Differential Treatment Intensity Research: A Missing Link in Creating Optimally Effective Interventions

Steven F. Warren, PhD
University of Kansas
October 26th, 2010

Acknowledgements

- Marc Fey, University of Kansas
- Paul Yoder, Vanderbilt University
- NICHD, NIDCD,US Department of Education, The LENA Foundation

Overview

- Defining treatment intensity
- Defining active intervention ingredients
- Knowledge generated by treatment intensity studies
- Methodological and design issues
- Common treatment intensity/fidelity issues in clinical/educational practice
- The Road Ahead and Postscript

A Brief History of IDD Behavioral Intervention Research

- Phase 1 – Developing interventions and conducting small N studies: Substantial evidence of limited effectiveness of numerous techniques and general approaches
- Phase 2 – Direct comparison studies of different interventions – we've only just begun

Single subject designs are critical early on but…

- Can only answer short term questions and do not allow well controlled comparisons
- Published SS studies have two serious limitations: a) attribution seldom reported; b) difficulty of generalization tests often ignored
- But a useful tool for early research!

Effectiveness varies by….

- Short term vs long term follow-up
- Proximal vs distal variables
- The skill domain targeted
- Characteristics of the participants
- Length of intervention (duration)

A key difference between drug and behavioral interventions

- When a therapeutic drug is developed, systemic research is virtually always conducted on its effects at different dosages.
- So why have behavioral scientists not adopted a similar approach to develop effective interventions?

What is treatment intensity?

- There is no standard definition of treatment intensity in behavioral research

The literature defines treatment intensity as……..

- "The quality and quantity of service delivered over a given period of time"
- "The number of hours of intervention over a period of time"
- "The level of participation in a service offered over time"
- "The ratio of children in a service context"
- "Number of specific teaching episodes per unit of time"

Intensity as “Duration of Treatment”

- The main advantage of defining intensity as the duration of treatment (e.g. hours per day or week of intervention) is that it is easily understood by a wide range of audiences including parents, teachers, and policy makers.
- Unfortunately this tells us nothing about the intensity of the presumed “active ingredients” of various interventions that may go on during this period of time

Terminology for Precisely Measuring Treatment Intensity

1. Dose
2. Dose Form
3. Dose Frequency
4. Total Intervention Duration
5. Cumulative Intervention Intensity

Dose

- Dose = the number of properly administered treatment episodes during a single intervention period
- A treatment episode contains one or more interventionist acts hypothesized to lead/push the child/adult toward a treatment goal

Dose is the function of 3 subcomponents

1. The average rate of treatment episodes per unit of time
2. The length of the intervention period/session
3. The distribution of treatment episodes over the period/session

Dose Form

- Dose form refers to the task/activity/context within which a treatment episode occurs
- Example….to teach word forms an adult might initiate imitation trials; or respond via conversation to child initiations.

Dose Frequency

- The number of times that a "dose of intervention" is provided per day or week.
- For example: a once per week 1 hour session of 1 teaching episode per minute (60 episodes) VS. 5 1-hour sessions of 1 teaching episode per minute (300 episodes)

Total Intervention Duration

- The total time period over which an intervention is delivered (for example, weekly for 6 months, or 9 months, 24 months, etc)

Cumulative Intervention Frequency

- The product of *dose* X *dose frequency* X *total intervention duration*
- *Cumulative Intervention Intensity* provides a useful general indicator of overall intensity

A Real Example

- One group receives a 40 week intervention that includes 60 defined treatment episodes per hour for 1 hour per week = 2,400 treatment episodes cumulatively
- Another group receives 40 weeks of same treatment episodes per hour, but 5 hours per week = 12,000 treatment episodes
- Our present early intervention study controls for: *Dose*, *Dose Form*, and *Total Intervention Duration*. Independent variable is *Dose Frequency* and ultimately *Cumulative Intervention Intensity*

Another Example

- *Cumulative Interventon Intensity* is held roughly constant
- A *Dose* of 8 treatment episodes over an 8 minute period once daily, 7 days per week for 40 weeks would have a *Cumulative Intervention* I*ntensity* of 2,240 treatment episodes ….nearly the same as the 1 episode per minute for 60 minutes once per week over 40 weeks previous example (it had a *Cumulative Treatment Intensity* of 2,400 treatment episodes)

The Bottom Line

- Cumulative intervention intensity is an inherently dynamic concept because it results from the values obtained by multiple variables
- We may struggle to measure these variables in practice – but that does NOT justify ignoring them.

Defining Treatment Episodes

1. Simple treatments are often more complex than they seem
2. Defining the *ESSENTIAL* ACTIVE TREATMENT ingredient may be difficult
3. Sometimes the "active ingredients" may not work

More is not necessarily better…

- A focus on cumulative intensity can lead to the belief that massed treatment episodes will always be the most effective approach, when in fact highly salient distributed treatment trials may lead to more efficient learning

A robust finding….

- …..across many domains of human cognition learning is more efficient when the same number of trials is distributed over several sessions rather than massed into one or a few sessions…

It may be more effective….

- ….to use a relatively low dose and dose frequency of over a relatively long duration depending on the intervention and target
- ….in contrast, a much higher dose and dose frequency might be more effective in some cases (e.g. teaching imitation skills)

People differ…….

- A child who is easy to engage may progress more rapidly with a lower dose and dose frequency relative to a less engaged, easily distracted child or a child at a lower developmental level and few play and social skills

What can be learned by focusing on treatment intensity?

1. A given treatment that is moderately effective at one intensity level may be more/less effective at another level
2. Changes in intensity may have different effects on individuals with different developmental profiles
3. Some intensity levels may generate unforeseen side effects (e.g. stress, problems behaviors, etc).

And furthermore….

- Studying treatment intensity highlights the important role of "cumulative intervention intensity".
- When comparing DIFFERENT interventions, cumulative treatment intensity ideally should be controlled.
- Comparing two treatments that vary in intensity and other variables (e.g. dose form) can lead to flawed conclusions
- The literature is full of these flawed studies!

Methodological Issues

- Randomized treatment designs are ideal for studying treatment intensity effects because two intensities can be pitted against each other with most other variables controlled.
- But a MAJOR threat to these designs is differential attrition – so "intention to treat" analyses may be necessary

A second problem

- IT may be difficult to control DOSE form when comparing two different intensities
- E.g. Differences in the dyadic relationship that may occur over time at two different intensity levels OR differences in child attention levels at two different intensities

Common “intensity” challenges to clinical and educational practice

“I left the key ingredient out of the cake!!!!!!!!!”

“ I trained them to do “it”, and they tell me they do “it”, so I just assume they will do “it”

Milieu Teaching Example

- A KEY ingredient in milieu teaching is the use of embedded imitation to establish new skills
- In a study by J. Smith et al, large number of teachers reported using this approach, but observations indicated they generally left a key active ingredient out!

Responsive Parenting Example

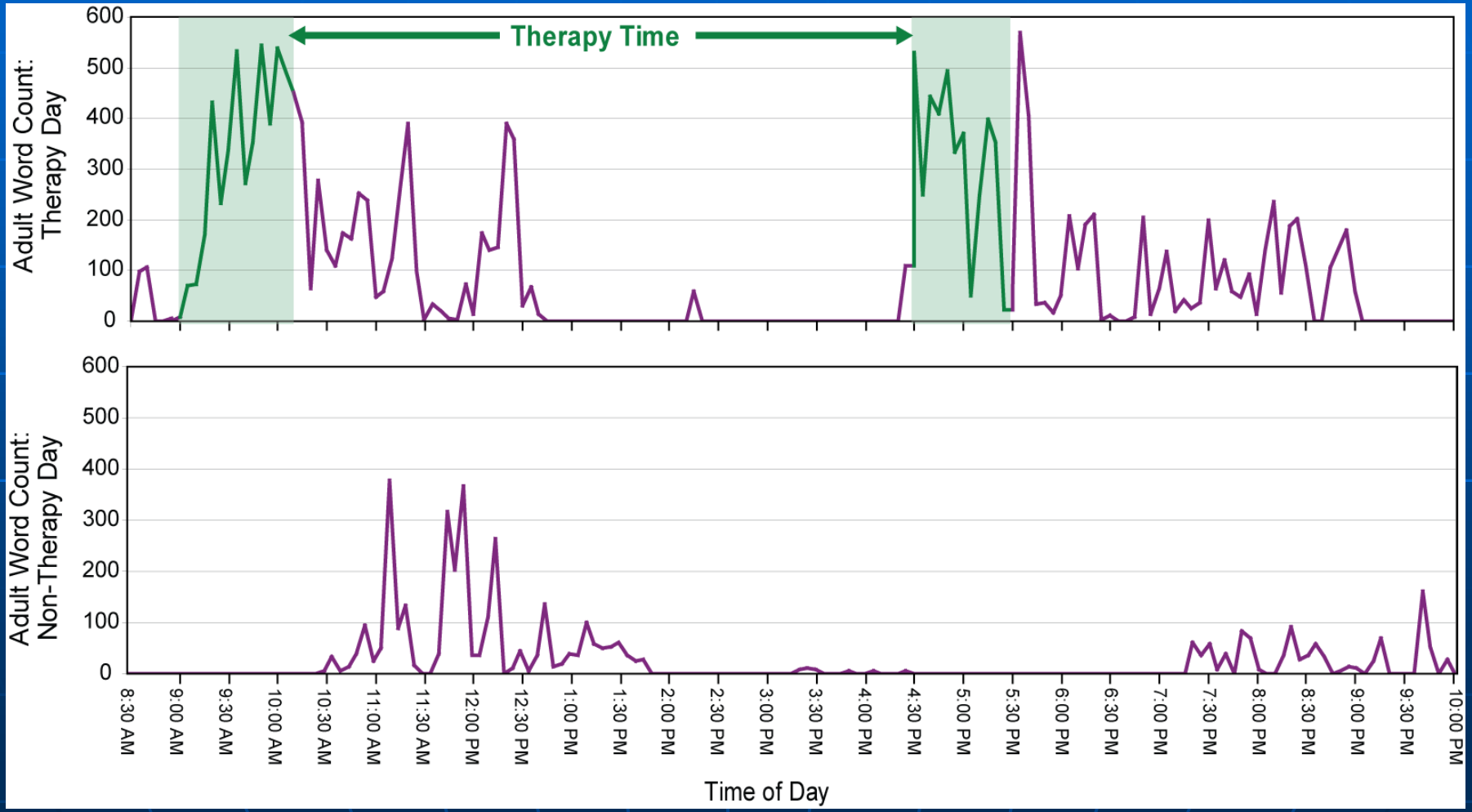
- Substantial evidence that frequent exposure to highly responsive adults has a cumulative impact on development
- A responsive parenting style can be taught relatively easily
- Do parents the use this parenting style sufficiently over long periods of time?

How would we know? How would they know?

- In the past we had no practical way to generate reliable answers to these questions
- The invention of the LENA system can allow easy monitoring of some key elements of adult-child interaction.

LENA IS BORN!

Adult Word Counts for Therapy and Non-therapy Days



The Road Ahead

- Behavioral research has only recently emerged from Phase 1
- A growing number of RCTs in literature over the past decade is an excellent sign
- Further progress = well controlled differential treatment intensity studies
- Clinical focus on treatment intensity and fidelity over long periods of time

Postscript: An example of building toward a study of differential treatment intensity

- Step 1 – Warren et al (1993) small N intervention study of active ingredients published in JSLHR; small N replication study published in 1994)
- Step 2 – first NICHD R01 to study approach using RCT design (1993-1998)
- Step 3 – Several Yoder and Warren pubs on this data (1998; 1999; 2001)

Postscript continued

- Step 4 – additional longitudinal studies of LOW intensity RE/PMT funded to Yoder, Warren, Fey (1997-2005): These studies demonstrate consistent, but limited effects of low intensity RE/PMT
- Step 5 – In 2005 NIDCD funded on first submission “differential intensities” R01 study by Warren, Fey, Yoder
- Step 6 – to be determined by the data

Selected References

- **Warren, S.F.**, Fey, M.E., Yoder, P.J. (2007). Differential treatment intensity research: A missing link to creating optimally effective communication interventions. Mental Retardation and Developmental Disabilities Research Reviews, 13 (1), 70-77
- **Warren, S.F.**, Gilkerson, S., Richards, J.A., Oller, D.K., Xu, D., Umit, Y., & Gray, S. (2010). What automated vocal analysis reveals about the vocal production and language learning environment of young children with autism. Journal of Autism and Developmental Disabilities, 40, 555-569.