

# **Special Methodological Challenges and Opportunities**

**Michael R. Hufford, Ph.D.**  
Vice President, Scientific Affairs  
invivodata, inc.

**PRESENTED AT:**  
**The Science of Real-Time Data Capture**  
**September 5, 2003**  
**Charleston, SC**

# Overview

---

- Adherence and real-time data collection
- Special (and not so-special) populations
- Subject burden
- Reactivity to real-time assessments
- Psychometric issues

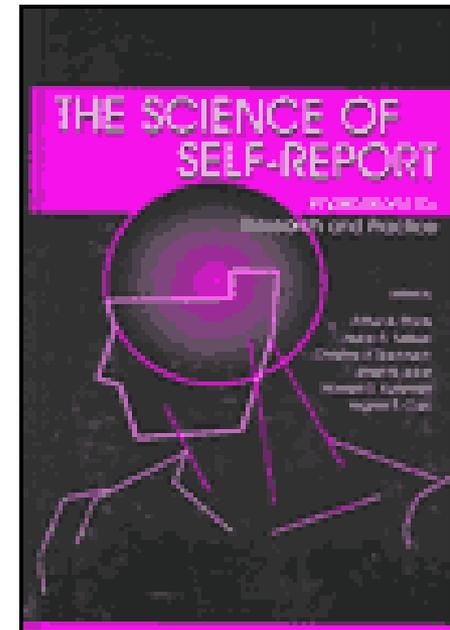
# ADHERENCE AND REAL-TIME DATA COLLECTION

“The palest ink is better than the best memory.” –  
Chinese Proverb

# Retrospective Recall: Problems\*

---

- Recall is often **inaccurate**
  - Especially for details, routine matters, and timing
- Recall is often **biased**
  - Heuristics used to reconstruct 'memories'
  - Content influenced by extraneous factors, e.g., recall context, salience
- Summary processes may add bias
  - “How many?” “On average...” “How severe?”
  - Estimation, not enumeration



Stone et al. 2000

\* Friedman, 1993; Henry et al., 1994; Thompson et al., 1993; Eich et al., 1994; Ross, 1989; Bradburn et al., 1987; Means et al., 1994

# Noncompliance and real-time data collection

---

- Noncompliance:
  - Undoes expected advantages of diary method
  - Reduces study power (by up to 30%)
    - Fewer data points
    - Less sensitive to treatment effects<sup>1</sup>
  - Increases magnitude of the placebo effect<sup>2</sup>
  - Introduces bias into the data<sup>3</sup>

1. Nived et al., 1994

2. Feine et al., 1998; Gendreau, 2003; Price et al., 1999

3. Shiffman, 2000

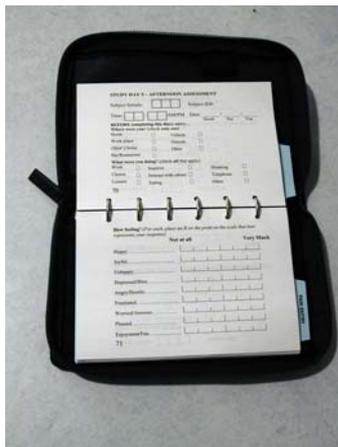
# Diary methods study: Design

(Stone et al., 2002, *BMJ*; 2003 *Controlled Clinical Trials*)

80 Pain Patients

Instrumented Paper Diary

N ≈ 40



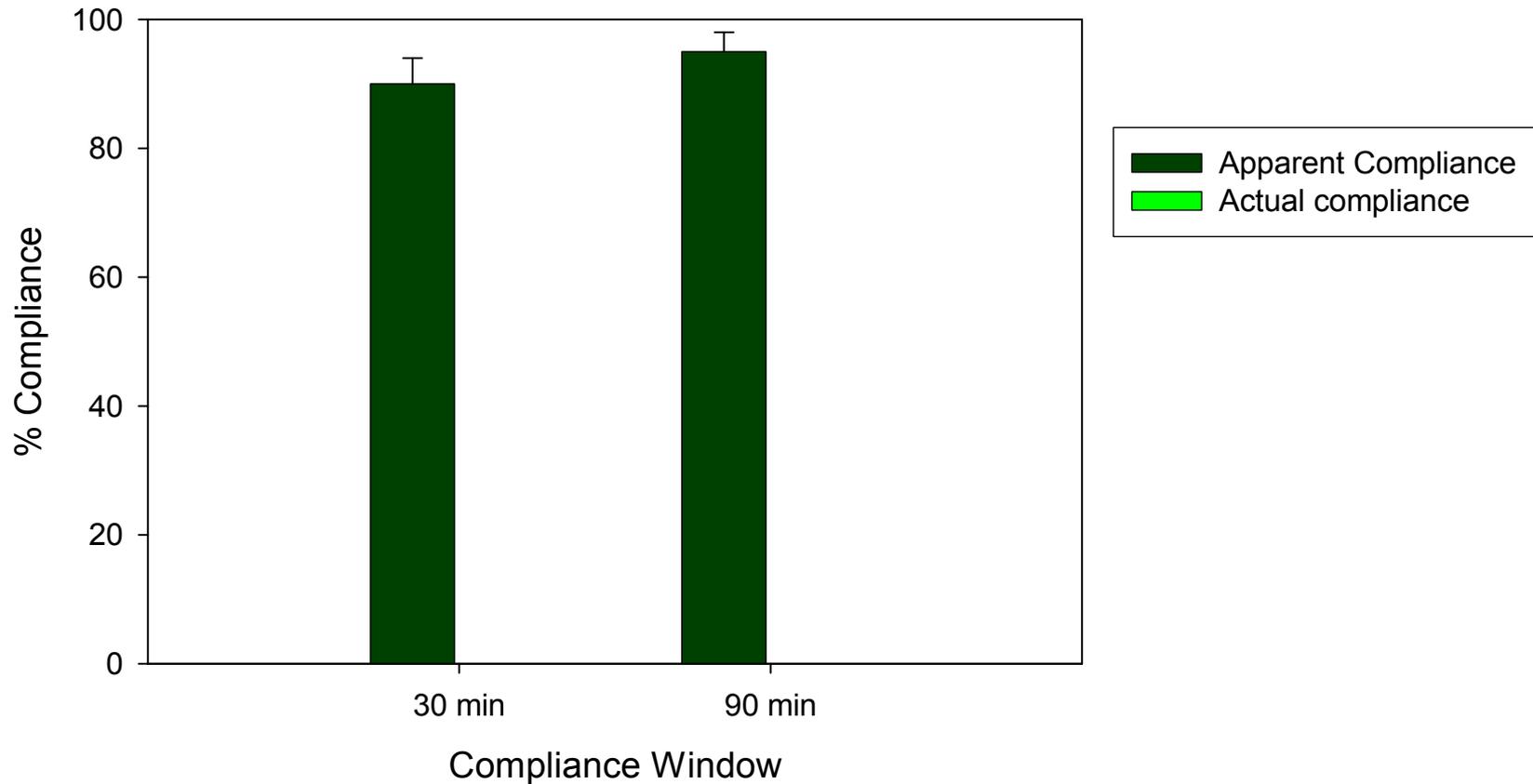
Patient Experience Diary

N ≈ 40



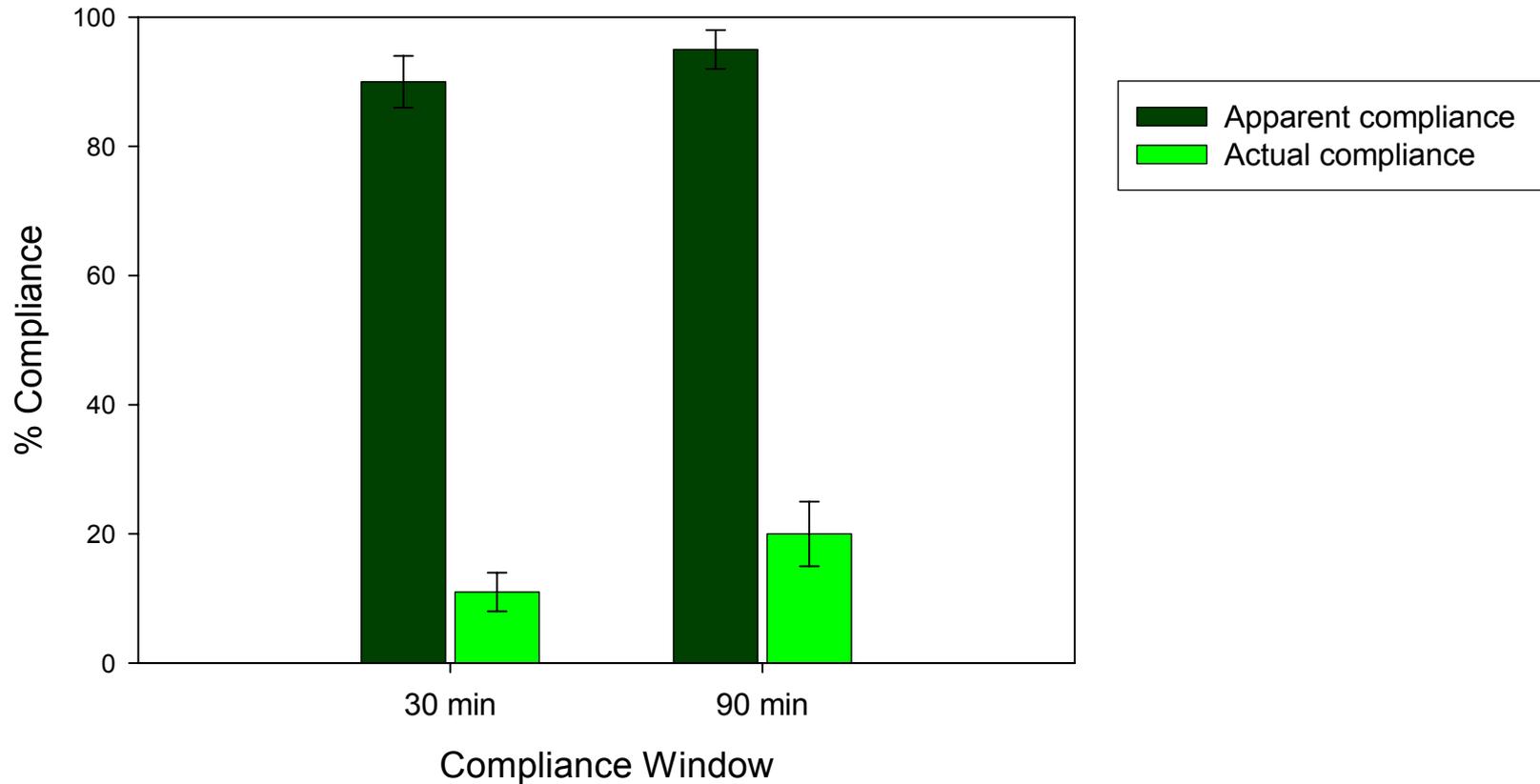
# Paper diary adherence: apparent

Apparent Compliance



# Paper diary adherence: actual

Apparent & Actual Compliance



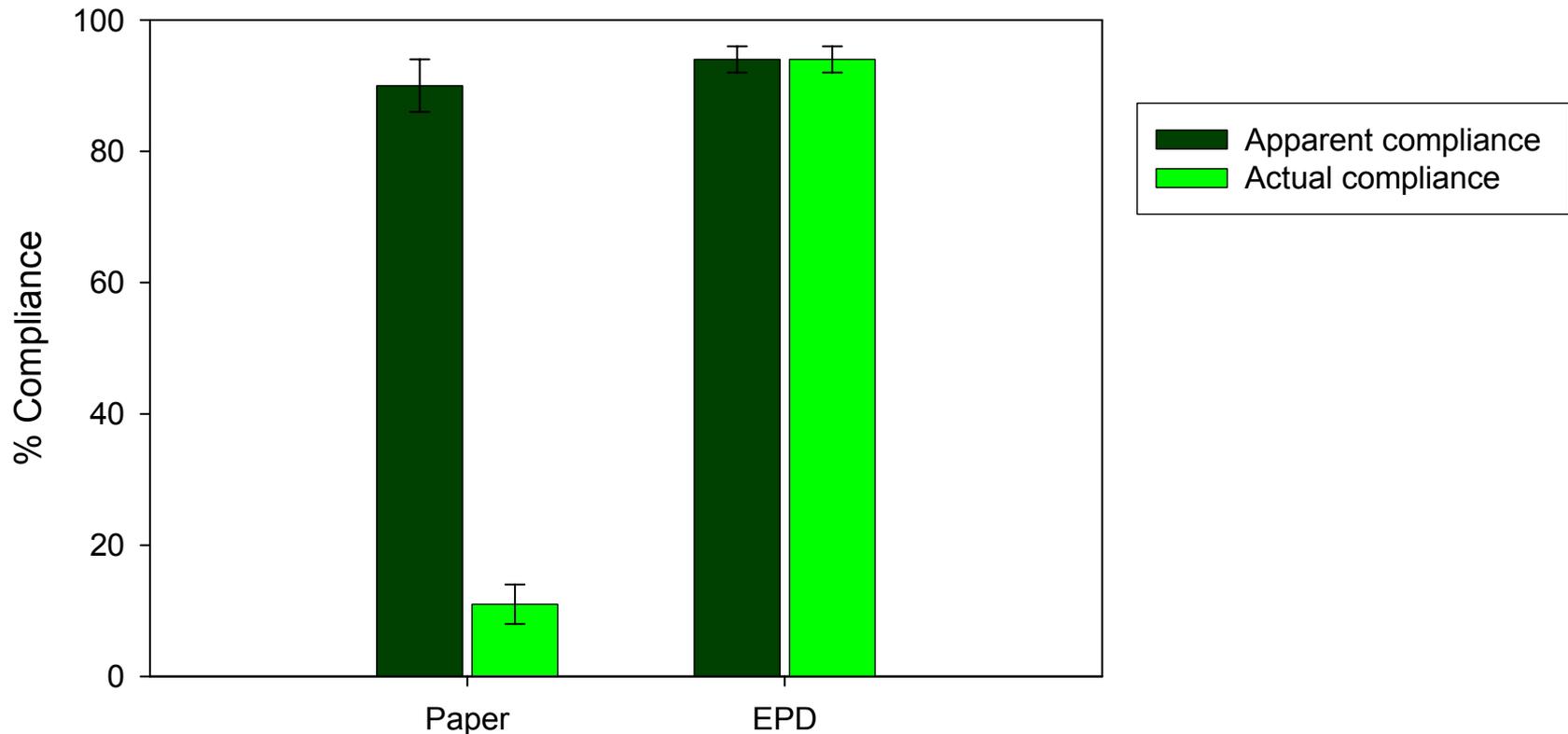
# Hoarding

---

- Completion of diary cards in batches
- Days with no paper diary use:  
32% of days
- On those days - Reported compliance:  
96%
- Back-filling
- *Forward-filling*

# eDiary vs. Paper diary adherence

Paper and Electronic Compliance: 30 Minute Window



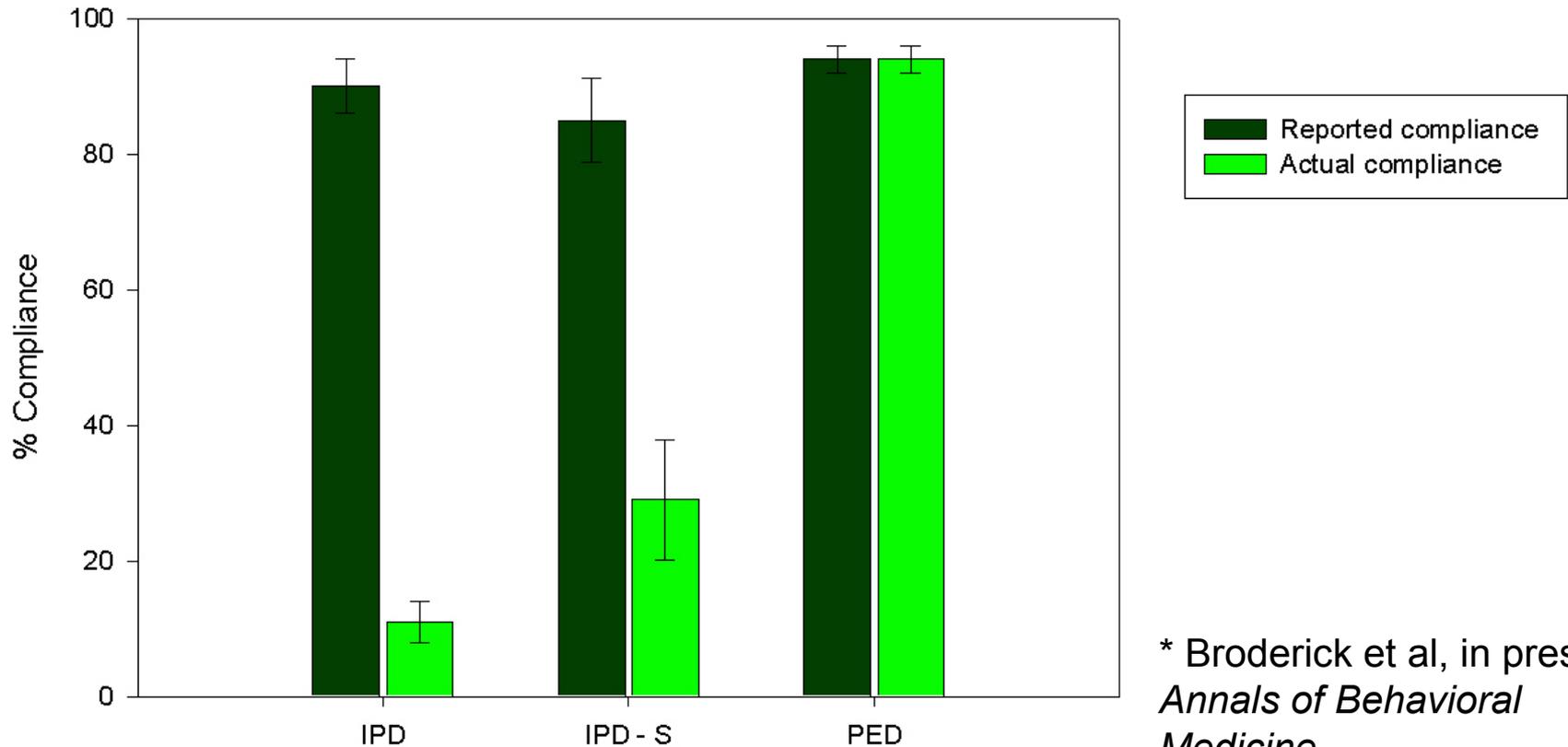
# Prompted paper diaries

---

- Could simply prompting patients account for improved adherence with EDs?
- Tested a condition of paper diary + active prompting
  - Prompting by programmable wristwatch
  - 'Beeped' until patient responded
  - Paper diary = IPD
  - Same methods, procedures

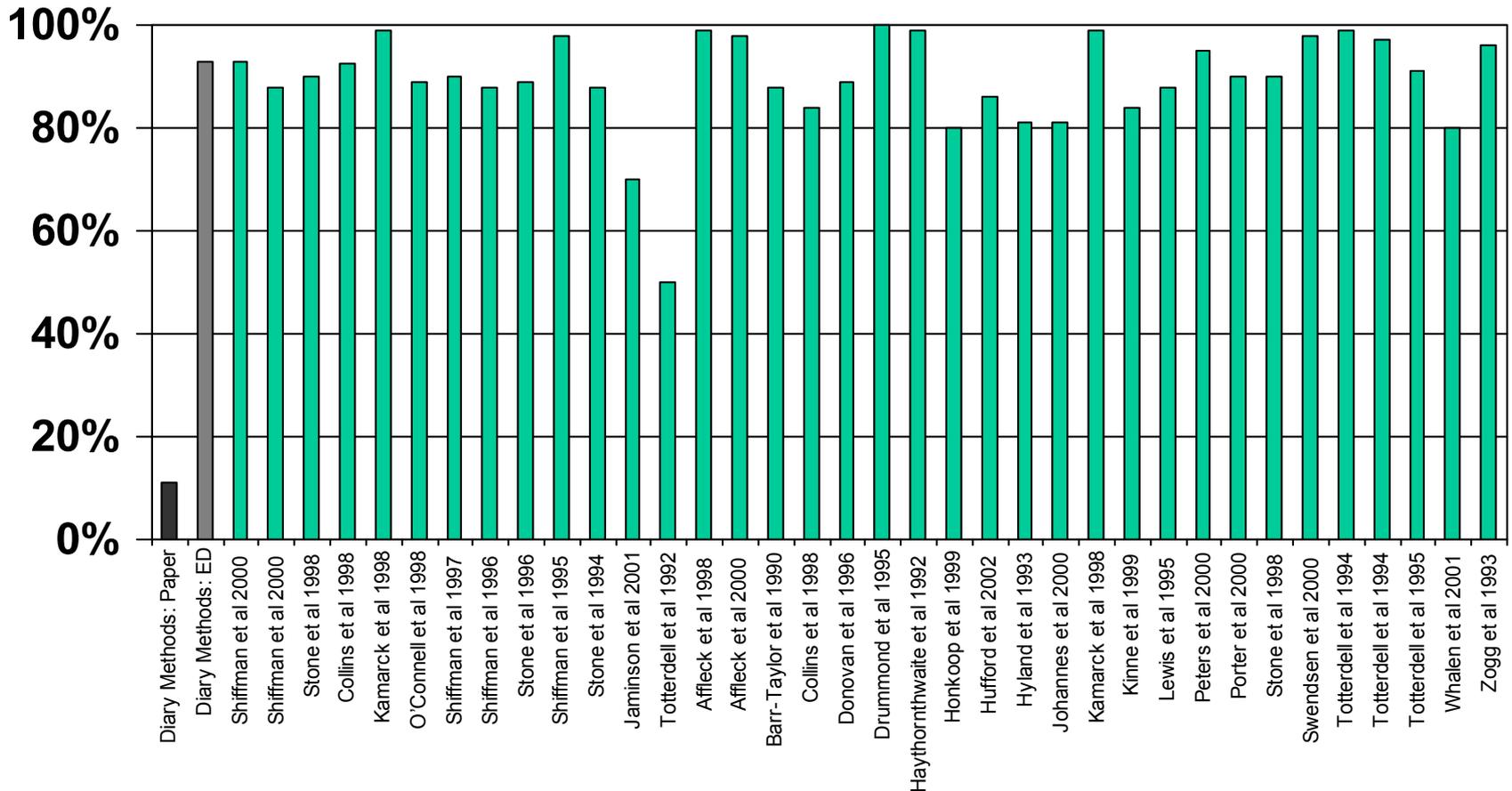
# Paper + prompting vs. eDiary\*

30 Minute Window



\* Broderick et al, in press, *Annals of Behavioral Medicine*

# Adherence with eDiaries\*



\*Hufford & Shields, 2002

# Helping adherence<sup>1</sup>:

---

- **Track adherence**
  - Mail-in paper diaries, IVRS and EPD time-stamping
- **Livability functions**
  - Helps patients be compliant with protocol
- **Patient-centric user-interface**
  - Easy to use regardless of ages, computer experience
- **Real-time compliance reminders**
  - Feedback can help remediate poor adherence
- **Backend compliance tracking**
  - Researcher feedback to subject
- **Create sense of accountability**

1: Hufford & Shields, 2002; Hufford & Shiffman, 2002; Stone & Shiffman, 1994; Broderick et al., under review

# **SPECIAL (and not so special) POPULATIONS**

# Special populations

---

- Computer experience (lack thereof)
- Age
  - Auditory impairment
  - Visual impairment
- Proxy reporting
  - Due to age
  - Due to specific ailments (e.g., advanced Alzheimer's)
- Specific disease states
  - e.g., Parkinson's disease

# Computer experience<sup>1</sup>

---

- Households with computer:
  - 1984 – 8.2%
  - 2000 – 51%
- Experience varies widely, across ages, socioeconomic strata, races...
  - Income under \$20K/yr: 31%
  - Income over \$75K/yr: 88%

1. 2000 U.S. Census, U.S. Department of Commerce

# Age issues: Case studies

---

## Smoking cessation study

- N = 303 smokers, 28 subjects 60+ years
- Mature subjects *more* compliant with assessment
- Fewer missed random assessments
  - 9.5% vs. 13.4%

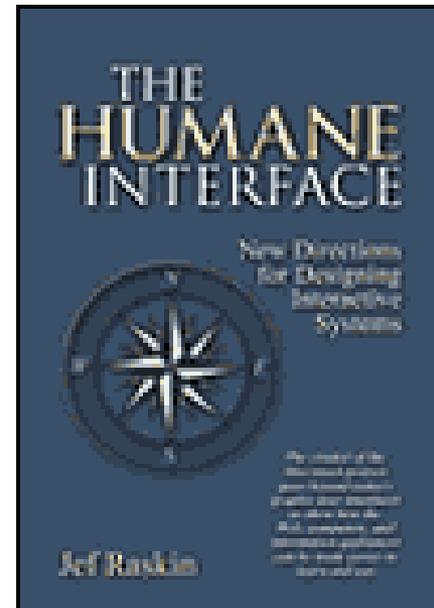
- Genitourinary study

- N = 1134, 482 subjects 60+ years
- EPD compliance (10+ assessments/day)
  - Below 60 = 93.2%
  - Above 60 = 93.4%

# Subject-centric computing:

## *Keeping it simple*

- EVERY interface that the subject sees should be simple
- What's simple?
  - What's being asked is clear
  - How to answer is clear
  - User sets the pace
  - Develops a good habit



Raskin, 2000

# Making interfaces anyone can use

- Assume no history of using computers
- Assume no familiarity with keyboards
- Avoid excessive colors, sounds
  - Shown to confuse older patient groups (Demiris et al., 2001)
- Prepare for impairment
  - 1 in 3 patients over 85 will have visual/auditory impairments

# Usability is one key to success

**ANGINA EPISODE REPORT**

Duration significant pain (min)  
26

Episode ended 16 minutes ago

If Rx therapy, Degree of Relief  
None Complete

Other Treatment  
NTG Pills  
NTG Spray

Back Next

WHAT OTHER SYMPTOMS ARE YOU CURRENTLY EXPERIENCING?

OTHER (PLEASE TYPE RESPONSE BELOW)

Esc	q	w	e	r	t	y	u	i	o	p	←
Tab	a	s	d	f	g	h	j	k	l	*	
Shift	z	x	c	v	b	n	m	;	'	←	
123	á	ü	Ctrl	@	&			,	.	/	?

**Headache Interview**

- HEADACHE -  
Rate the severity of your headache:

Not at all Severe

Back Go

# Preference studies

---

- **Drummond et al. (1995): N = 46 GI subjects**
  - 57% preferred the e-diary, 13% preferred the paper diary (30% no preference)
  - Neither age, gender, nor comfort with technology/use of computers predicted preference
- **Tiplady et al. (1997): N = 22 respiratory subjects**
  - 59% preferred the e-diary, 18% preferred paper (23% no preference)
  - Age, gender, and comfort/familiarity with technology were not associated with diary preference
- **Rabin et al. (1996): N = 72 UI patients/controls**
  - Over 98% of their UI subjects and over 80% of their control group explicitly expressed preference for e-diary
  - Both groups more positively evaluated the e-diary on a variety of attributes (e.g., 'fun,' 'easy to use,' and 'feel involved')
- **Finkelstein et al. (1998): N = 17 asthma subjects**
  - Low SES subjects from urban community without previous computer experience
  - 82% of subject found the e-diary 'not difficult at all' to use
  - Previous computer experience is not necessary for subject compliance

# SUBJECT BURDEN

“Complex tasks may require complex interfaces, but that is no excuse for complicating simple tasks.” – Raskin, 2000

# Subject burden: Art and science

---

- Density of sampling
  - Once weekly to 15+/day
  - 90% of published studies sample patients >1/day
- Assessment length
  - 1 item measures to 50+ per interview
- Assessment complexity
  - Importance of minimizing cognitive load (Hufford & Shiffman, 2002)
- Duration of monitoring
  - On/off period: pros and cons
- Durability of hardware/software
- ***Compliance is key dependent measure***

# Patients' response to EMA

	No EMA	3 per day	6 per day	12 per day
Willingness to participate again	2.43 <sub>ab</sub>	2.73 <sub>a</sub>	2.18 <sub>b</sub>	2.50 <sub>ab</sub>
Burden of participation	.43 <sub>a</sub>	.64 <sub>ab</sub>	.91 <sub>bc</sub>	1.33 <sub>c</sub>
Interfere with daily activities	.57 <sub>a</sub>	.50 <sub>a</sub>	.64 <sub>a</sub>	1.25 <sub>b</sub>

Response Scale: 0= Not at all, 1=Slightly, 2=Moderately, 3=Extremely

# REACTIVITY TO REAL-TIME ASSESSMENTS

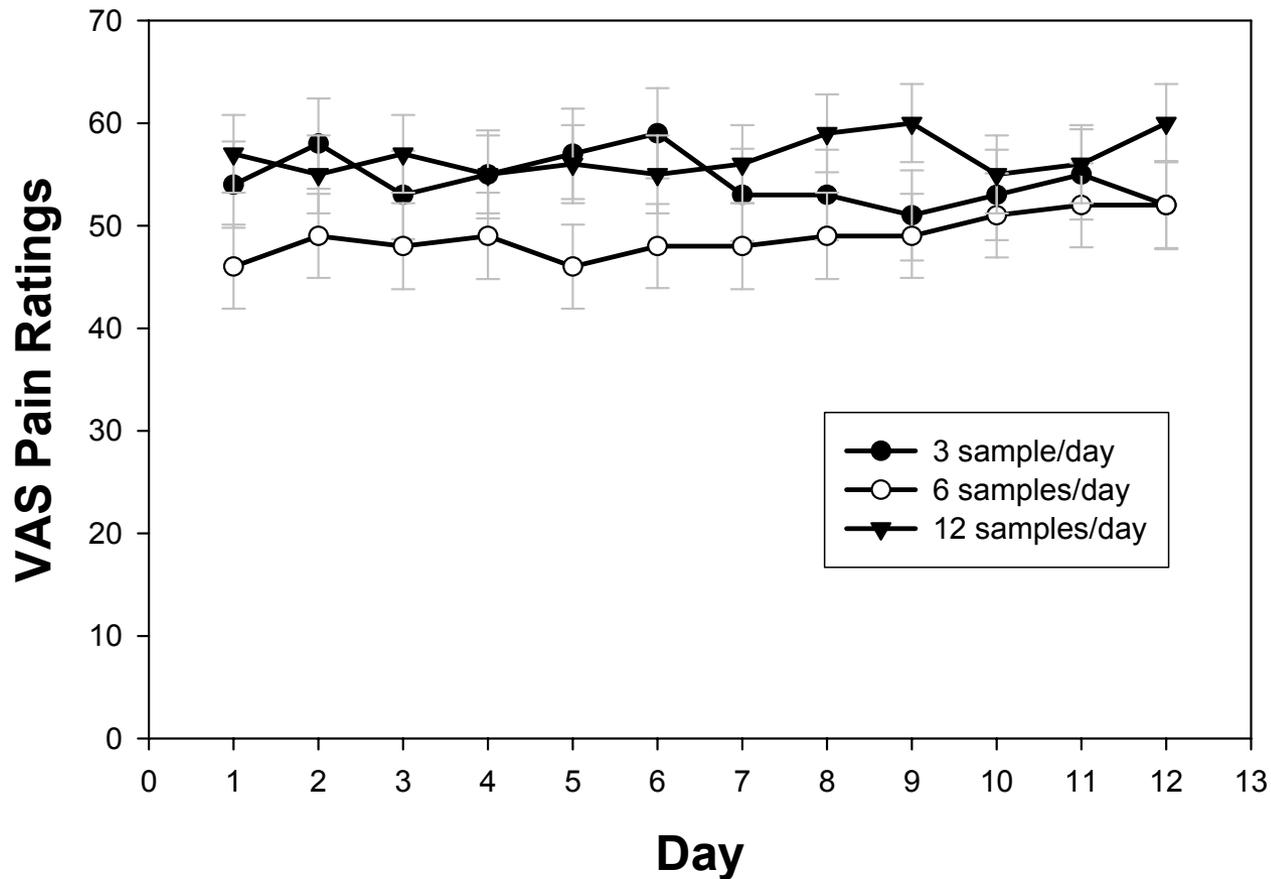
# Reactivity

---

- A *reactive effect* describes the degree to which the intensity, frequency, or quality (or some combination of these) of a target variable will change when it is being observed, monitored, or assessed (Nelson, 1977)
- Reactivity:
  - To self-monitoring
  - To prompting for assessments
- EMA and reactivity
  - Cruise et al. (1996); Hufford et al. (2002); Collins et al. (1998); Litt et al (1998)

# Reactivity

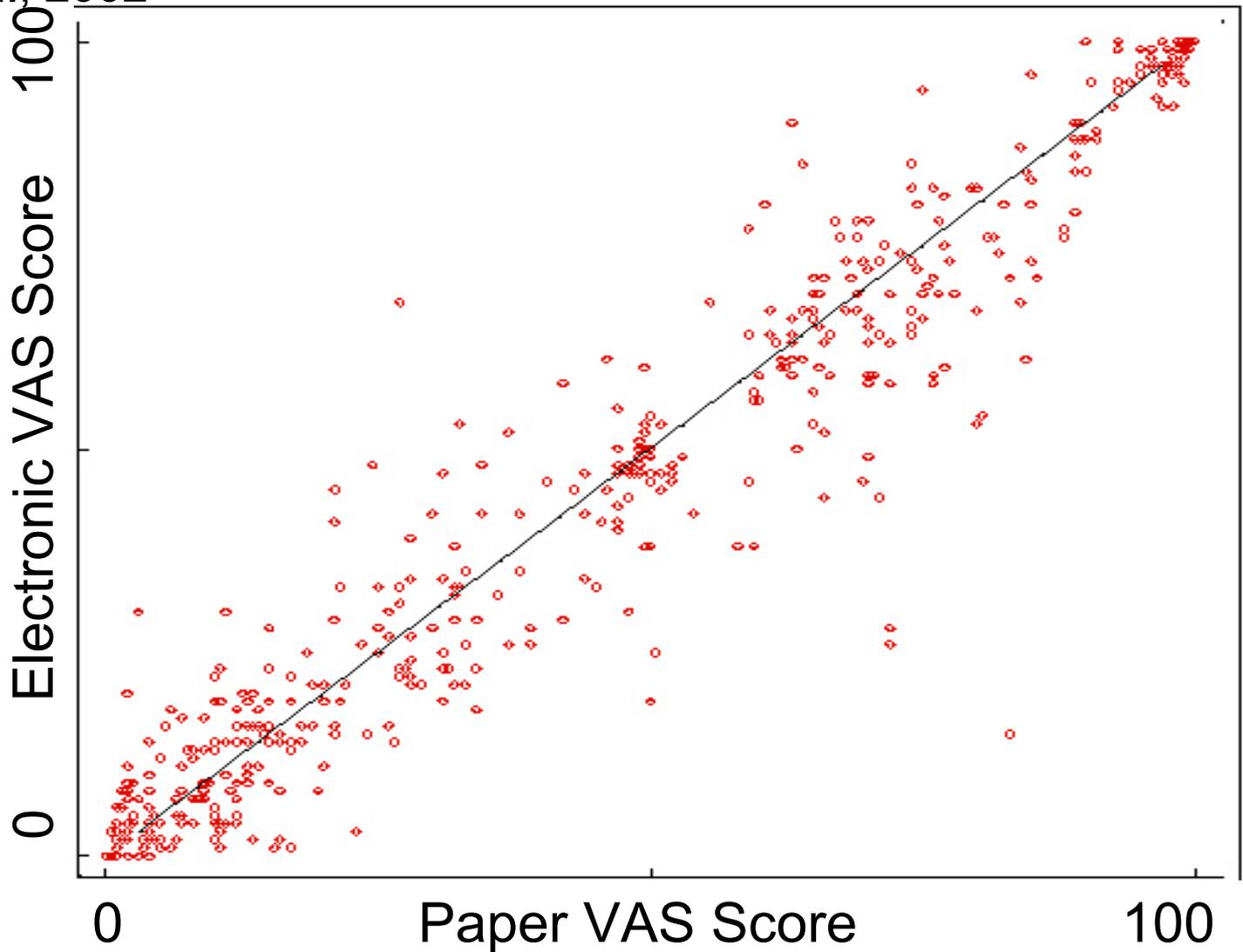
## *Means and SEs of VAS Pain Ratings with Reported Pain*



# PSYCHOMETRIC ISSUES

# Research on Psychometric Validation

- Does a PAPER questionnaire or capture element lose validity in an “electronic” version?
  - Literature says no
    - Provided psychometric attributes preserved
    - e.g., Jamison et al., 2002; Price et al., 1994; Stubbs et al., 2000, 2001; Hank & Schwenkmezger, 1996; Ryan et al., 2002
  - Example: Research study of Visual Analog Scale on paper vs. electronic implementation
    - Jamison et al., 2002; Hufford & Shiffman, 2000

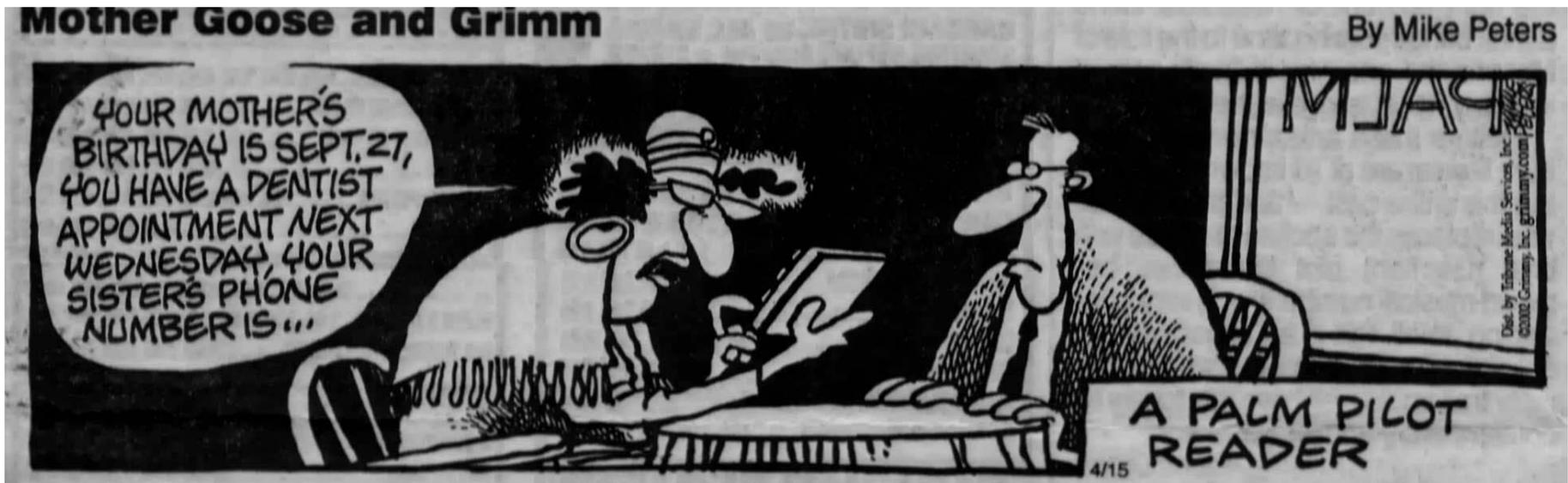


Correlation  $r = .97$  ( $r^2 = .997$  Cognitive Means  
= .999 Sensory Means)

# Research on Psychometric Validation

- Translation of recall to real-time measure
- Translation from paper measure to IVRS?
- Translation from desktop PC to PDA? (!)

# Summary



For more information, contact:

Michael R. Hufford, Ph.D.

[mhufford@invivodata.com](mailto:mhufford@invivodata.com)

412.390.3008