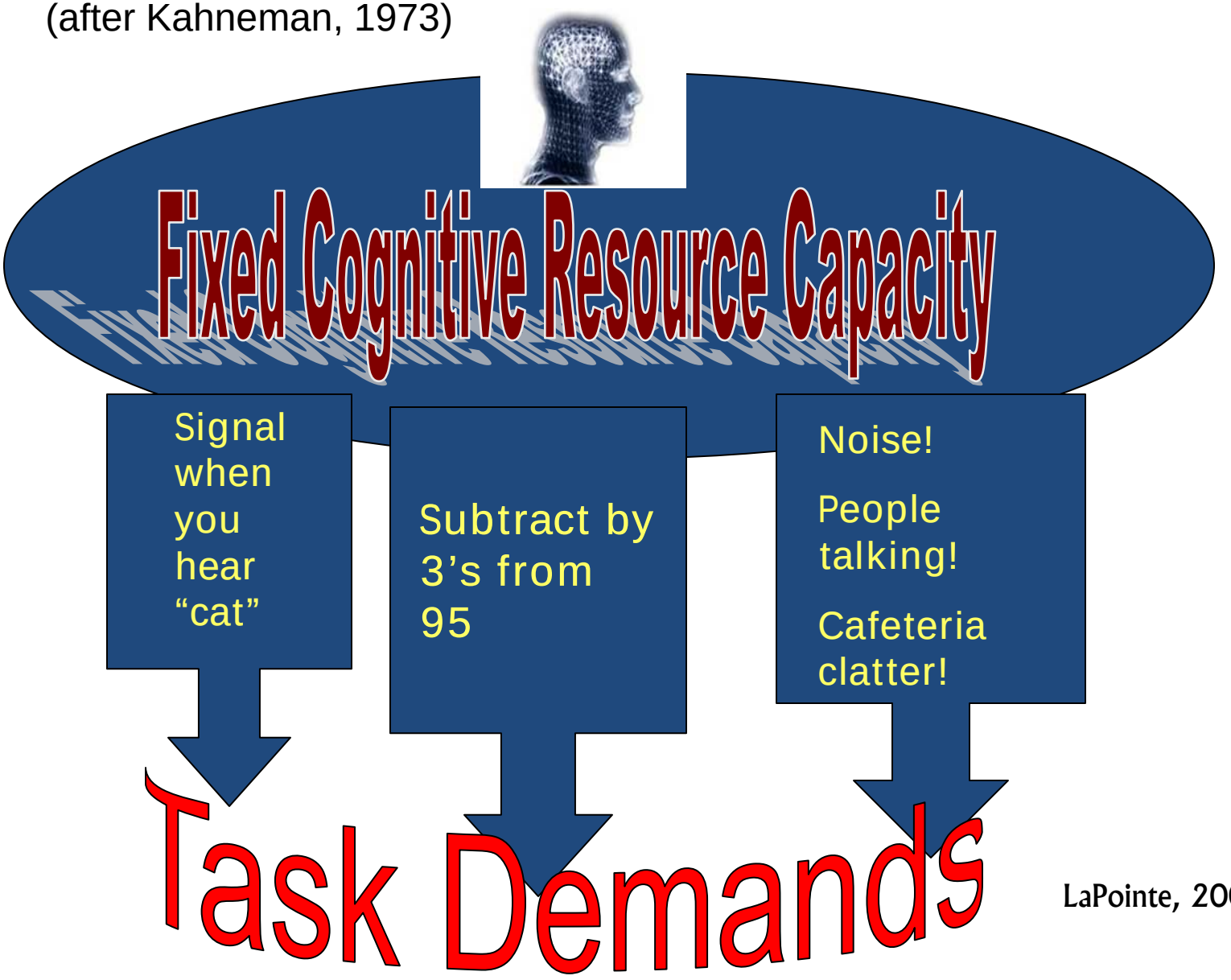
- Cognitive-linguistic interactions
- Cognitive resource allocation theory (Kahneman, 1973)
- Cognitive systems models of signal extraction from interference, competition, distraction (Welford, 1998; Endsley, 1999)
- Intersystemic Reorganization (Luria, 1970; and a host of others)

Kahneman Model: Cognitive Resource Allocation



Cognitive Resource Allocation Model

(after Kahneman, 1973)



LaPointe, 2004

Automatic and Controlled Processing

Automatic Processing

- Do not require attentional resources
- Occur without intention
- Not available for conscious inspection
- Well practiced responses
- Fast

Controlled Processing

- Require resources
- Require conscious intention
- Conscious activities
- Not well practiced
- Slow

For Example…

Automatic Processes

- Walking
- Freeway driving
- Recognition of common words
- Counting, alphabet
- Boring, repetitive tasks

Controlled Processes

- Walking a tightrope or on stones across a stream
- Freeway driving during a thunderstorm
- Recognition of rare words
- Tracking digits and alphabet ("D 8…continue the sequence")

Models of Cognition During Distraction: Lots of Questions, Testable Hypotheses

- Distraction effects on working memory?
- Interference and competition effects on executive function?
- Does conversational coherence disintegrate with distraction…or during ambulation?
  - Kimberly Wilson, doc student, FSU
- Does aging affect distraction tolerance?
- Distraction and dual task effects across clinical populations
- What are the reciprocal effects of multitasking or distraction on linguistic processing and motor activity?
- How does intersystemic manipulation affect fluency?

A.R. Luria

- Alexander Romanovich Luria (1902-Aug 14, 1977…2 days before Elvis perished)
- Giant of cognitive science and neuropsychology
- Studied twins, genetics, cultural influences on brain damage, mental functions in ontogeny and phylogeny…and shattered minds left with aphasia
- Deeply studied intra- and inter-individual differences in aphasia and compensatory strategies of treatment of aphasia

Intersystemic Reorganization:
Rich Tradition in Communication Disorders

- Apraxia of speech (AOS) (Rubow, et al, 1985; Wertz, LaPointe, Rosenbek, 1989)
- Intersystemic reorganization in the treatment of AOS involves pairing fragments of a speech motor program with internal cues generated by some other, more intact system
  - provides an organizational framework for the proper sequencing of motor speech movements
    - Gestural reorganization
    - Pairing speech with limb gestures
    - Vibrotactile stimulation

Intersystemic Reorganization: Aphasia

- Luria (1970)
  - Train intact systems with rhythm, pacing, walking, gestures to activate impaired language systems
- Skelly (1980)
  - AMERIND gestures improved naming
- Rosenbek, LaPointe, Wertz (1989)
  - Summary of intersystemic facilitation
- Pashek (1998)
  - Improved naming with gestural training
- Crosson et al (2002)
  - Non meaningful limb movements to stimulate naming
- Helm-Estabrooks (2002)
  - Luria-based theories of reorganization of language
- Raymer (2005)
  - Great summary of intersystemic facilitation for naming
- Kim, Stierwalt, LaPointe (2007)
  - Spontaneous gestures for word retrieval in TBI

Intersystemic Reorganization: Dysarthria

Murdoch, 1998; Yorkston, et al,1999; Duffy, 2005

- Pacing
- Tapping
- Slapping
- Dancing
- Slap-dancing
- Other rhythmic activities

Prior Evidence of Cross systemic Fluency Effects?

- Gated speech (metronomes)
- Choral reading
- Pitch shift
- Acting (different character or voice)
- Delayed Auditory Feedback
- Singing
- Dysfluency on wind instruments
- Dysfluency during signing (ASL)

Neurogenic Stuttering

- Disfluency patterns are reported to be different from developmental stuttering
  - Word initial, medial, and final positions
  - Distribution across grammatical classes
  - Little/no anxiety about disfluency
  - No adaptation
  - Lower incidence of secondary behaviors
  - Disfluent across all speech tasks

(Jokel, De Nil, & Sharpe, 2007; Manning, 2001)

Parkinsonism & Neurogenic Stuttering

- One of the progressive neurological diseases in which disfluency has been observed

  (Carluer, Marie, Defer, Coskun, & Rossa, 2000; Ciabarra, Elkind, Roberts, & Marshall, 2000; Duffy, 2005; Goberman & Blomgren, 2003; Leder, 1996; Koller, 1983; Shahed & Jankovic, 2001)

- These reports have contributed to the increased interest in the roles of
  1. the basal ganglia and
  2. dopamine metabolism

  in deepening our understanding of

How Does Stuttering Relate To Movement Disorders?

- If
  - The basal ganglia are related to movement disorders like the dystonias and Parkinsonism, and
  - Increasingly, the basal ganglia are implicated as having a role in stuttering
- Then
  - Understanding disfluency in movement disorders and the factors that influence it may help us increase our understanding of the relationship between the basal ganglia and stuttering

Possible Factors

- Changes in linguistic demand
  - Kleinow & Smith (2000) compared utterances that varied in length to those that varied in linguistic complexity
    - Utterances that were more complex were more likely to contain stuttering
    - Asserted that language formulation processes may affect speech production processes and the speech motor systems of adults who stutter may be especially susceptible to linguistic demands
- Dual task demands
  - Vasic & Wijnen (2005) found that
    1. performing a secondary, non-linguistic task during speaking suppresses disfluency, particularly blocking, in persons who stutter;
    2. forcing focus toward the lexical content of the output of the production mechanism also reduces disfluency.

- Bosshardt (2006)
  - Asserted that the speech of stuttering persons is sensitive to concurrent cognitive processing interference, especially if that processing involves phonlogical coding
  - Found that under dual-task conditions stuttering persons produced sentences containing a smaller number of content units
    - Persons who do not stutter did not show a significant single- vs. dual-task contrast.
  - Interpreted findings as evidence for
    - greater sustained attentional processing requirement in people who and that
    - These individuals reduce the amount of "conceptual work" in order to keep their stuttering rates low.

Big Questions

- Intersystemic effects on fluency
  - Does walking affect talking?
- Intersystemic effects on gait and balance
  - Does talking (specifically dysfluency) affect walking?
- Does cognitive load create dysfluent speech?
- What are the interactions among cognitive-linguistic load, gait and balance, and dysfluent speech in Parkinson disease and movement disorders?
  - And in people who stutter??

Group with Parkinson Disease

- 27 individuals
  - Mean age = 67.44 (range 41-91)
    - Gender Distribution
      - Women N = 6
      - Men N = 21
  - Mean UPDRS rating = 26 (range 6-42)
  - Hoehn & Yahr Staging
    - Stage 2 = 19
    - Stage 3-4 = 3
    - Stage 4 = 1

Method

- Dementia Rating Scale-2
- Beck Depression Inventory
- Speaking Measures
- Gait Measures

Conditions

- Conversation
- Low load (counting by ones)
  - Each attempt began with a different number
- Medium load (subtracting by 3s)
  - Originating number varied for each attempt
- High load (letter, number sequence)
  - D-7, E-8, F-9…
  - A new sequence for each attempt

Procedures

- Tasks were completed during “on” phase of medication
- Order of administration was counterbalanced for load to account for order effect
- Two trials were conducted for each load condition to account for learning
  - Averages were used as dependent measures for analysis

AS

- Age: 72
- Married
- AS had 16 years of education.
- Occupation: retired Account Administrator
- DRSII score 136, 49-51%ile.
- No H&Y or UPDRS scores.

Cognitive Tasks

- Low cognitive task: counting from 10-40
- Medium cognitive task: counting backwards from 100 and subtracting by threes.
- High cognitive task: Alpha-numeric, matching increasing letters and numbers (i.e. I-12, J-13, K-14, etc).
- Each task was performed at rest and while walking.

Review of Observations

- **Respiration:** clavicular breathing, shortness of breath, gasping for breath
- **Phonation:** strained or weakened during times of heavy load
- **Movement:** shut down at times of high cognitive load (i.e. tripped during subtraction). Slowed movement when under moments of high stress.
- **Fluency:** Clear changes in fluency from baseline to experimental conditions – instersystemic reorganization?

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