I. Introduction to Vanderbilt’s DSP and Personnel

“All my rowdy friends are coming over tonight…”
Hank Williams Jr.

“Nothing important gets done alone”

Those that who have and/or continue to contribute

Principal/Co-Principal Investigators

Jan Karrass, Ph.D., Developmental Psych, Peabody, Vanderbilt
Ralph Ohde, Ph.D., Speech Science, DHSS, Vanderbilt
Tedra Walden, Ph.D., Developmental Psych, Peabody, Vanderbilt
Ellen Kelly, Ph.D., Speech-Lang. Path., DHSS

Post Doc/Research Asst on DSP

Anthony Buhr, Ph.D., Univ. of Iowa
Anna Lineback, BA, Princeton Univ.
Jessika Morrison, BA, Rhodes College

And, of course, Wheatley...

"Wag more, bark less..."
Wheatley

Recent DHSS graduate students who have participated/ are participating on DSP

Dr. Hayley Arnold (Purdue)  Dr. Courtney Byrd (UTexas)
Dr. Julie Anderson (Indiana Univ)  Dr. Kia Johnson (James Madison Univ., Fall 2008)
Dr. Mark Pellowski (Towson Univ)  Robin Jones
Dr. Kurtis Ntourou

Some early ideas and theory for this presentation based on:

II. Purpose, Premises, Some Facts, Notions, Urban Legends and Definitions

“Quote me as saying I was misquoted…”
Groucho Marx

Purpose
To present theory as well as evidence for a dual diathesis-stressor model of developmental stuttering

“I’m not sure what theory is, unless it’s the pursuit of fundamental questions.”
David Antin

Developmental Stuttering: Some Notions & Urban Legends

• Notion: Developmental Stuttering causes temperament
  • Reality: Temperament is the emotional reactivity a child is born with based on his or her biological makeup
• Notion: Changes in developmental stuttering cause changes in temperament
  • Reality: Temperament involves a set of behavioral characteristics that are stable over time

Developmental Stuttering: Some Notions & Urban Legends Cont’

• Notion: Developmental Stuttering causes Emotions
  • Reality: Emotions can certainly “flow” from stuttering, particularly for older children and adults;
• Caveat: Many emotional processes are quick and unconscious, being “driven” by stimuli that exceed limbic-thalamic thresholds for reactivity. The resulting emotional responses neither require conscious involvement nor instances of stuttering to occur, having more to do with exogenous stimuli and/or stressors

Stuttering: Some Notions & Urban Legends Cont’

• Notion: Children who stutter are typical in every way except stuttering
  • Reality: Some children who stutter, but not all, exhibit subtle to not-so-subtle challenges to (non) speech motoric as well as linguistic planning and production processes

Developmental Stuttering Stuttering that starts in childhood and changes across the lifespan, particularly from preschool to high school

Preschool
High School
School-age
Origins of Stuttering: Genetic/Inherited?

Picture of double helix/DNA
From Wikipedia

Origins of Stuttering: Environment?

Ad showing little girl’s angst listening to parents argue.
©Ad Council/Met Life

Origins of stuttering: Inherited, environment, or some of both?

Cartoon showing Garfield the cat “training”/teasing Odie the dog with a ball, Odie is drooling, perhaps due to the combined “forces” of canine hunting instincts and noise/smell/sight training with the ball

Three basic problems for all models of stuttering

- (1) Varying effect/unvarying cause
- (2) Deficiency for some, sufficiency for others
- (3) One cause fits all

(1) Varying behavior/unvarying cause

- “...a varying effect may not be accounted for by reference to an unvarying cause” (p. 5).
(2) Deficiency for some, sufficiency for others
• Some children who stutter, but not all, exhibit subtle to not-so-subtle challenges to (non) speech motoric as well as linguistic planning and production processes.
• In other words, for some CWS speech-language is deficient (Anderson, Pellowski & Conture, 2005, JFD), but for some sufficient (e.g., Watkins & Yairi, 1997, JSLHR) for all normal purposes.

(3) No one cause fits all
If stuttering varies, and some CWS have sufficient speech-language abilities while others have deficient speech-language abilities, then positing ONE, non-varying cause for stuttering is all but impossible.

Possible solution for problems with some models of stuttering

<table>
<thead>
<tr>
<th>Problem</th>
<th>CAUSE</th>
<th>BEHAVIOR</th>
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?Solution?

<table>
<thead>
<tr>
<th>CAUSE</th>
<th>ACTIVATOR</th>
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Relatively stable diathesis, relatively variable stressor
Relatively variable stressors may “activate,” in fairly predictable ways, relatively stable diatheses contributing to fairly predictable but variable disruptions in the fluency of ongoing speech-language planning and production.

III. Dual Diathesis-Stressor (DD-S) Model of Stuttering and its predecessor, the Communication-Emotional (C-E) Model of Stuttering (Conture et al., 2006)

“Is it in our stars or in ourselves...” Old USA rock song

Some models help organize our thoughts, some help organize our research and some do both...

D-S Model: *Basic Premise*

“Stress activates a diathesis, changing potential of predisposition into presence of psychopathology” (Monroe & Simons, 1991):

Genetics loads the gun, the environment pulls the trigger

Note: The presenter is NOT equating stuttering with psychopathology

**Diathesis & Stressor: Defined**

- **Diathesis1 (classic):** a biological or constitutional predisposition (tendency or proclivity) towards a particular disorder (traditional definition);
- **Stressor1 (classic):** Daily life hassles (e.g., hurrying to avoid being late), acute (e.g., death of spouse) and chronic (e.g., poverty) stress
- **Diathesis2 (revised):** Domains of predisposition not restricted to constitutional, for example, cognitive, linguistic, motor or social vulnerability
- **Stressor2 (revised):** Environmental changes, differences, or novelty (emotions) or spontaneous, on-the-fly generation of speech-language (communication)

**Definitions cont’**

- **Temperament:** The emotional reactivity the child is born with...the biological contribution to the child’s emotional, cognitive and motor systems; a *stable-over-time* set of behavioral characteristics.
- **Personality:** How child’s temperament is shaped by his or her environment.
- **Mood:** The child’s typical or chronic emotional state...heavily influenced by temperament

**IV. The DD-S Model Briefly Deconstructed**

“The whole is greater than the sum of its parts”
Dual Diathesis-Stressor Model of Developmental Stuttering

Speech-Language Diathesis: Most likely point in utterance for stuttering – sentence-initial position – involves many covert (conceptual/linguistic) as it is overt (motoric) processes (figure after Richels & Conture, in press).

Emotional Diathesis

Emotion: Defined

“Emotion is a process, a constant, vigilant process...which periodically reaches a level of detection for the person (i.e., a feeling) or an observer” (Cole, Martin & Dennis, 2003, p. 319).

Emotional behavior (unconscious, quick)

Feelings (conscious, slower)

The Environment: What Does it Matter?

For Better or Worse cartoon showing the dentist trying to soothe the child’s fears while the mother aids and abets them

Emotional diathesis: Deconstructing “anxiety”

- Anxiety is not a monolith: Apprehensive arousal (e.g., worrying, rumination, cogitating) differs from anxious (e.g., negative/positive emotion) arousal; some may exhibit both, but for some one may predominate

“Some people tell me these worried blues ain’t bad, Ooo child, it’s the worst old feeling, I ever had…”

Robert Johnson (circa 1930)
Anxiety is not a monolith: Two basic types (Engles et al. (2007). Specificity of regional brain activity in anxiety types during emotion processing. Psychophysiology, 44, 352-363.)

Anxious apprehension

Anxious arousal

Both anxiety types can co-exist within a person; however, it is also possible for one to dominate

I don’t sit around worrying when something goes wrong. I just quickly panic.

Joseph Farris, Ref jfa0171, www.cartoonstock.com

Stressors: Our environment can sometimes be quite stressful

Stressors can take various forms, for example, daily life hassles, acute or chronic events

Influence of environmental model

“You have to see it to be it… If a girl sees a woman succeed at something new, the sky truly is the limit.”

Billie Jean King (2008)
Wimbledon Tennis Champion

Ordinary environmental events, repetitively experienced, can have extraordinary impact, for some children:

© Ad Council/Met Life

Some early thoughts:

• “To better understand the young stutterer’s environment as well as his or her psycho-social-emotional behavioral tendencies, we must progress beyond the notion that young stutterers’ psyche and/or environment can only contribute to stuttering if these children are neurotic or psychotic, possess character disorders or have a home life wildly disparate from that of their normally fluent peers.”


Some early thoughts:

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Why is the environment/experience relevant?

1. A child’s environment has a profound influence on his or her academic, athletic, emotional, musical, social, and vocational choices, development and interests.

2. Further, it is logically inconsistent to insist that learning plays a role in stuttering - a process that clearly involves, at least in part, significant interaction between the child and his/her exogenous environment - but that the environment does not.

3. For example, this 2-year-old has never met her father, being born after his deployment to Iraq and his death; thus her obvious sadness/worry/concern could have only come from the emotional/social/intellectual environment created by her mother.

Environmental Influences

- **Environmental contribution:** “Several independent sources of evidence can be adduced to show that environmental influences play a decisive role in stuttering.” (Bloodstein, 1997, p. 170).
- **Original D-S Model**: “Language difficulties, articulatory defects, and other chronic failures in communication appear to act as provocations to stuttering, particularly in an environment of speech or language pressures” (Bloodstein, 1997, p. 175).
- **Similar biology/different environment**: A review of empirical studies of speech-language traits of identical twins raised apart (n = 75 twin pairs); investigators noted remarkable similarity of pitch, tone and overall characteristics of voices; however, in the 5 cases of stuttering reported, stuttering was only present in one member of each of the 5 twin pairs (Farber, 1981).
- **Nature interacts with nurture**: “There is apparently something that some young children inherit in such measure that it makes them prone to outbreaks of extreme disfluency, especially in the presence of constant or recurring communicative pressure” (Bloodstein, 1997, p. 177).
- **Biology interacts with environment**: Temperamentally fearful children more apt to respond fearfully if parent-child relation less harmonious (Gilissen et al., 2007).

V: Some evidence for DD-S Model

“Keep your facts, I’m going with the truth.”

Stephen Colbert

Speech-language processes

Fluency of CWS more vulnerable relative to certain speech-language events/processes:

- Childhood stuttering significantly associated with certain word-classes (e.g., function versus content words), length and complexity of utterances, and position of word within the utterance (Hall, Wagovich & Bernstein-Ratner, 2007).

We will consider a deficiency (less than adequate) (e.g., Anderson, Pellowski & Conture, 2005, JFD) as well as sufficiency (adequate to more than adequate) (e.g., Watkins & Yairi, 1997, JSLHR) perspective of speech-language contributions to childhood stuttering.
Speech-language processes: **Deficiency**

**Perspective:**

**Articulation/Phonology:**
- Greater percentage of CWS than CWNS exhibit disordered phonology (e.g., Blood et al., 2003, JCD);
- Removing CWS with disordered articulation/phonology, CWS score still significantly lower than CWNS on tests of speech sound articulation and phonology (e.g., Petelowski, Anderson & Pellowski, 2001);
- CWS more apt to be holistic (i.e., word-like) than incremental (i.e., sound-like) in their phonological planning than CWNS (Byrd, Conture & Ohde, 2007, AJSLP).
- Neural processes related to phonological encoding that mediate rhyming decisions operate atypically for CWS, when compared to CWNS, especially during the rehearsal period before the target words appear, and during the interval when lexical integration is thought to occur (Weber-Fox et al., 2008).

**Articulation, Vocabulary, and Language:**
- CWS more apt than CWNS to exhibit dissociations among vocabulary, articulation and language, with greater frequency of stuttering being associated with greater dissociations (Anderson, Pellowski & Conture, 2005; Coulter, Conture & Anderson, 2008).

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**Study 1 (Finding 1): minimal relation between articulatory mastery and speech reaction time in children who stutter**

(After Melnick, Conture & Ohde, 2003, JSLHR)

**NO PRIME**:
- For example, silence before child saw picture of “dog” in name

**CWNS**

**CWS**

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**Data adapted from Melnick, Conture & Ohde (2003)**

**Study 2 (After Byrd, Conture & Ohde, 2007, AJSLP)**

**Acoustic example of incremental, e.g., “b(uh)” versus holistic, e.g., “ed” primes**

**Holistic (offset-related) versus Incremental (onset-related)**

(Pronunciation: After Byrd, Conture & Ohde (2007, AJSLP))

- Holistic (offset-related) faster
- Incremental (onset-related) faster

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**Figure 1**

**Figure 2**

**Figure 3**

**Figure 4**
Clinical Case #1: 5 year, 6 month old CWS who is struggling, but starting to improve

“og” prime before “dog” naming response; “d” prime before “dog” naming response

Clinical Case #2: 8-year-old CWS who is improving

“og” prime before “dog” naming response; “d” prime before “dog” naming response

Clinical Case #3: 12-year-old male who stutters who is not improving

Speech-language processes: Sufficiency perspective:

- Superior speech-language: Childhood stuttering can be associated – at least for some – with above average to superior speech-language planning and production systems (e.g., Watkins & Yairi, 1997).
- Conundrum (puzzle): A major puzzle for both motor and linguistic accounts of childhood stuttering: Some CWS are below normal limits, others marginal, still others average and still others superior re speech-language planning and production.

Speech-language processes: Take-away message

- Vulnerabilities in speech-language planning and production appear to be part of a chain of causal contributors to childhood stuttering, for some but not all children who stutter.

For example, clinical sample (n = 12) of preschool CWS: Some below, some well above mean of speech-language composite score (based on 4 standardized tests) (after Ntourou, 2008)
Emotional Processes:

Descriptive Data:
- Thirteen of eighteen empirical studies found that adults who stutter exhibit more state/trait anxiety than adults who do not stutter (Craig & Tran, 2006)

Observational Data:
- Pre-school age CWS, when compared to CWNS, look significantly more often, that is, they adapt less cognitively/emotionally to environmental change (Schwenk et al., 2007).

Parent-based questionnaire data:
- CWS when compared to CWNS less adaptable, less distractible, less rhythmic (Anderson et al., 2003; Behavioral Style Questionnaire (BSQ))
- CWS when compared to CWNS more reactive, less regulated and less attentional regulated (Karrass et al., 2006; Selected items from BSQ)
- CWNS girls when compared to CWS girls and CWS/CWNS boys, more proficient at inhibitory control and attention shifting. CWS boys marginally more proficient at inhibitory control than CWS boys, but no difference re attention shifting (Child’s Behavioral Questionnaire (CBQ) Karrass et al., submitted).

For example, clinical sample (n = 12) of preschool CWS: Some inhibited, some very expressive, temperamentally: based on Temperamental Characteristics Scale (TCS) (Oyler, 1996). Same differences apply to girls only and boys+girls.

CWS (n = 67) have higher reactivity and lower emotion and attention regulation than CWNS (n = 56; Karrass et al. 2006): BSQ data

SomeExperimental Data:
- CWS more apt to stutter following positive than negative arousal and less able to regulate or “hide” negative nonverbal behavior when disappointed (Johnson et al., submitted).
- CWS produce fewer errors of commission under affective than non-affective conditions (Johnson et al., 2008).
Changes in (1) Stuttering (MLU corrected) and (2) regulatory strategies of preschool CWS during a narrative task completed after listening to 5-minute conversations of two adults using flat (neutral), positive (happy), or negative (angry) affect. Experimental data: Karrass et al. (2008), preliminary findings.

Emotional contributions to stuttering: Some conundrums
- Too much of a good thing? Just as emotional reactivity can be minimally regulated, perhaps, for some, it can be overly regulated
- Implicit (unconscious) emotional learning can occur without explicit (conscious) emotional feelings. Which is more salient to stuttering: implicit or explicit or neither?
- Which is the most influential “diathesis” in terms of persistent of stuttering: emotions or speech-language or neither?

Emotional Processes: Take-Away Message
- Dispositional/trait (temperament) as well as situational/state (reactivity) aspects of emotion appear to be part of a chain of causal contributors to childhood stuttering, at least for some children who stutter.

VI. Speech-language interacts with emotions: Some treatment outcome evidence

“Interplay and interaction are the integral parts of music - they’re as important as the notes.”
John McLaughlin

Speech-language interacts with emotions: Some treatment evidence based on group data (n = 45 preschool to school-age CWS; Richels, Conture, in press)
- Measures of stuttering predictive of short-term (6-12 months) treatment outcome
- Measures of speech-language and emotion more predictive of long-term (over 12 months) treatment outcome (Richels, Conture & Karrass, in press)
Speech-language interacts with emotions. Speech-language characteristics of selected individuals (n = 12 preschool CWS; Ntourou, 2008) from the group (n = 45). Some CWS below and some well above mean of speech-language composite score (based on 4 standardized tests) (after Ntourou, 2008).

Taken together, initial speech-language and temperamental characteristics appear to influence long-term treatment outcome. UNL = upper normal limits, LNL = lower normal limits for speech-language composite (based on 4 standardized speech-language tests) (n = 12 preschool CWS).

Temperament: Inhibited and/or relatively reluctant to talk in combination with speech-language that is: Ready, willing and able to talk: A bad mix?

- Having speech-language abilities in the upper ends of normal limits does not seem to sufficiently inoculate/protect some CWS from struggling in treatment if they are shy, introverted, inhibited and/or poor adaptors to changes in their environment.

Speech-language interacting with emotional processes: Take-away message

- Emotional and speech-language processes co-occur within children during communication.
- Sometimes emotions may “trump” speech-language and vice versa, at least, for some children, in terms of persistence of stuttering.
- Degree of “trumping” may depend on “loading” of the two diathesis as well as the chronicity or strength of stressors...

VII: Predictions, Summary and Conclusions

“If you’ve heard this story before, don’t stop me, because I’d like to hear it again.” Groucho Marx

Dual Diathesis-Stressor Model of Developmental Stuttering
DD-S Model: Summary of some of its attributes and contributions

- Describes a factor missing from many models of stuttering: the child’s environment, and how it may contribute, at least indirectly, to developmental stuttering
- Describes both internal (diathesis) as well as external (stressors) contributors to development stuttering and their possible interaction
- Describes how a relatively stable diathesis could interact with a relatively variable stressor to cause a relatively predictable, but variable symptom
- Permits minimal to maximal loading of a diathesis as well as the absence of a diathesis
- Predicts empirically-testable subgroups and makes prediction how these subgroups might influence persistence of stuttering as well as treatment outcome

DD-S Model Predictions: Chronicity and Treatment Outcome

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<th>Maximum Load: Speech-Language Diathesis</th>
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<tr>
<td>Maximum Load: Emotion</td>
<td>Most persistent; Poorer treatment outcome</td>
<td>Somewhat persistent; Poorest treatment outcome</td>
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<tr>
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Conclusions

- **Different strokes for different folks:** Stuttering is not a monolith, at least in terms of its causal contributors and/or variables that activate these contributors
- **Genetics loads the gun, environment pulls the trigger:** While some contributors to stuttering are likely congenital and/or genetic in nature, others are just as likely environmental in nature, with interaction between them just as likely.
- **E pluribus stuttering:** While the destination (i.e., behavioral symptoms of stuttering) is roughly the same across children who stutter, the different routes (i.e., causal contributors) traveled by children to reach this destination undoubtedly, due to sampling error, leads to different findings from one study to the next.
- **Like the pigs in Animal Farm, some contributors more equal than others:** Although the potential causal contributors to stuttering are many, most modern-day research points in the direction of attentional, emotional, linguistic and motoric variables and/or their combined interactions.