

The Fluency-accuracy trade-off

What it is, and why it matters

Paul Brocklehurst PhD

University of Edinburgh

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Outline of the talk

- The relationship between fluency and speech accuracy
- 2 accuracy-enhancing mechanisms:
 - error repair and error avoidance
- The Vicious Circle Hypothesis
- The Variable Release Threshold Hypothesis
- Evidence supporting these hypotheses
- Clinical implications

Successful communication

For successful communication, our utterances must be clear and accurate enough to fulfil the function for which they are intended...

- Appropriate words
- syntax
- phonology
- prosody
- timing
- register
- pitch
- Loudness

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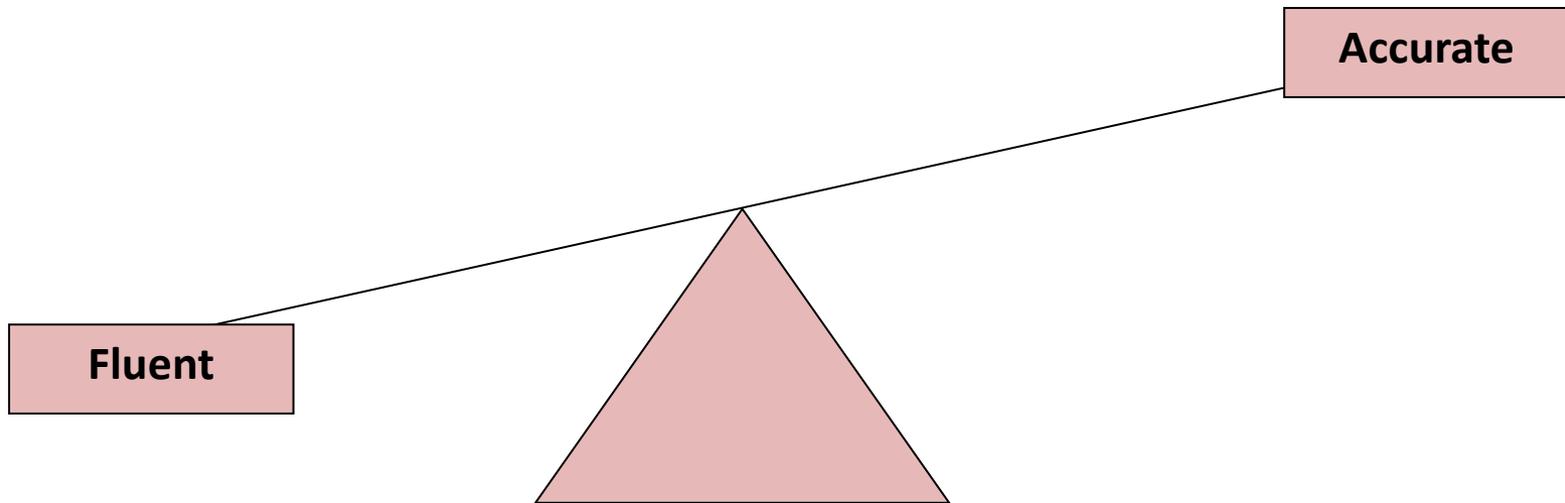
But clarity and accuracy may come at a cost

- Slow speech rate
- Loss of fluency

Getting the balance right

For optimal effectiveness, speech needs to be...

- Clear and accurate enough to be understandable
- Fast and fluent enough to fit the window of opportunity



Two ways of increasing accuracy

- Error repair
- Error avoidance
 - Both may result in disfluencies

Error-repairs



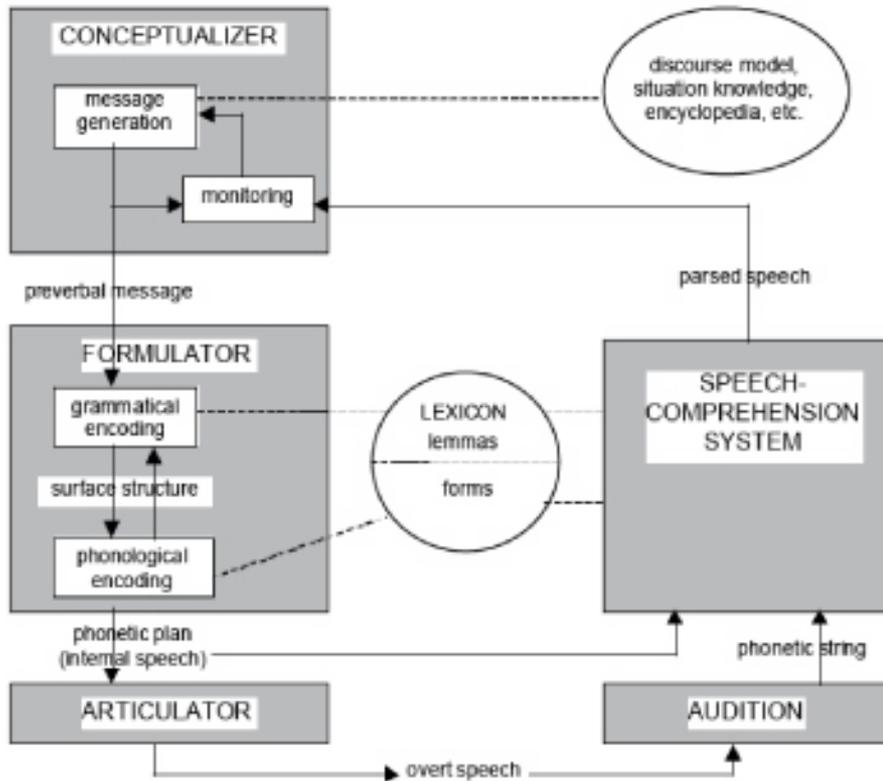
Error-repairs



- Note that errors per se do not normally disrupt the flow of speech;
- however, *error repairs* do.

Error repair – the Leveltian perspective

-the perceptual loop



Involves

- Monitoring (for errors)
- Cancellation
- Reformulation

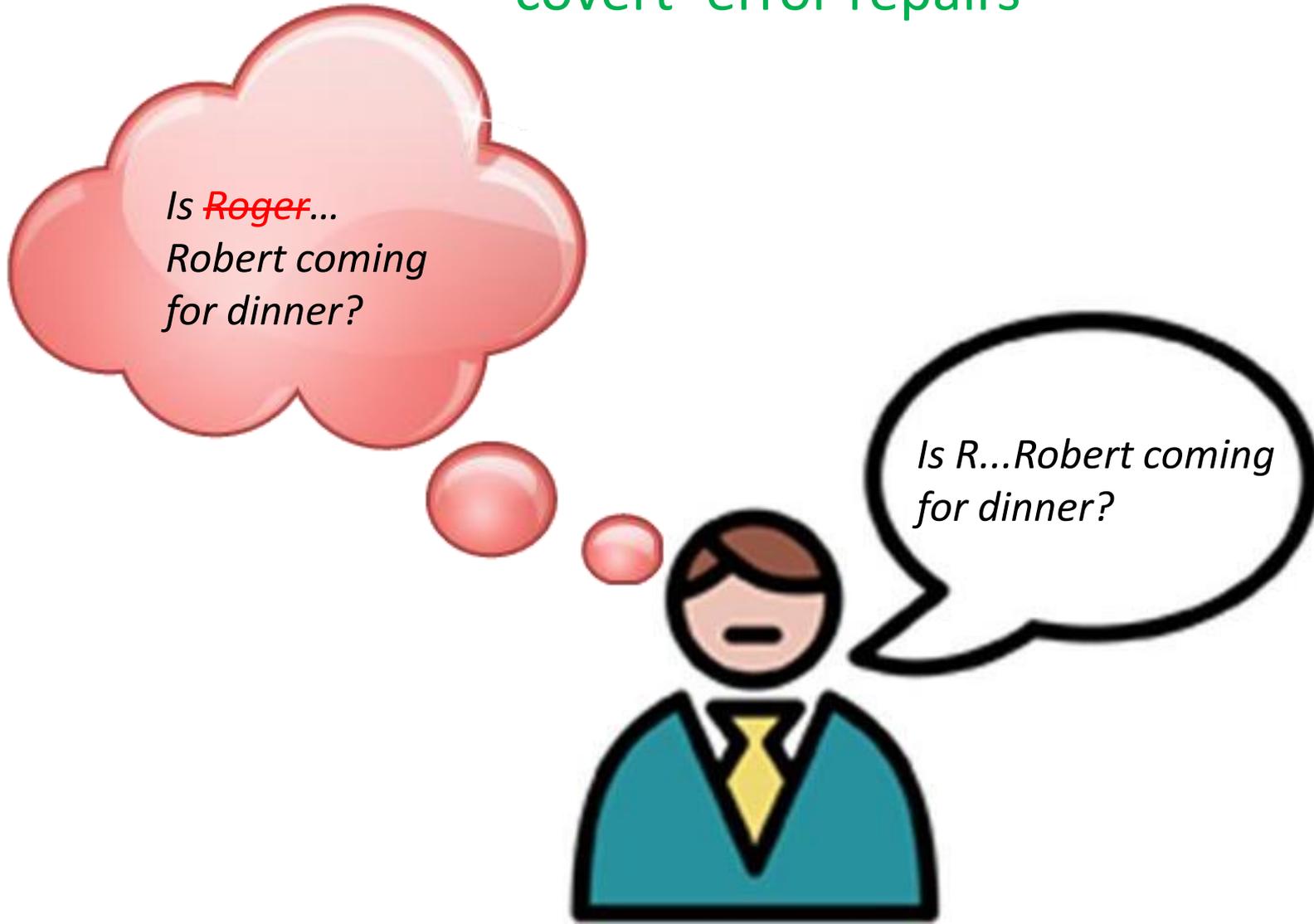
May occur on different levels

- Speech planning
- Motor execution

Levelt's speech production model
(Levelt et al.,1999)

Postma & Kolk (1993):

Stuttered disfluencies are the perceptible symptoms of
'covert' error repairs



Postma & Kolk (1993):

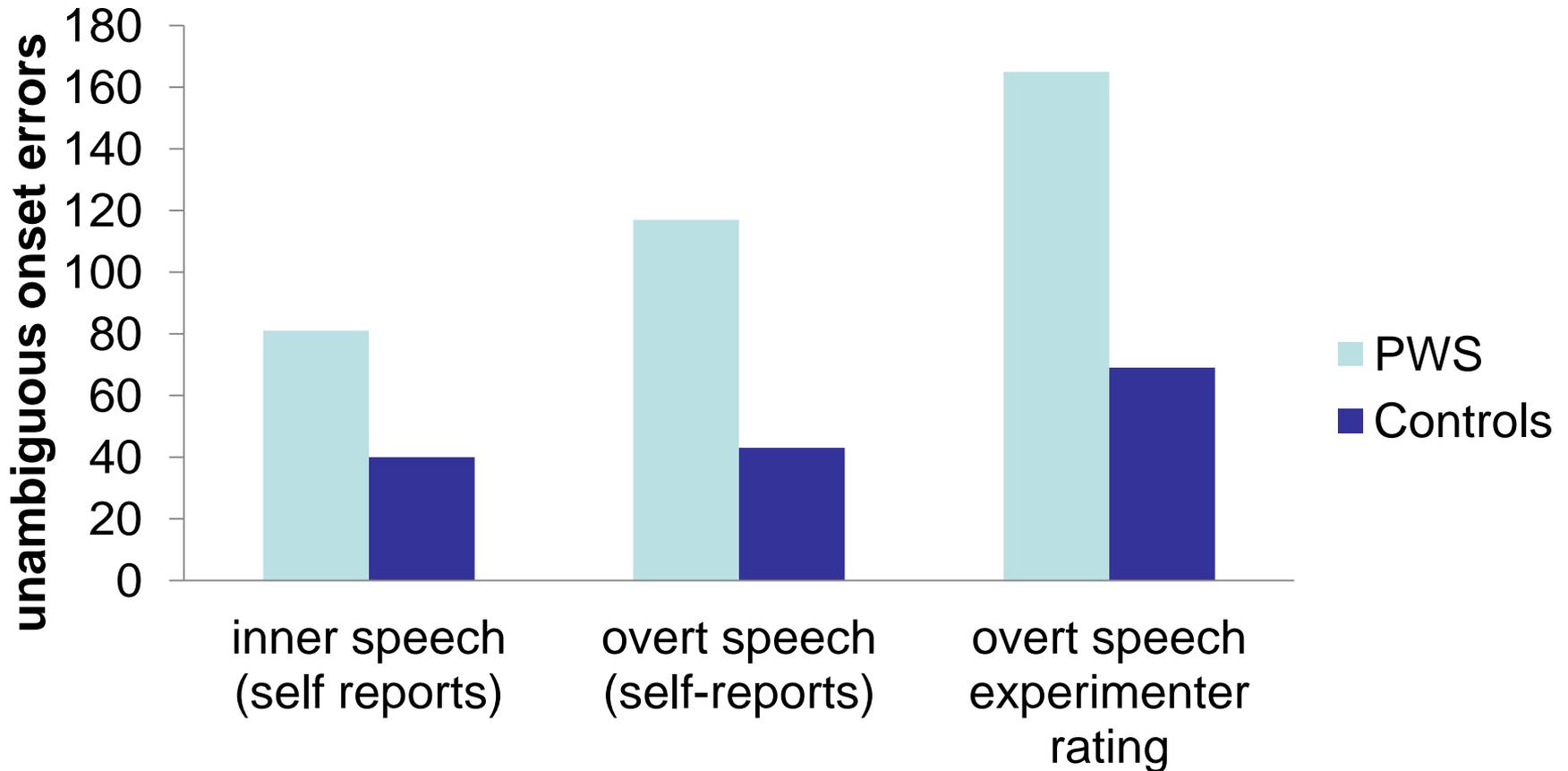
- PWS make excessive numbers of covert error-repairs
 - The speaker monitors his inner speech for errors (or inaccuracies)
 - When he perceives one, he stops and tries again.
 - Cancellation and re-formulation of speech plans (Postma & Kolk, 1993)

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 - Cancellation and re-formulation of speech plans (Postma & Kolk, 1993)
 - Some forms of error repair may not involve conscious awareness
 - Cancellation and re-issuing of motor commands (Civier et al., 2010)

PWS make more onset errors

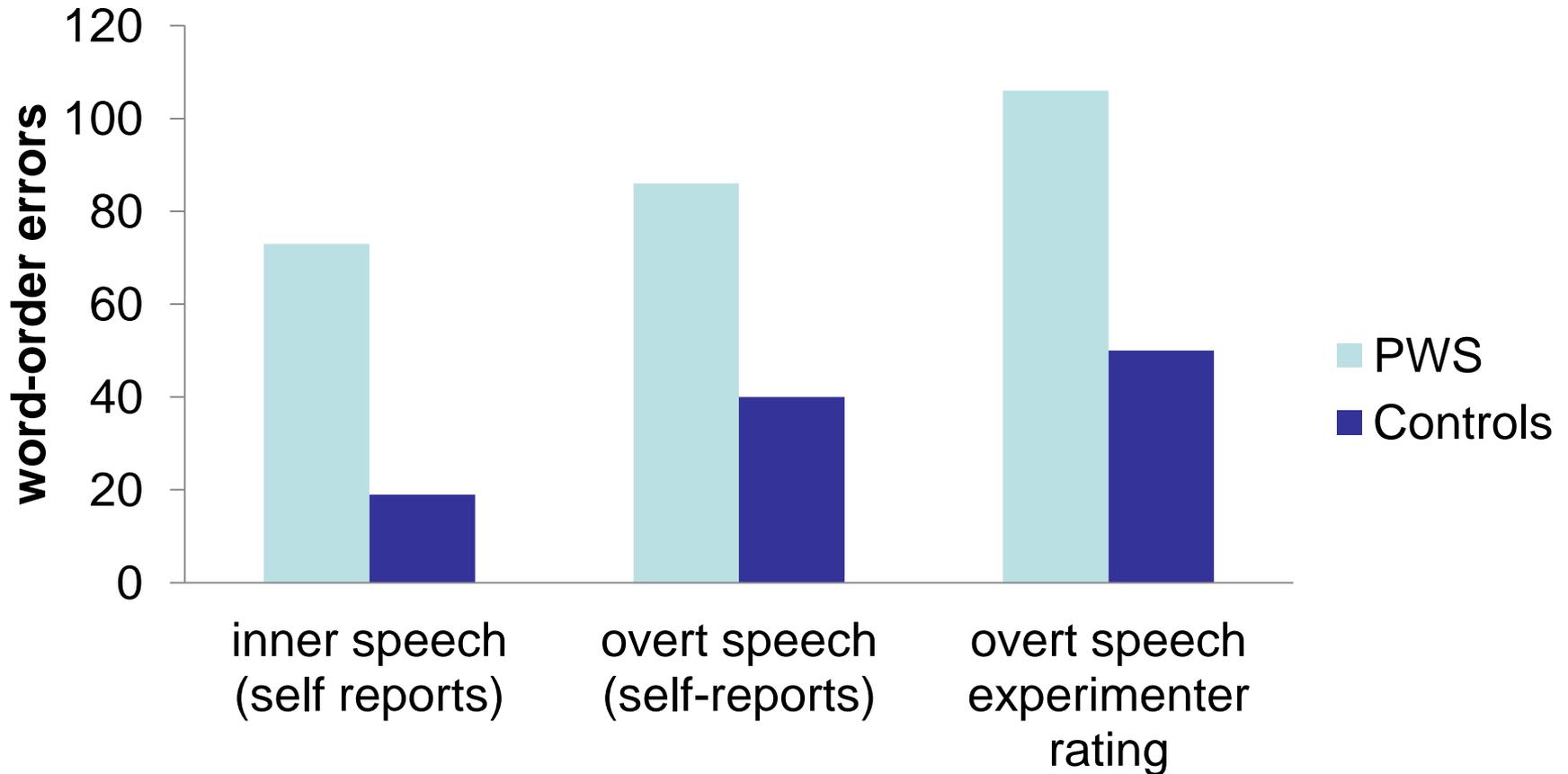
Brocklehurst & Corley 2011 Tongue-twister study



6144 tongue-twister recitations in each condition

PWS make more word-order errors

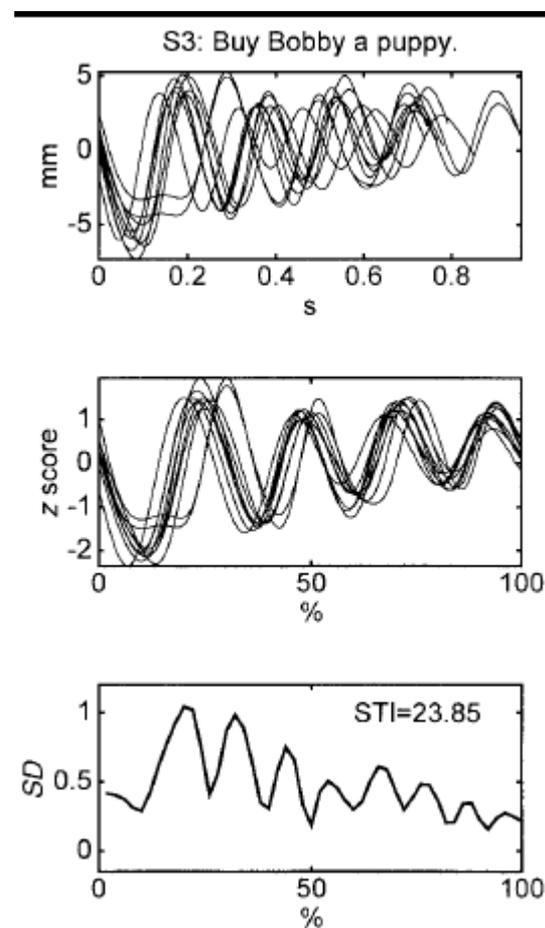
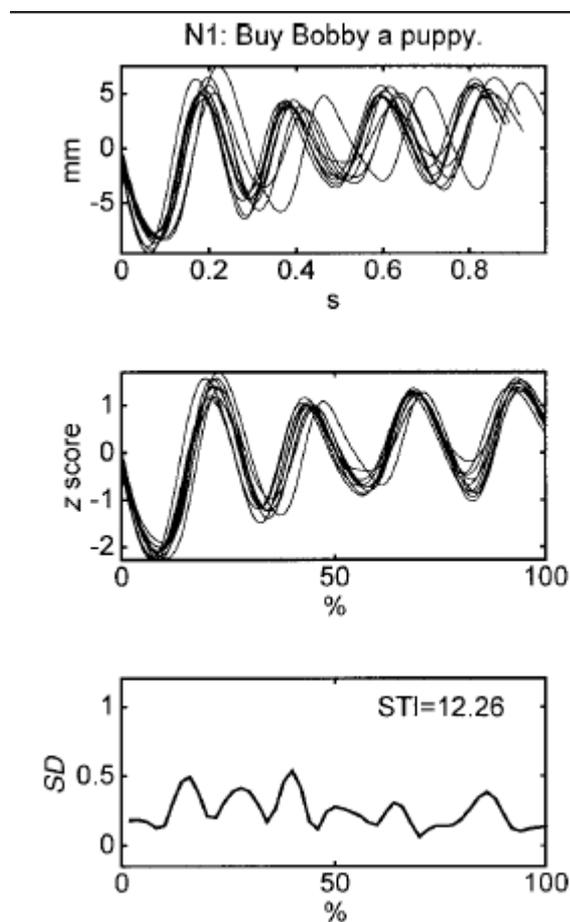
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6144 tonguetwister recitations in each condition

PWS' utterances are more variable

(Kleinow & Smith, 2000)



Kinematic signals from the forehead and lower lip
Spatio-temporal index - control vs. PWS

Overlap between PWS & Controls' speech-error rates and variability

In both the Brocklehurst & Corley (2011) and Kleinow & Smith (2000) studies...

- there was, a large degree of overlap between PWS and controls.

This overlap suggests that...

- neither error-proneness nor excessive motor variability are sufficient or even necessary for stuttering to occur.

Why else might PWS make excessive error-repairs?

Vasić & Wijnen's (2005) Vicious Circle Hypothesis

- PWS *perceive* excessive numbers of errors
 - Excessive attentional resources devoted to monitoring
 - Excessive focus on temporal cues (silent pauses, breaks etc.)
 - Threshold for repairing an error is too low
 - Disfluencies are interpreted as errors (hence the vicious circle)

Evidence for the Vicious Circle Hypothesis

- Disfluencies reduce when stutterers' attention is distracted away from monitoring (Vasić & Wijnen, 2005)
 - dual-task paradigms
- Compared to controls, stutterers' judgements of the fluency of recorded speech samples are more harsh (Lickley et al. 2005)
- On encountering a 'block', stutterers do frequently stop, retrace and try again
 - It seems that blocks are treated by stutterers as errors-that-need-to-be-repaired.

In line with the Vicious Circle Hypothesis

Situations under which stuttering is reduced or absent (Bloodstein 1950).

- Reduced communicative responsibility
- The absence of unfavourable listener reactions
- No urgency to create a favourable impression

- Changes in accustomed speech pattern
- Speech accompanied by bodily activity
- The presence of intense and unusual stimulation

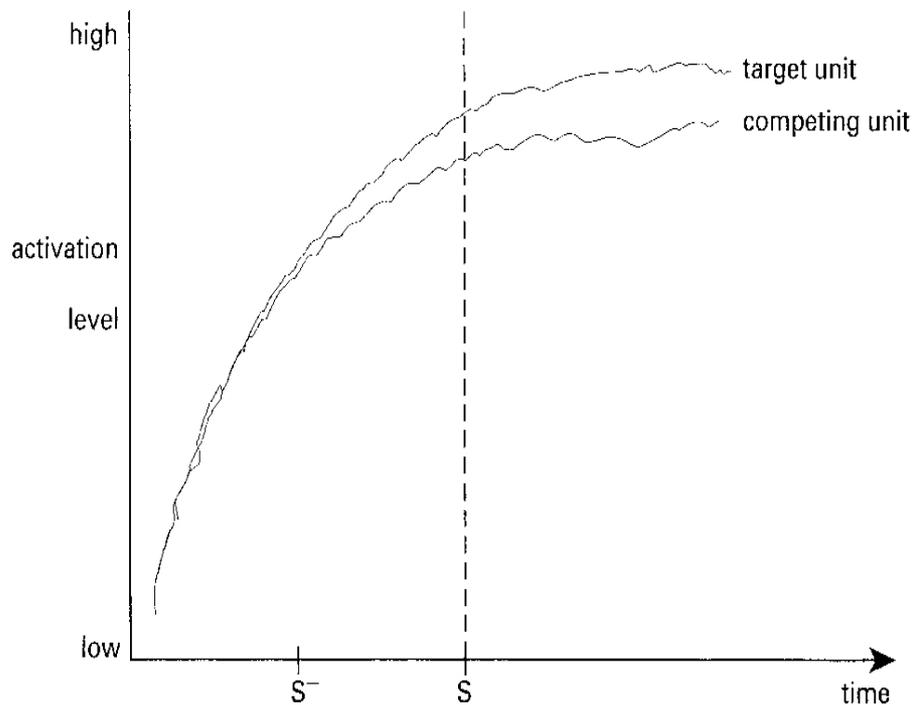
Underlying factors:

1. it doesn't matter whether subject stutters or not;
2. distraction

PWS interviewed and completed a questionnaire asking about experiences of stuttering in 115 speaking situations.

Error avoidance

– an alternative perspective



Gradual build-up of word or phoneme
activation over time

(Dell, 1986)

- The more time available for planning, the greater the likelihood that speech plans will be error-free.
- Error avoidance involves delaying the moment of execution until the target unit is more activated than any competitors
- Speaker repeats or prolongs the last available syllable (or phoneme) until the problem word is sufficiently activated (EXPLAN Hypothesis; Howell & AuYeung, 2002)

EXPLAN

Howell and AuYeung (2002)

A cartoon illustration of a man with brown hair, wearing a teal suit jacket and a yellow tie. He has a neutral expression. To his left is a large, pink, cloud-like thought bubble containing the text 'Is R??? coming for dinner?'. To his right is a white speech bubble with a black outline containing the text 'is is is is is'. Three smaller pink circles of varying sizes connect the thought bubble to the man's head.

*Is R??? coming
for dinner?*

is is is is is

Stalling behaviour
(more common in young CWS)

EXPLAN

Howell and AuYeung (2002)

A cartoon illustration of a man with brown hair, wearing a teal suit jacket and a yellow tie. He has a neutral expression. To his left is a large, pink, cloud-like thought bubble with a smaller pink bubble leading to it. To his right is a white speech bubble with a black outline. The text inside the thought bubble is "Is R???" coming for dinner?". The text inside the speech bubble is "is R..R..R..R..R..".

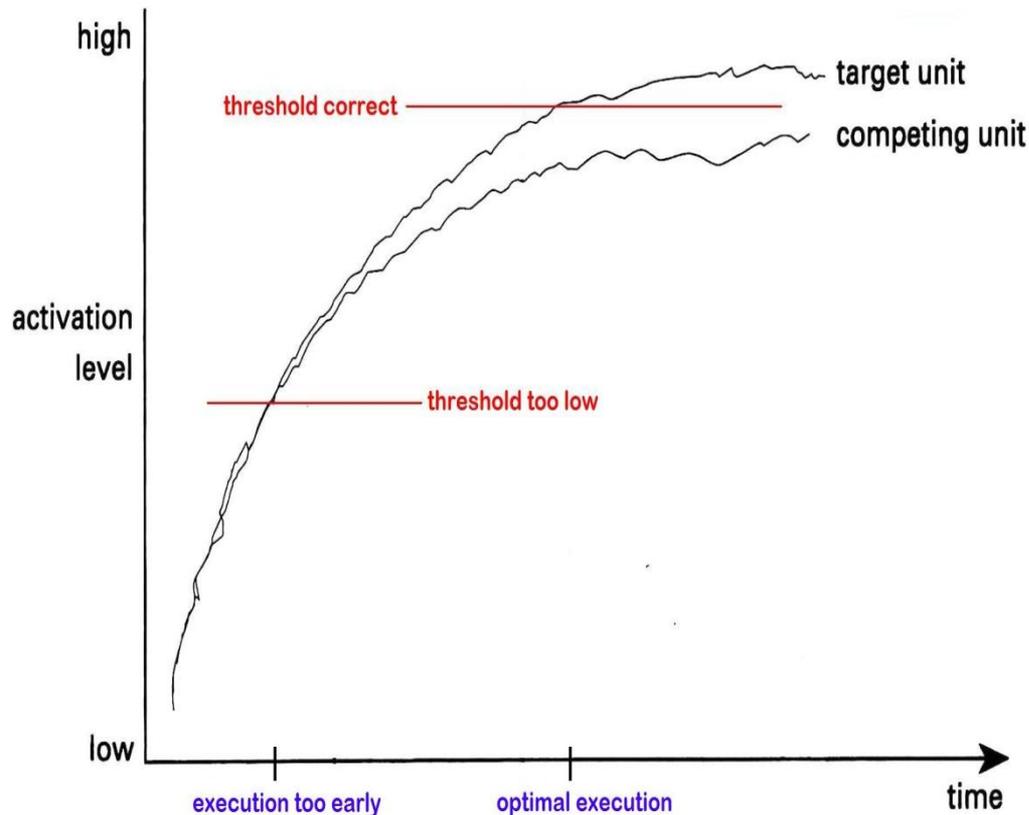
Is R??? coming
for dinner?

is R..R..R..R..R..

Advancing behaviour
(symptom of persistent stuttering)

Error avoidance

The Variable Release Threshold Hypothesis



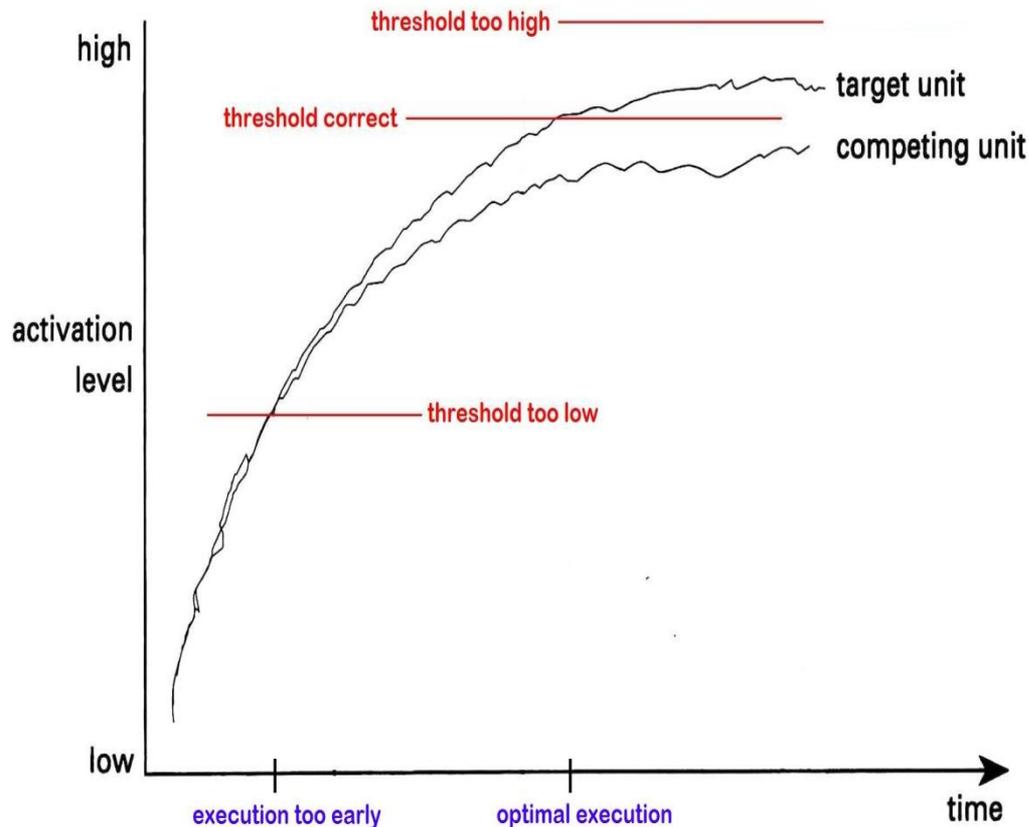
- An extension of the EXPLAN Hypothesis (Howell & AuYeung, 2002)
- If the speaker anticipates that an unacceptable error might occur, he can delay the initiation of execution.
- Delay of execution could be achieved through a variable release threshold mechanism

activation must exceed the 'release threshold'
before overt execution can commence

(Brocklehurst, 2011; cf. Howell & AuYeung, 2002; Howell, 2003)

Error avoidance

The Variable Release Threshold Hypothesis



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- Delay of execution could be achieved through a variable release threshold mechanism
- In stutterers, trying to increase accuracy causes the release threshold to rise too high, preventing execution altogether
- **Result = blocking**

Summary

2 Hypothesised causes of stuttered disfluencies

- Excessive numbers of error-repairs
 - The speaker monitors his speech for errors (or inaccuracies)
 - When he detects one, he stops and tries again.
 - Cancellation and re-formulation of speech plans (Levelt, 1989; Postma & Kolk, 1993)
 - Cancellation and re-issuing of motor commands (Civier et al., 2010)
- Excessive error avoidance
 - Anticipation of upcoming difficulty causes the release threshold to rise
 - Speech plan for a key syllable cannot be executed (its threshold is too high)
 - Phonemes/syllables with lower thresholds are repeated/prolonged until the key syllable can be executed

(Brocklehurst, 2011; Howell & Au-Yeung, 2002)

Threshold variability

The speaker's anticipation of a need to speak more clearly or accurately leads to...

- A lowering of his threshold for initiation of error repairs
 - Excessive unnecessary speech error repairs
 - Vasić & Wijnen (2005: Vicious Circle Hypothesis)
- A rise in his threshold for release of plans for execution
 - Excessive difficulty initiating overt execution of speech plans
 - Brocklehurst (2011: Variable Release Threshold Hypothesis)

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 - Excessive unnecessary speech error repairs
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- A rise in his threshold for release of plans for execution
 - Excessive difficulty initiating overt execution of speech plans
 - Brocklehurst (2011: Variable Release Threshold Hypothesis)
- Either way, trying to speak more accurately is likely to be a key proximal causal factor underlying the production of stuttered disfluencies

Clinical relevance

Can fluency and communicative effectiveness be improved by giving less priority to speaking clearly and accurately?

If so, how can this be achieved?

Fluency shaping approaches?

Cognitive therapy?

Clinical relevance

An awareness of the fluency – accuracy trade-off may help therapists to identify the key fluency-enhancing components of existing therapy programmes.

Teaching clients about the fluency – accuracy trade-off has the potential to empower them by...

- Providing an easily understandable theoretical basis for whatever techniques are taught
- Providing clients with a means of identifying which of their personal beliefs, behaviours and attitudes may be causing their ‘release thresholds’ to rise too high.

Clinical relevance

Cognitive Therapy

Can the concept of a Fluency-Accuracy trade-off be explained to clients?

Can the relationship between disfluency and error-repair be explained?

Can the Variable Release Threshold Hypothesis be explained?

- Are such concepts useful to them?
 - Cognitive therapy in isolation?
 - As an adjunct to fluency shaping programmes?
 - Need for practice based evidence

Clinical relevance: slowed speech rates

Many current therapeutic approaches encourage PWS to adopt a slower speech rate

- Might this have unforeseen consequences?

The Variable Release Threshold Hypothesis would predict that...

- The outcome may depend on whether or not a decrease in speech rate is accompanied by an increased focus on accuracy
 - Which may itself depend on the details of the instructions given by the therapist

- trade-offs

Speed – accuracy \approx Fluency – accuracy

Clinical relevance: speech naturalness

Most of the time, the ideal that PWS aim for is 'natural sounding' speech

- Might this goal be counter-productive?

The Variable Release Threshold Hypothesis would predict that...

- If a PWS aims for natural sounding speech, any deviations from natural sounding speech may be interpreted as 'errors'.
- The less a PWS cares how natural his speech sounds, the lower the release threshold.

Clinical relevance

Things that PWS may perceive as 'errors'

- Wrong phonemes
- Wrong words
- Wrong syntax
- Wrong stress
- Wrong prosody
- Wrong tone
- Wrong pitch
- Wrong amplitude

Lexical and emphatic stress

Most stuttering occurs on stressed syllables

- Is the release threshold higher for stressed syllables than for unstressed syllables?
- If so, reducing the level of planned emphatic or lexical stress should be fluency-enhancing.
 - Syllable-timed speech
 - Prolonged speech

Concluding remarks

Future research is needed to establish...

- the existence (or not) of a variable release threshold.
 - Its role in the regulation of inner vs. overt speech
- The extent to which covert error repair accounts for stuttered disfluencies
- Our capacity to learn ways of adjusting the height of the thresholds.
- Whether/how clients may benefit from therapy based upon these two hypotheses.