Reliability of reported sexual partnership dates and measures of concurrency

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Timing of sexual partnerships constrains potential flow of STIs

Concurrency (overlapping sexual partnerships) associated with STI <u>transmission</u> (Potterat et al.; Koumans et al.)

Gap between serial partnerships also thought to influence transmission (Foxman et al.)

With few exceptions, sexual networks have been studied as static entities

# Cumulated romantic network, midwestern US high school (Moody)

54% of all romantically involved students directly or indirectly linked to each other when considered statically
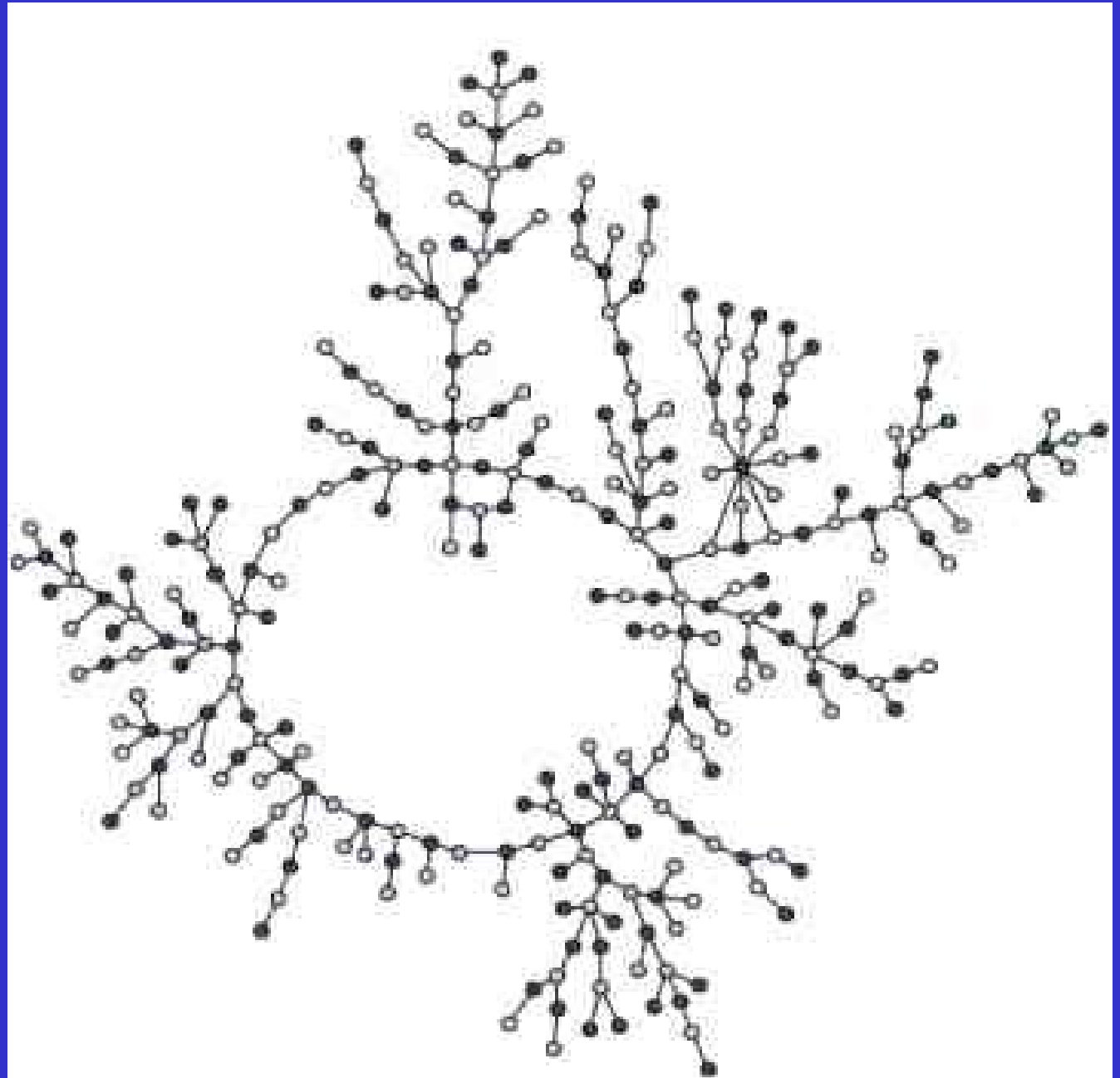
Time-ordered romantic network, midwestern US high school (Moody)

One timing considered, network fragments

Fragmentation would inhibit transmission (network isn't a true sexual network, though -- graphs overstate transmission potential)
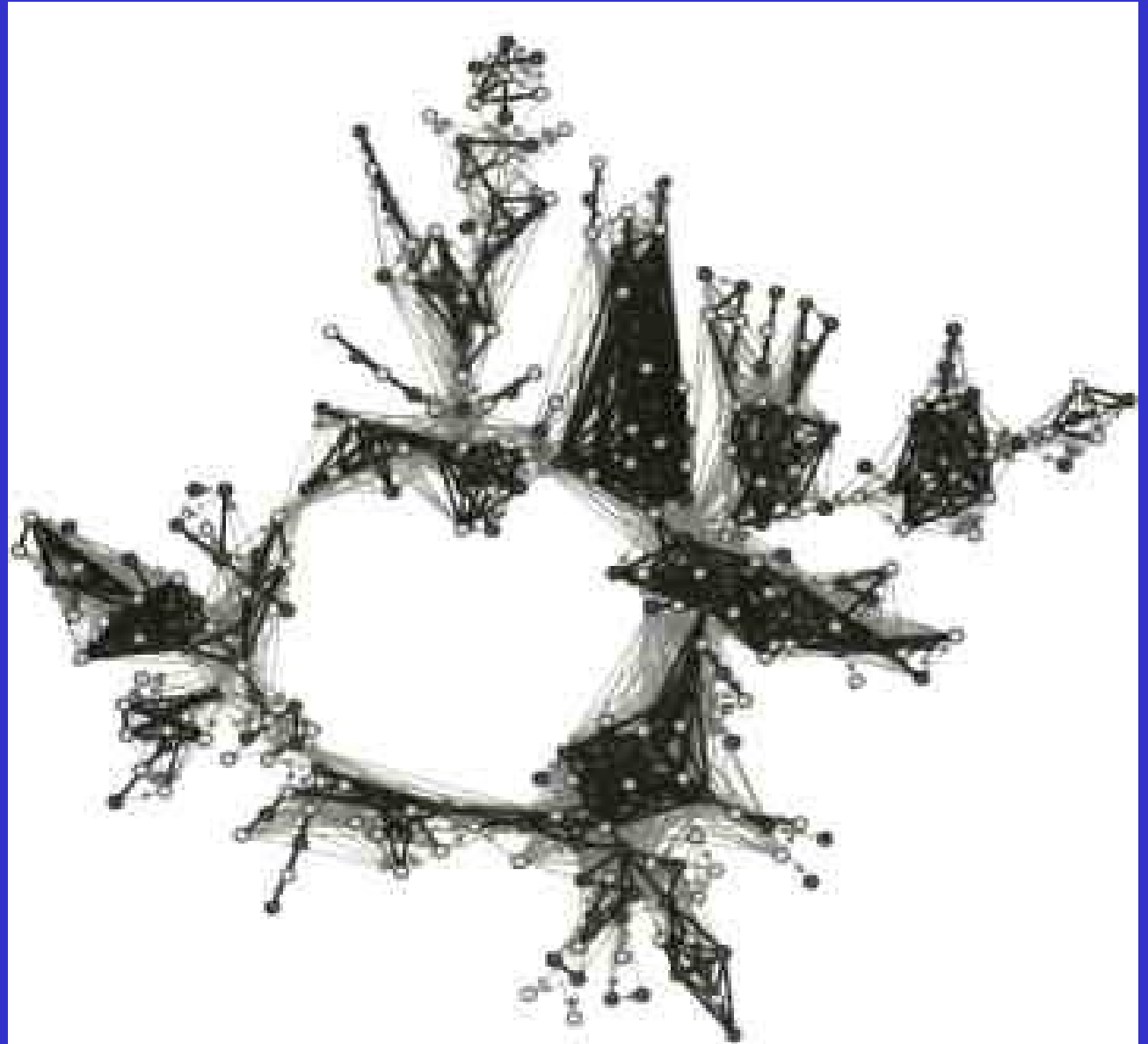
Development and assessment of relevant time-dependent network measures just beginning for epidemiologic research

Sexual & other contact networks = metaphors for persons with episodic interactions forming momentary links

Practical importance of temporal data for contact tracing, e.g.:

- **identifying partners at risk**
- **prioritizing partners for intervention**
- **classifying source and spread cases**

Crucial to determine quality of reported data on sexual partnership timing

Validity difficult (but not impossible) to assess

At least two types of reliability:

• test-retest (consistency of repeated reports)

• interpartner (agreement between partners in a dyad) (Brewer, Rothenberg et al., 2006)

Methods

Test-retest

1) chlamydia & gonorrhea contact tracing, Colorado Springs, USA, 1995-2001

• 355 persons diagnosed on repeated occasions who reported 1+ sex partners whom they also reported in another contact interview (persistent partnerships)

• recall/interview periods for elicitation ranged from ~ 30 days - 6 months

1) Colorado Springs, test-retest (cont.)

- reported date of first sex analyzed only

- precision of reports inferred from interviewer recording conventions

    - e.g., July 1, YYYY ---> precise to year if > 400 d prior to interview)

- 438 partnerships (1.2 per respondent); analyzed first 2 reports of partnership only

    - 67 persons reported 3+ times on same partnership

2) Test-retest reliability, Seattle, 1996-7

- respondents = MSM, IDUs, & presumed "high risk" heterosexual adults

- interval between interviews intended to be either 2 or 12 weeks

- recall/interview periods for elicitation were 12 or 24 months at 1st interview, 24 months at 2nd interview

- 21 respondents reported 88 partnerships in both interviews; verbatim reports recorded

Interpartner reliability

- **5 contact tracing data sets from Colorado Springs and metropolitan Atlanta, USA, 1981-1999 (Brewer, Rothenberg et al.)**

  - **chlamydia, gonorrhea, syphilis, & HIV**

  - **774 unordered partnerships involving 1,253 unique persons**

  - **recall/interview periods for elicitation ranged from ~ 21 d to 12+ months**

  - **precision of reported dates inferred from recording conventions**

Characteristics of partnerships

	Test-retest		Interpartner
	CO Springs	Seattle	CO Springs/ Atlanta
N partnerships	438[a] (ordered)	88 (ordered)	754[a] (unordered)
% partners interviewed	72	0[b]	100
Mean/median no. days between interviews	242/137	24/9	57/10
Mean/median no. days between 1st reported date & 1st interview	393/154	831/448	407/93[c]

[a]72 unordered (144 ordered) partnerships overlap in these data sets
[b]No known partners interviewed, but likely some were
[c]As reported by partner interviewed first

Absolute difference in reported date of first sex

% of partnerships

	Test-retest		Interpartner	
Degree of difference	CO Springs	Seattle	Netherlands[*]	CO Springs/ Atlanta
0 d/perfect	34	9	14	32
<= 30 d	52	51	41	64
<= 60 d	59	63	---	72
<= 365 d	86	93	82	90

*STD cases (Van Duynhoven et al.)

Precision of reported first date of sex

Precision	Test-retest		Interpartner
	CO Springs	Seattle*	CO Springs/Atlanta
Day	13%	7%	56%
Month	60%	53%	32%
Year	28%	40%	12%

*day = day/week; month = month/season; year = year/cruder period

Absolute difference in reported date of first sex

Statistic/precision	Test-retest		Interpartner
	CO Springs	Seattle	CO Springs/Atlanta
Mean days			
Day	19	2	21
Month	134	100	113
Year	314	202	400
All	169	136	122
Median days			
Day	1	0	2
Month	29	39	26
Year	166	30	137
All	30	30	13

Test-retest reliability, reported date of first sex, CO Springs

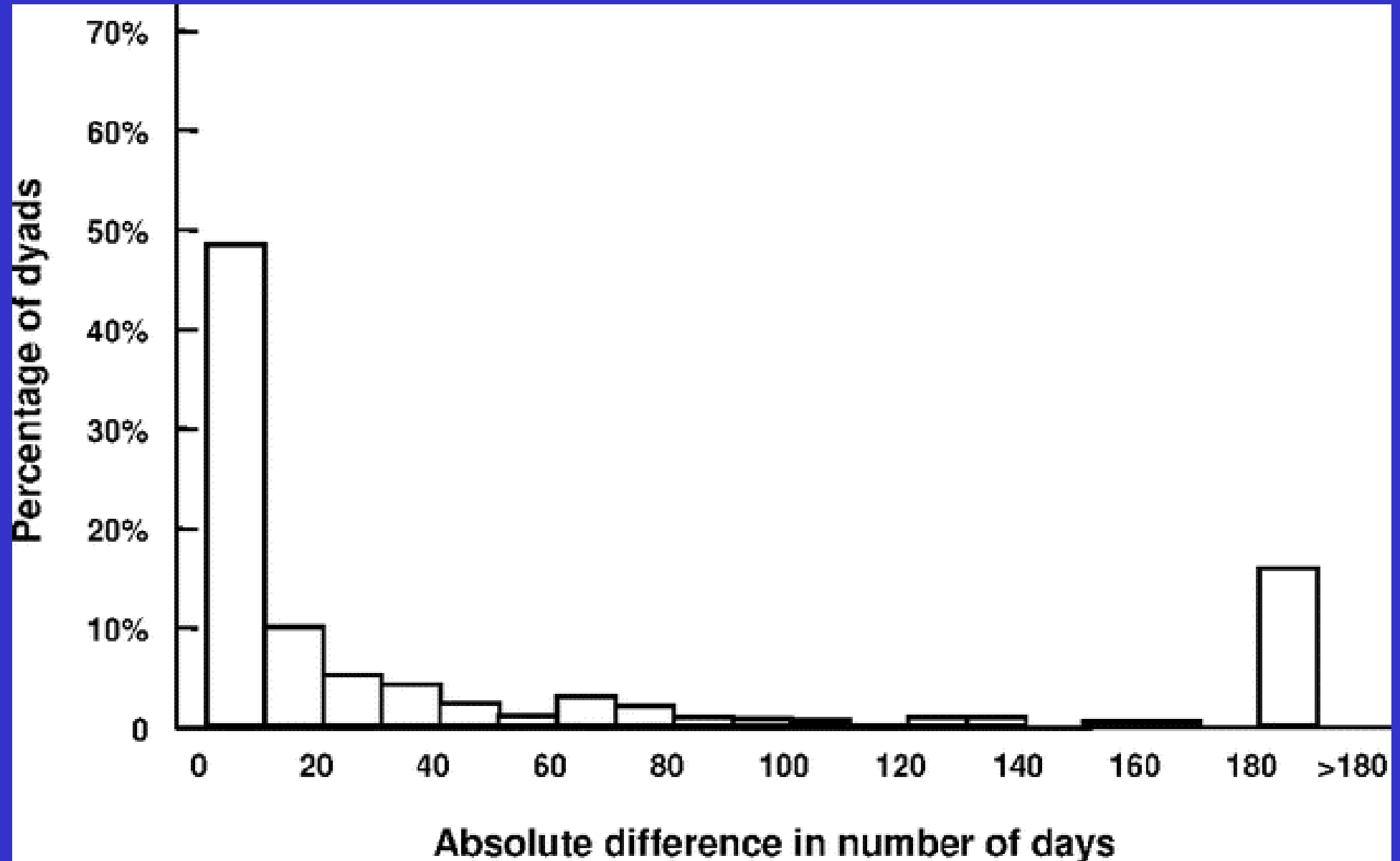Percentage of partnerships vs. Absolute difference in reported date (days)
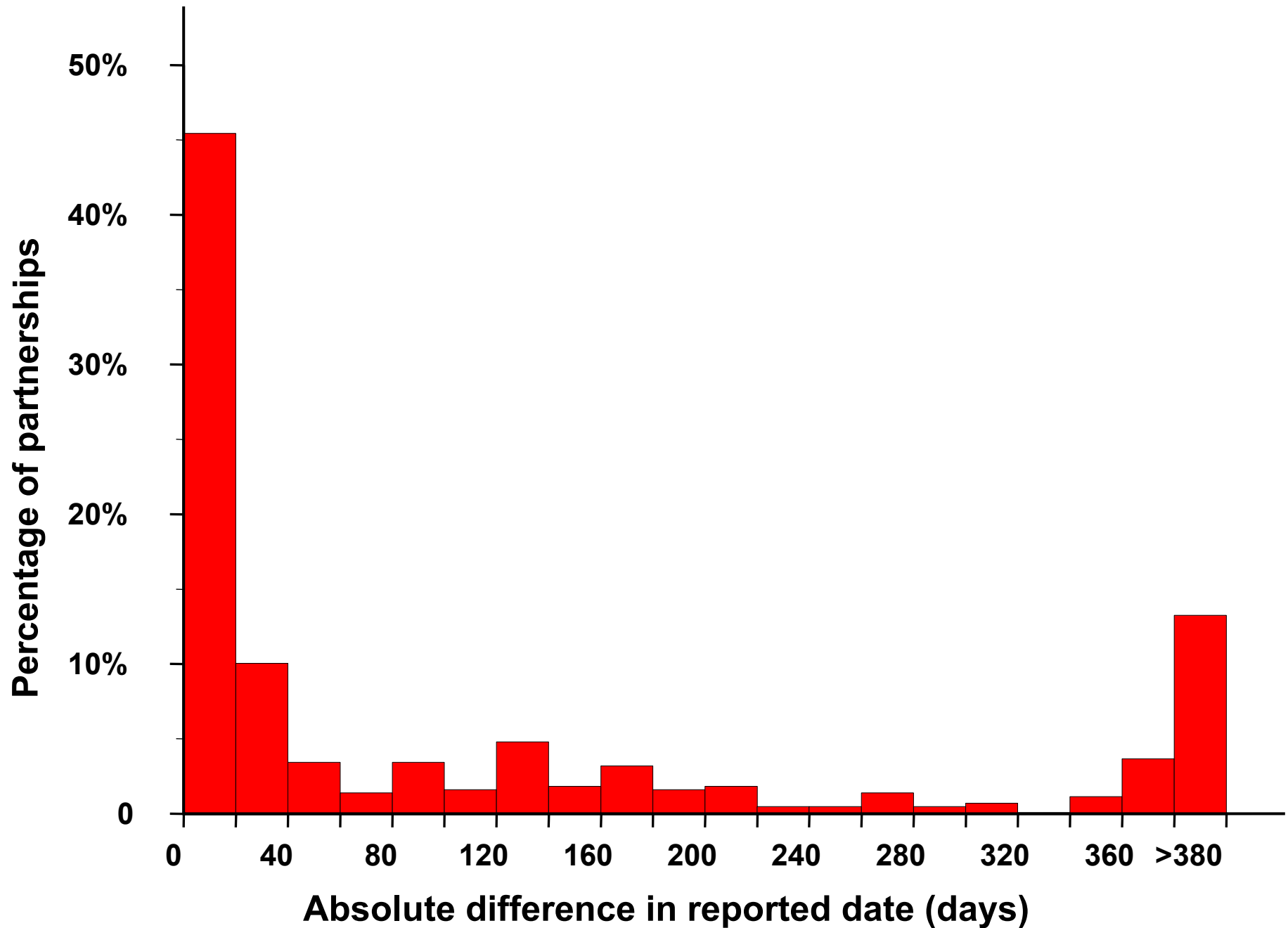
Test-retest reliability, reported date of first sex, Seattle
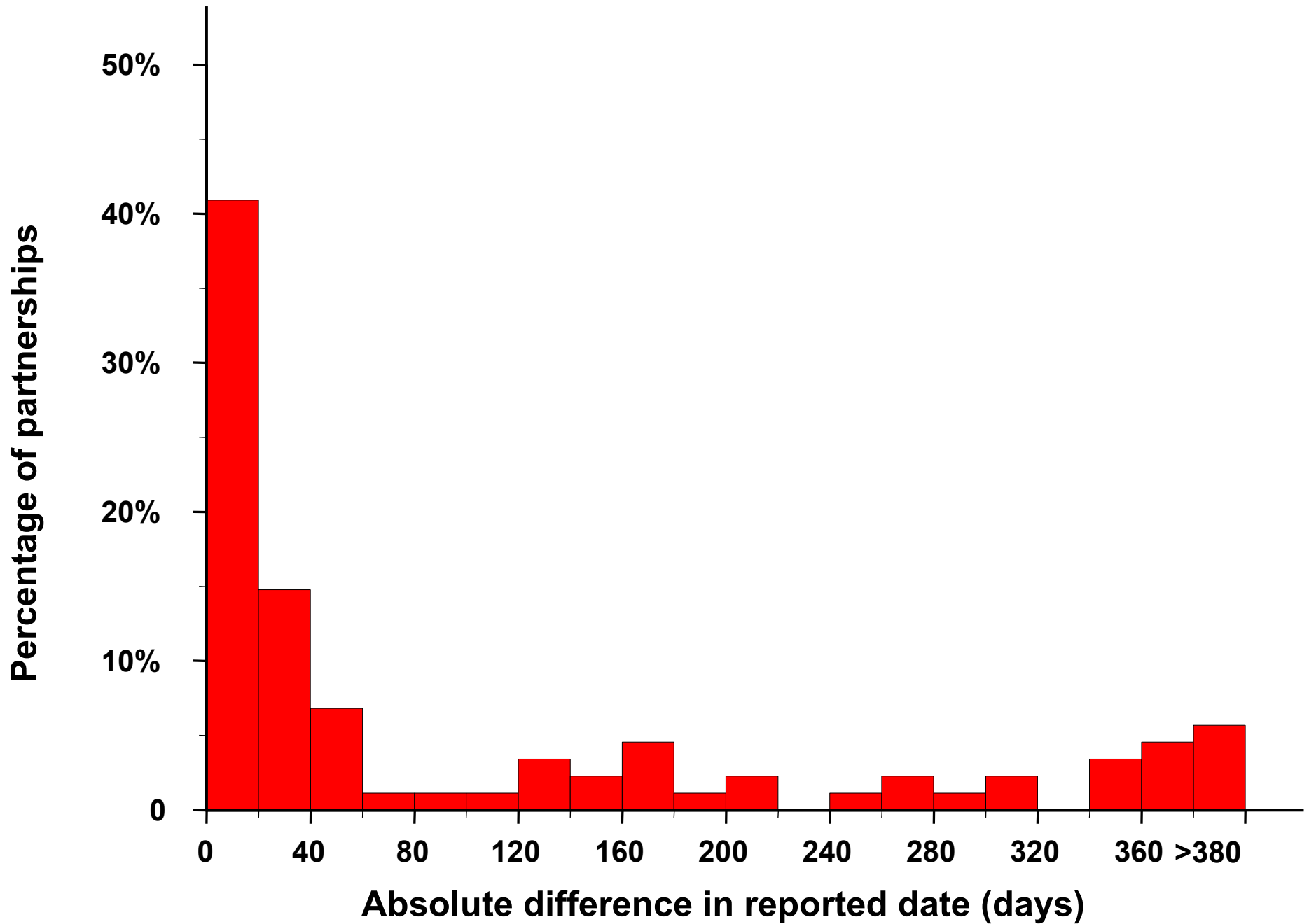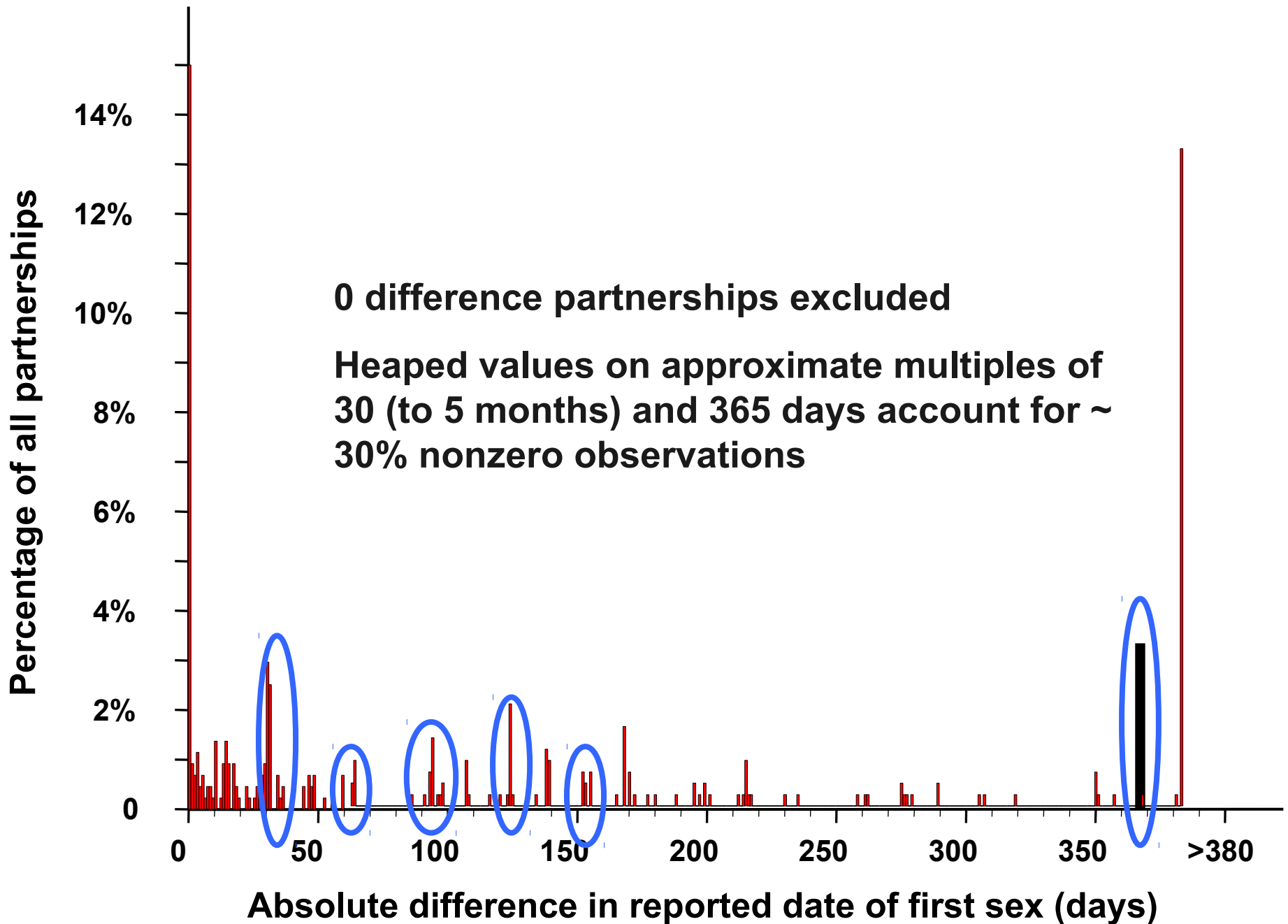
Interpartner reliability, reported date of first sex, Colorado Springs and Atlanta

Test-retest reliability, CO Springs, heaping

0 difference partnerships excluded

Heaped values on approximate multiples of 30 (to 5 months) and 365 days account for ~ 30% nonzero observations

Percentage of all partnerships

Absolute difference in reported date of first sex (days)

Test-retest reliability, Seattle, heaping

7 d

0 difference partnerships excluded

These heaped values account for 33% nonzero observations

14 d

30 d

365 d

Percentage of partnerships

Absolute difference in reported date of first sex (days)

Signed difference in reported date of 1st sex

Statistic/precision	Test-retest reliability	
	CO Springs	Seattle
Mean (SE) days		
Day	9 (6)	0 (2)
Month	54 (18)	13 (22)
Year	55 (49)	-13 (66)
All	49 (17)	7 (29)
Median days		
Day	0	0
Month	0	2
Year	0	0
All	0	2

Test-retest reliability, reported date of first sex, CO Springs

Perfectly reliable observations (0 difference) excluded

reverse telescoping

forward telescoping

Percentage of partnerships

16%

14%

12%

10%

8%

6%

4%

2%

0

Signed difference in reported date (days; 1st interview - 2nd interview)

<-380   -320   -240   -160   -80   0   80   160   240   320   >380

Test-retest reliability, reported date of first sex, Seattle

Percentage of partnerships

Perfectly reliable observations (0 difference) excluded

reverse telescoping

forward telescoping

Signed difference in reported date (days; 1st interview - 2nd interview)
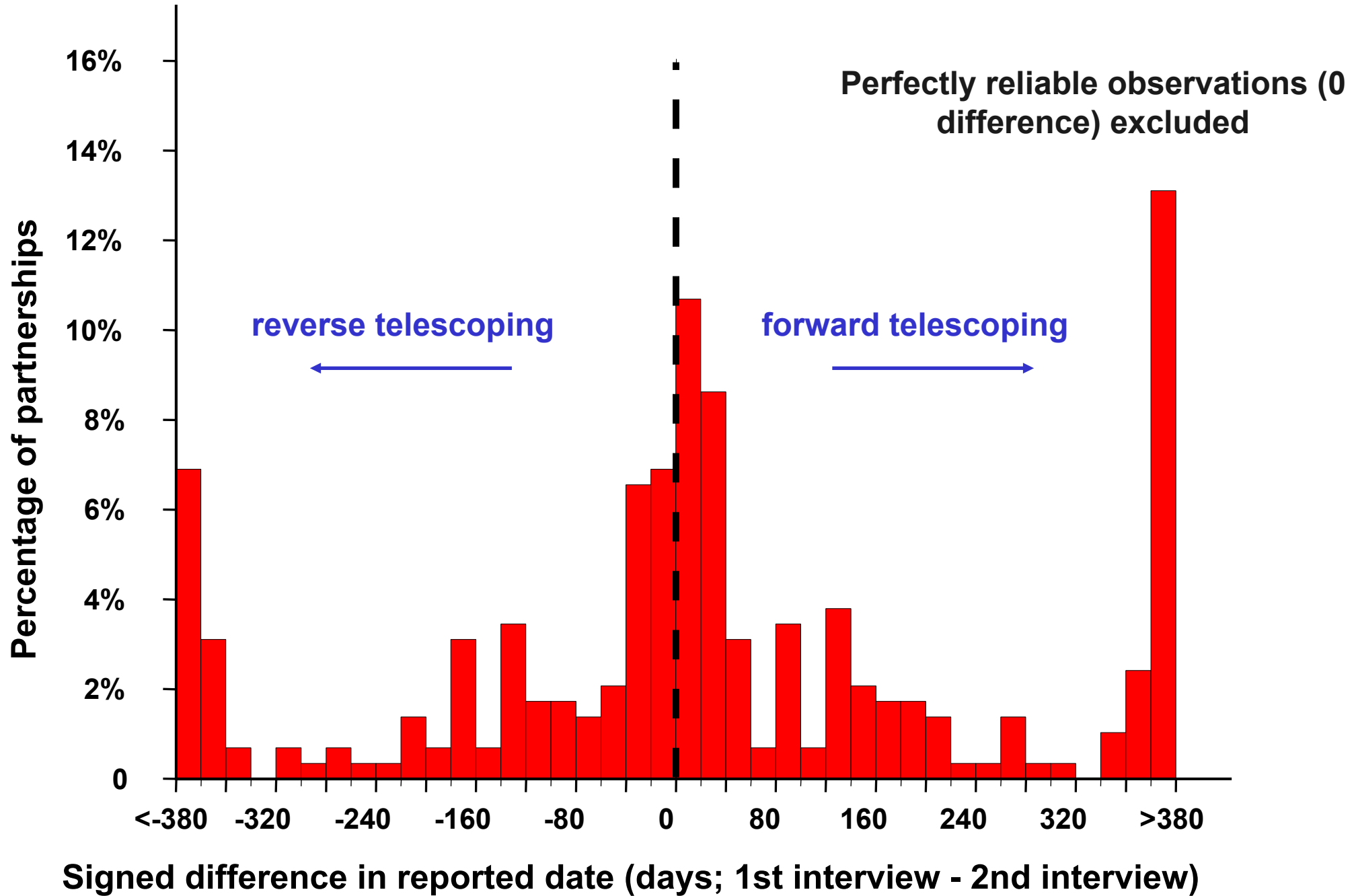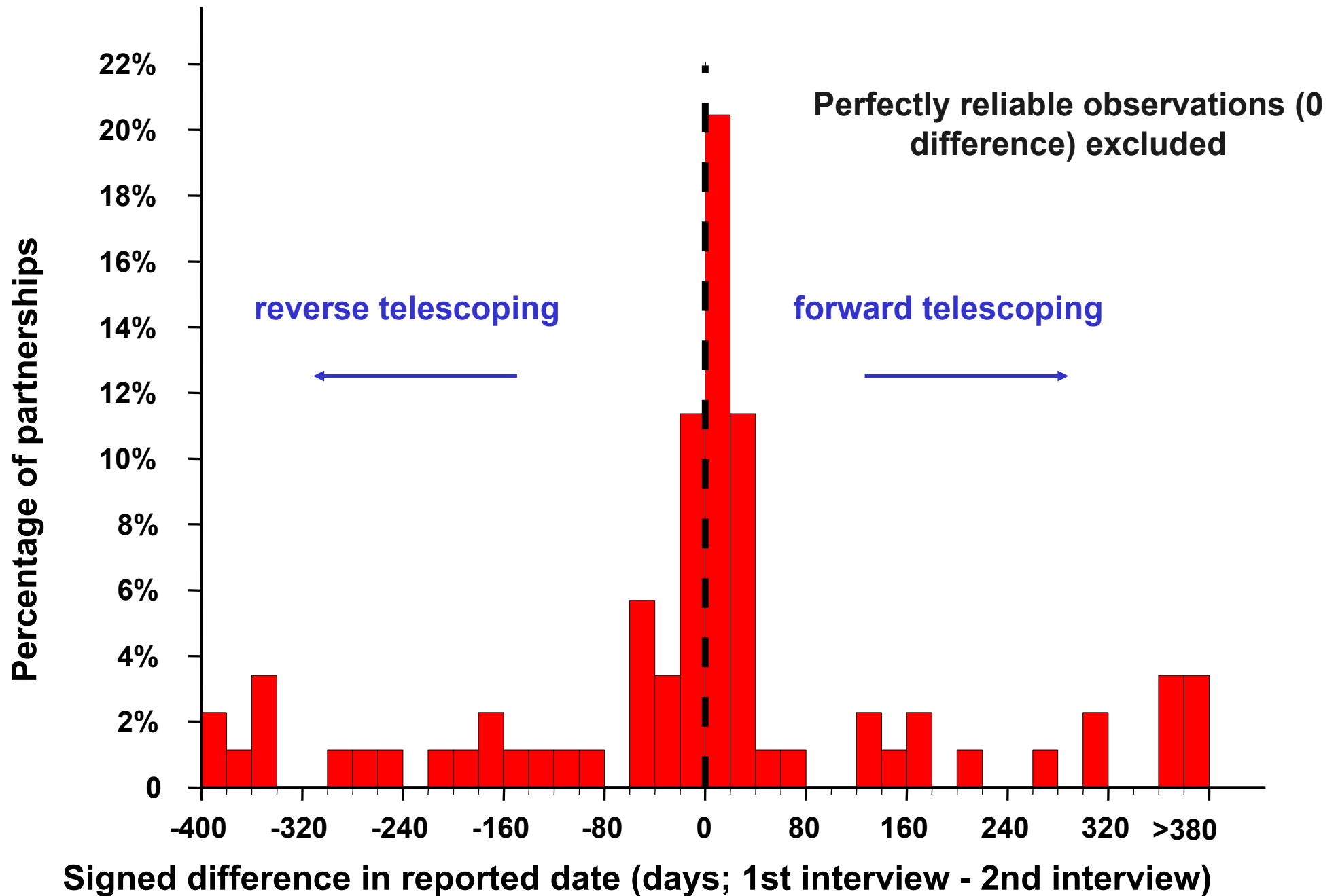
However, no indirect evidence of telescoping reported date of first sex in interpartner data (Pearson r of interval between interviews and signed difference = .00)

Absolute difference in days for reported date of first sex, Colorado Springs test-retest

Variable	Unstd. coeff.	Partial r	p
Constant	55 (32-55)	---	.24
Month precision	78 (92-95)	.08 (.09)	.08
Year precision	233 (220-263)	.22 (.19-.22)	<.001
N$^{\text{o}}$ days betw. interviews	0.21 (.14-.23)	.18 (.11-.19)	<.001
Same interviewer	-89 (-85- -64)	-.14 (-.13- -.10)	<.01

Values outside of parentheses for all partnerships (n = 438); values in parentheses = range from 10 data sets constructed by randomly sampling one partnership per respondent (n = 355)

$R^2 = 0.15$

Signed difference in days for reported date of first sex
(1st - 2nd; positive coefficients ---> forward telescoping)

Variable	Unstd. coeff.	Partial r	p
Constant	0 (-11- +10)	---	1.0
Month precision	18 (18-26)	.02 (.01-.02)	.73
Year precision	-12 (-.24- +29)	-.01 (-.02- +.02)	.85
N° days betw. interviews	0.23 (.17-25)	.17 (.12-.18)	<.001
Same interviewer	-30 (-.47- -.19)	-.04 (-.06- -.02)	.39

Values outside of parentheses for all partnerships (n = 438); values in parentheses = range from 10 data sets constructed by randomly sampling one partnership per respondent (n = 355)

$R^2 = .04$

Addition of demographic characteristics (age, sex, race, Hispanic ethnicity) and infections (gonorrhea, chlamydia) did not improve model fits significantly ($p > .05$; change in $R^2 = .03$, change in adjusted $R^2 < .02$)

Primary correlate of absolute difference in reported date of first sex in interpartner analyses (Colorado Springs/Atlanta) = interval between respondents' interviews

Regression models for Seattle study showed similar results, except for interval between interviews (estimates hovered around 0)

- **likely due to very restricted range of observed interval between interviews; association disappears in Colorado Springs data when analyses restricted to similar range of intervals between interviews**

Females are more likely to display perfect reliability (identical reported dates across interviews)

AOR for female sex and perfect reliability = 1.76 (95% CI 1.06-2.95) in Colorado Springs, adjusting for
- precision of report
- interval between interviews
- whether same interviewer in both interviews

with demographic and infection covariates added, AOR = 1.64 (0.92-2.91) in Colorado Springs

Absolute difference in reported date of last sex

	Test-retest	Interpartner
Degree of difference	Seattle*	CO Springs/Atlanta
0 d/perfect	8	36
<= 30 d	38	81
<= 60 d	61	88
<= 365 d	93	98

*n = 76 partnerships with a last date reported in the 2nd interview that predated 1st interview

Precision of reported last date of sex

	Test-retest	Interpartner
Precision	Seattle*	CO Springs/Atlanta
Day	7%	83%
Month	67%	15%
Year	26%	2%

*day = day/week; month = month/season; year = year/cruder period

Absolute difference in reported date of last sex

Statistic/precision	Test-retest Seattle	Interpartner CO Springs/Atlanta
Mean days		
Day	11	20
Month	112	46
Year	178	207
All	123	32
Median days		
Day	7	2
Month	42	9
Year	67	41
All	42	3

Test-retest reliability, reported date of last sex, Seattle

Percentage of partnerships (y-axis): 0, 5%, 10%, 15%, 20%, 25%, 30%, 35%

Absolute difference in reported date (days) (x-axis): 0, 40, 80, 120, 160, 200, 240, 280, 320, 360, >380
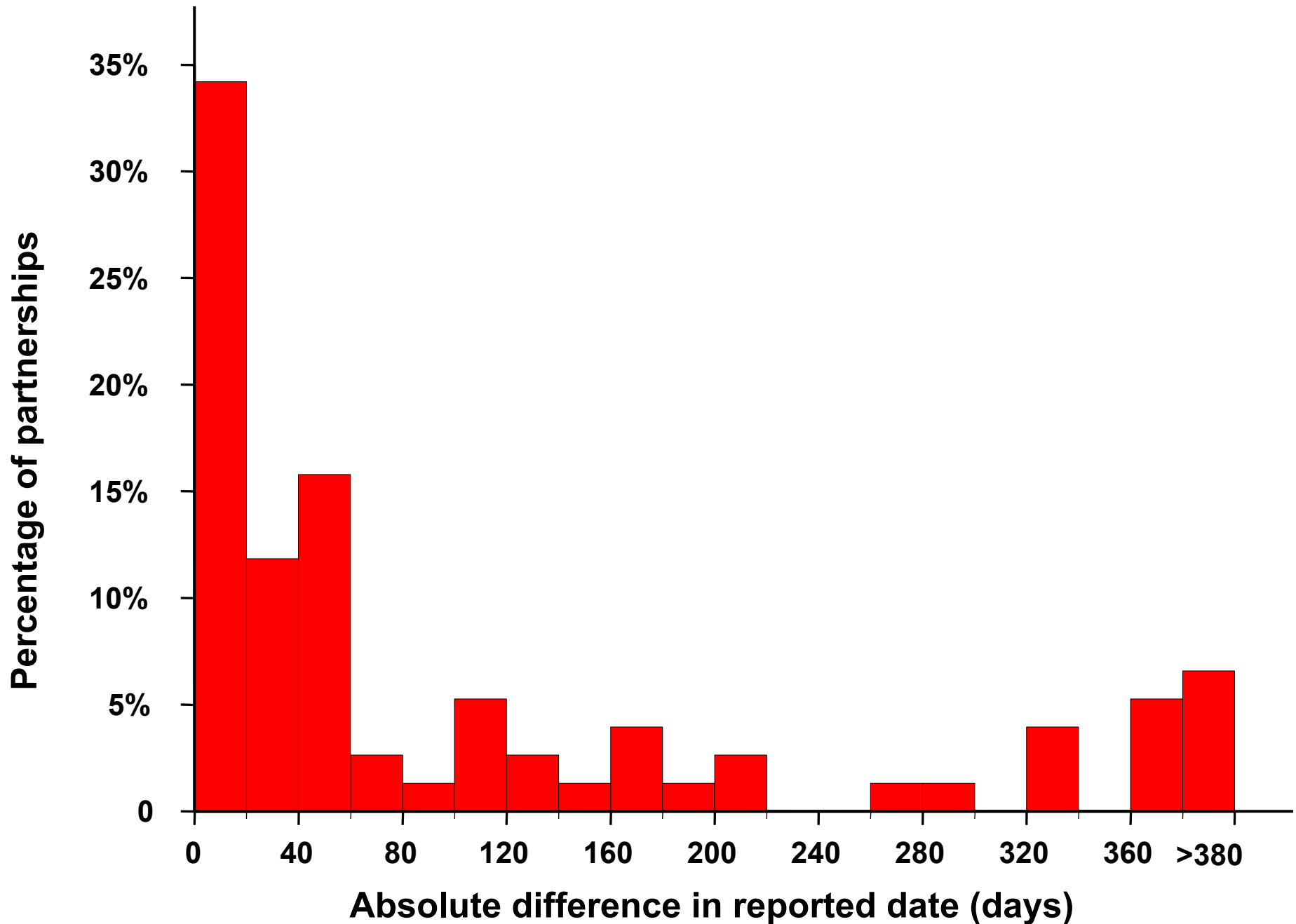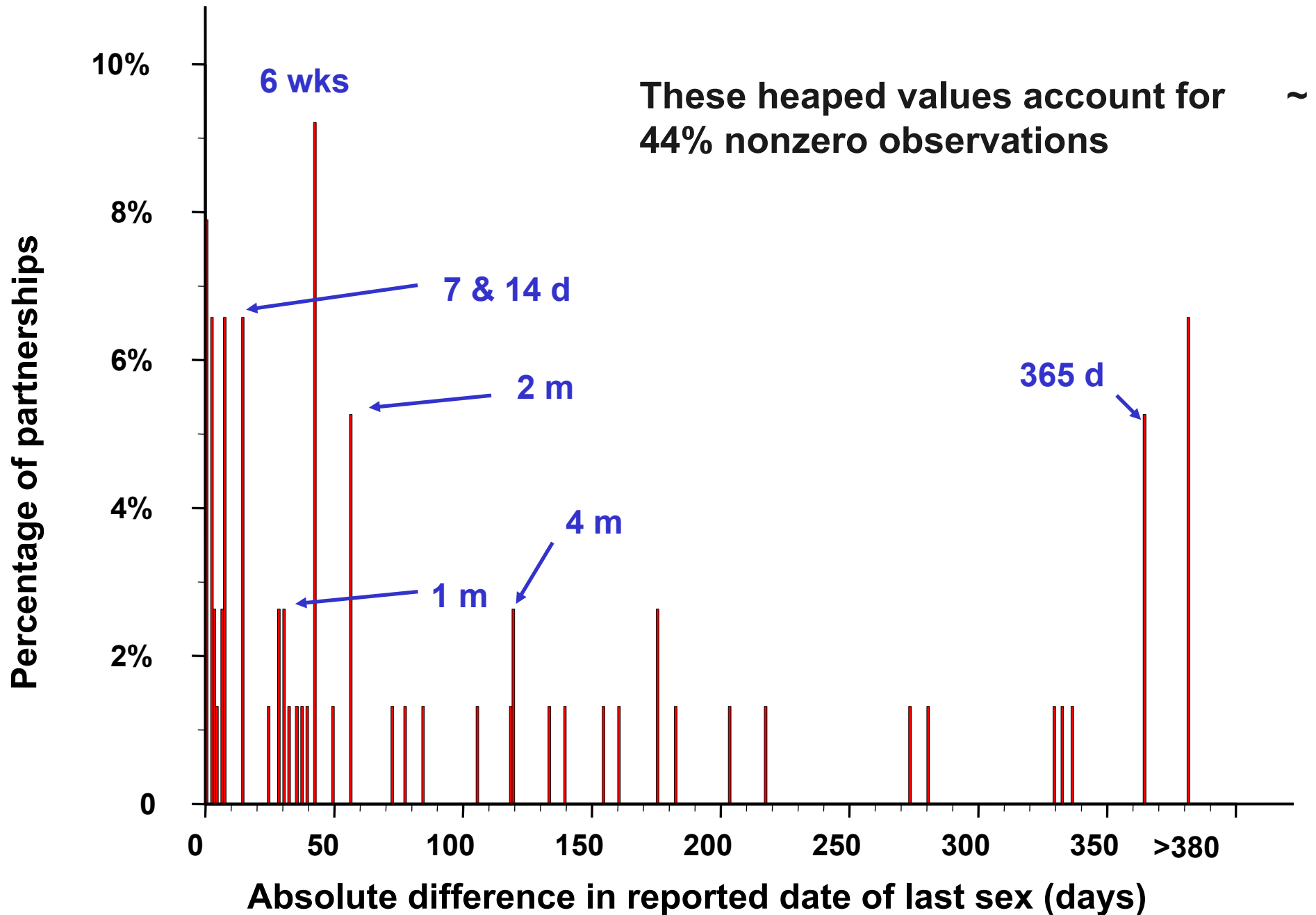
Interpartner reliability, reported date of last sex, Colorado Springs and Atlanta

Test-retest reliability, Seattle, heaping

Percentage of partnerships (y-axis): 0, 2%, 4%, 6%, 8%, 10%

Absolute difference in reported date of last sex (days) (x-axis): 0, 50, 100, 150, 200, 250, 300, 350, >380

Labels on chart:
- 6 wks
- 7 & 14 d
- 2 m
- 4 m
- 1 m
- 365 d
- These heaped values account for 44% nonzero observations   ~
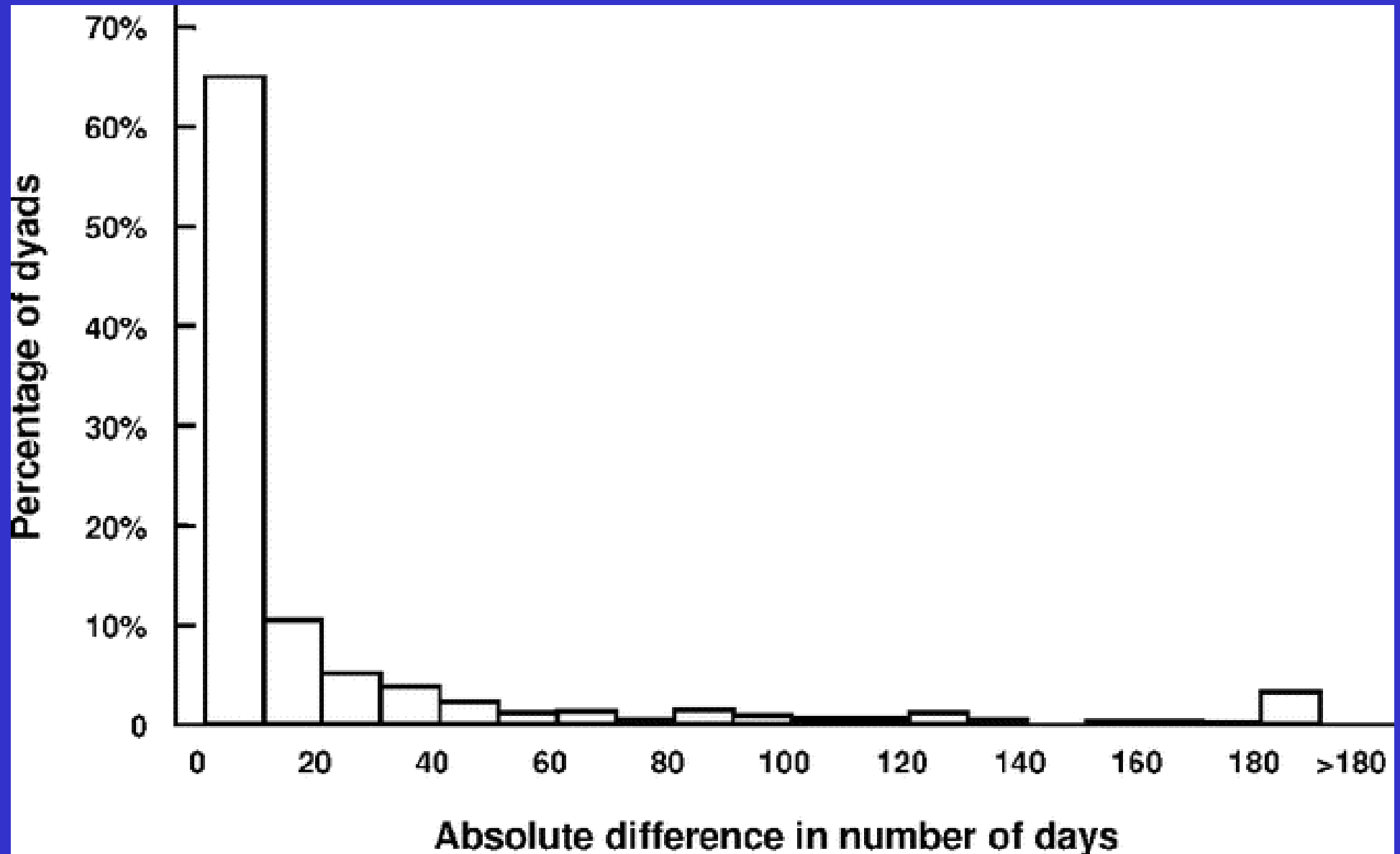
Reliability of reported partnership duration

Statistic	Absolute difference		Signed difference (1st – 2nd interview)
	Interpartner	Seattle* test-retest	Seattle* test-retest
Mean (SE) days	120	114 (32)	13 (34)
Median days	13	7	0

*Based on 76 partnerships for which reported date of last sex in 2nd interview preceded date of 1st interview

Reliability of reported partnership ordering and duration

	First sex n = 14	Last sex n = 13	Duration	
			Seattle n =12	interpartner
Median gamma (range)	.85 (.00-1.0)	.71 (.20-1.0)	1.00 (.33-1.0)	---
Median r (range)	.99 (-.38-1.0)	.93 (.44-1.0)	.99 (.59-1.0)	.87*

*based on 723 unordered partnerships, not median for individual respondents

Simulating impact of unreliability of reported dates on measured concurrency (Brewer, Rothenberg et al.)

- used observed absolute differences as errors added/subtracted to simulated partnership dates

- varied precision of reporting and "true" lag between/overlap of partnerships

- "measured" configuration (based on dates with added error) corresponded with "true" temporal configuration (whether concurrent) 80% of time

Reliability of concurrency measures

Seattle (n = 18 respondents with data on >1 partner)

- 1st interview: 56% had concurrent partners

  - mean proportion of partnerships concurrent = .32 (median = .29, range 0-1)

- 2nd interview: 61% had concurrent partners

  - mean proportion of partnerships concurrent = .36 (median = .34, range 0-1)

Test-retest correlations for 18 Seattle respondents reporting on 2+ partners:

- whether any concurrent partners: r = .66, (proportion concordant = .83)

- proportion of concurrent partners: r = .52

Specific configuration of concurrent partnerships (matrix of partnership pairs):

- median r = .82 (range = -.20-1.0), n = 8

- mean proportion concordant = .80, median = .97 (range = 0-1.0), n = 18

Discussion

Fairly good test-retest and interpartner reliability of reported partnership timing

• dates of last sex reported more reliably than dates of first sex

• heaping in test-retest difference corresponds to temporal units used in reporting dates (week, month, year)

• modest forward telescoping in Colorado Springs STD contact tracing data, none in Seattle study of much older adults

- correlates of reliability: precision of report (presumably reflecting age of event), interval between interviews, same interviewer across interviews

    - recent events dated more reliably

    - females more often <u>perfectly</u> reliable, but not more reliable overall

Simulations suggest that observed (un)reliability produces mild error in measured concurrency -- largely confirmed by small Seattle sample

Differences in telescoping across studies

- temporal boundaries (i.e., known points before which event could not have occurred) induce forward telescoping (Huttenlocher et al.; Rubin & Baddeley; Thompson et al.)

    - boundary in Colorado Springs = sexual debut?

        - mean/median respondent age = 21 vs. 38 in Seattle sample

- no telescoping in interpartner data -- reflects intraindividual process, short interval between interviews?

Females' greater tendency toward perfect reliability matches their greater likelihood of dating personal events <u>exactly</u> accurately although females are no more accurate on average (Thompson et al.)

Limitations (vary across data sets):

• **inferred precision of reports**

• **persistent partnerships only (C. Springs)**

• **traced partners only (interpartner)**

• **repeatedly recalled partnerships only [i.e., not forgotten] (test-retest)**

The quality of reported data on partnership timing seems sufficient for deeper analysis of time-ordered sexual networks