Measuring poverty efficiently using adaptive deprivation scales

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Urban Studies

Subtitle:

"How we can get (almost) all the information in half the time"

Why efficient poverty measures matter

- Costs – (survey) time is money

- Respondent burden

- Get better measures included in a wider range of surveys

Deprivation scales

- Fifty years of development
  - Part of UK official measure of child poverty (DWP 2018)
  - Part of EU official poverty target (Guio et al 2016)
  - Implemented in wide range of countries

- Method in brief (Guio et al 2016, DWP 2018):
  - A **set of indicative items** for different domains of living standards – material goods and social activities
  - Check they are **seen as 'necessities of life' by public** and pass barrage of statistical tests
  - Identify how many items each individual **lacks because they cannot afford them**
  - **Make a score** for each individual and decide if '**deprived**' or not

Deprivation scale in the FRS

Adults/household items

- Keep home in decent state of decor
- Replace worn out furniture
- Replace/repair broken electrical goods
- Money to spend on self each week
- Regular savings of £20 a month
- Household contents insurance
- Home adequately warm
- [NEW] Able to keep up with bills
- Holiday one week a year

Child items

- [NEW] Fresh fruit/veg once a day
- Bedroom for every child 10+ of different sex
- [NEW] A warm winter coat
- Garden or outdoor space
- Bicycle
- Hobby or leisure activity
- Celebrations on special occasions
- Friends round once fortnight
- Holiday away from home once a year
- Toddler/nursery group once a week
- School trip once a term
- [NEW] Activities or clubs

[NEW] – added in 2010/11

- FRS deprivation items (McKay 2011)
  - 21 items - 9 household and 12 child
  - Updated in 2010/11– four dropped, four added

- FRS deprivation score
  - 'Prevalence weighted' – give more weight to items which **more** people **have** (DWP 2018)
  - Add up, re-scale (0-100)
  - 25 or over – 'deprived'

  NB: Simple count works just as well (corr. = .996) [!]

Deprivation scale in the FRS

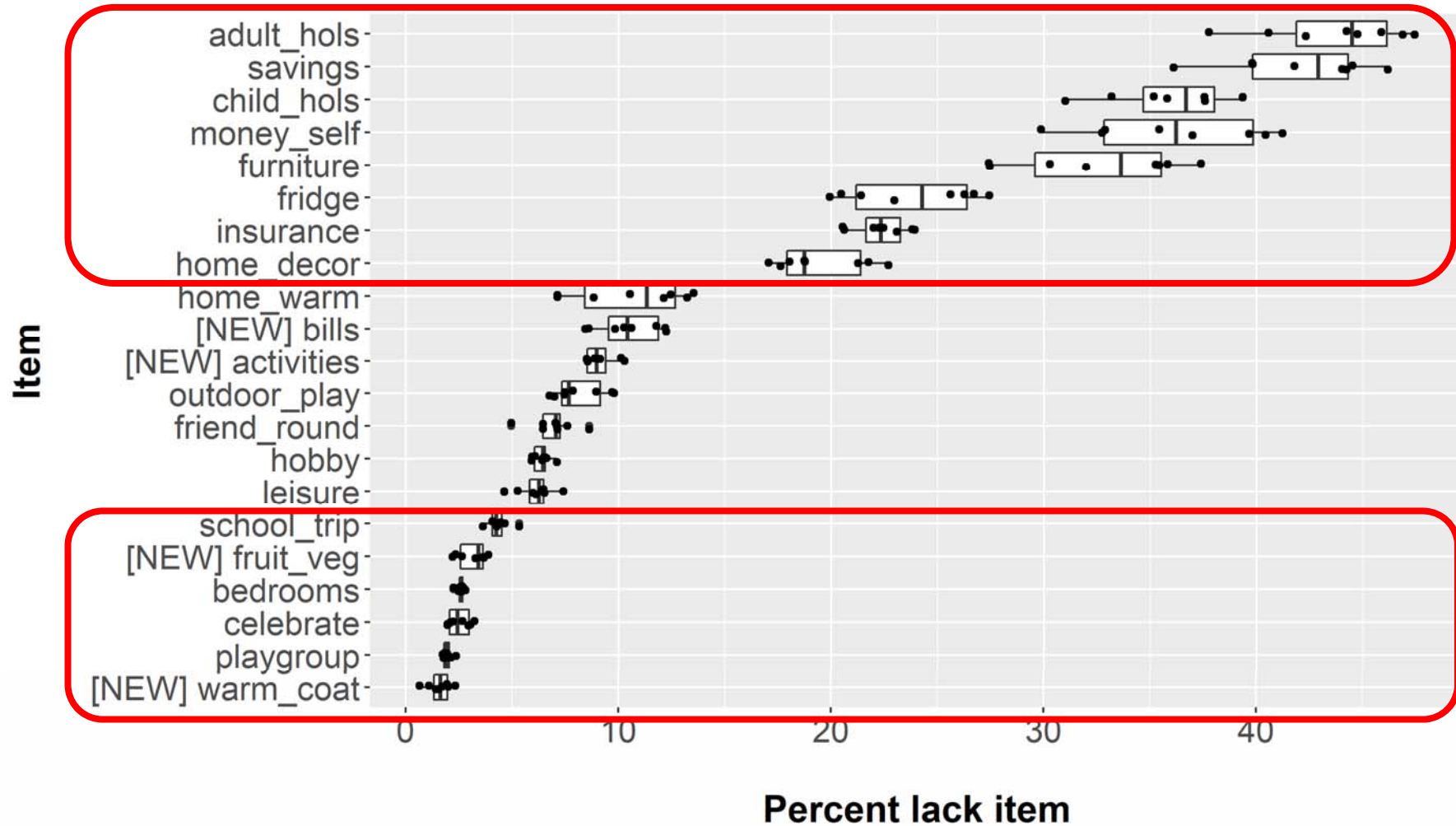| Number of items lacked	Percent of children
0	33.8%
1	11.0%
2	8.9%
3	7.3%
4	6.9%
5	6.3%
6	5.6%
7	5.1%
8	4.0%
9	3.3%
10	2.6%
11	1.8%
12+	3.4%
All	100%

1-in-3 lacks no items

More than half lack two items or fewer

Lacking seven items ~ 'deprived' on DWP measure

1-in-5 is 'deprived' (>25/100)

FRS 2010/11-17/18   N = 87,842 children

Some items more commonly lacked than others

FRS 2010/11-17/18   N = 87,842 children

Item Response Theory (IRT) and deprivation scales

- Response to given item in a scale depends on:

  (i) individual 'ability' (level of deprivation) and

  (ii) item 'difficulty' (severity)

- Items have an order & patterns of 'lacking' not random

  – People with **low levels of deprivation** typically lack only the **commonly-lacked items**

  – Only people with **high levels of deprivation** tend to lack the **rarely-lacked items**

  – If someone **doesn't lack** the commonly-lacked items, **very unlikely** they will lack the rarely-lacked items

Item 'difficulty' from Latent Trait Models

Item difficulty in each year
(percentile scale)
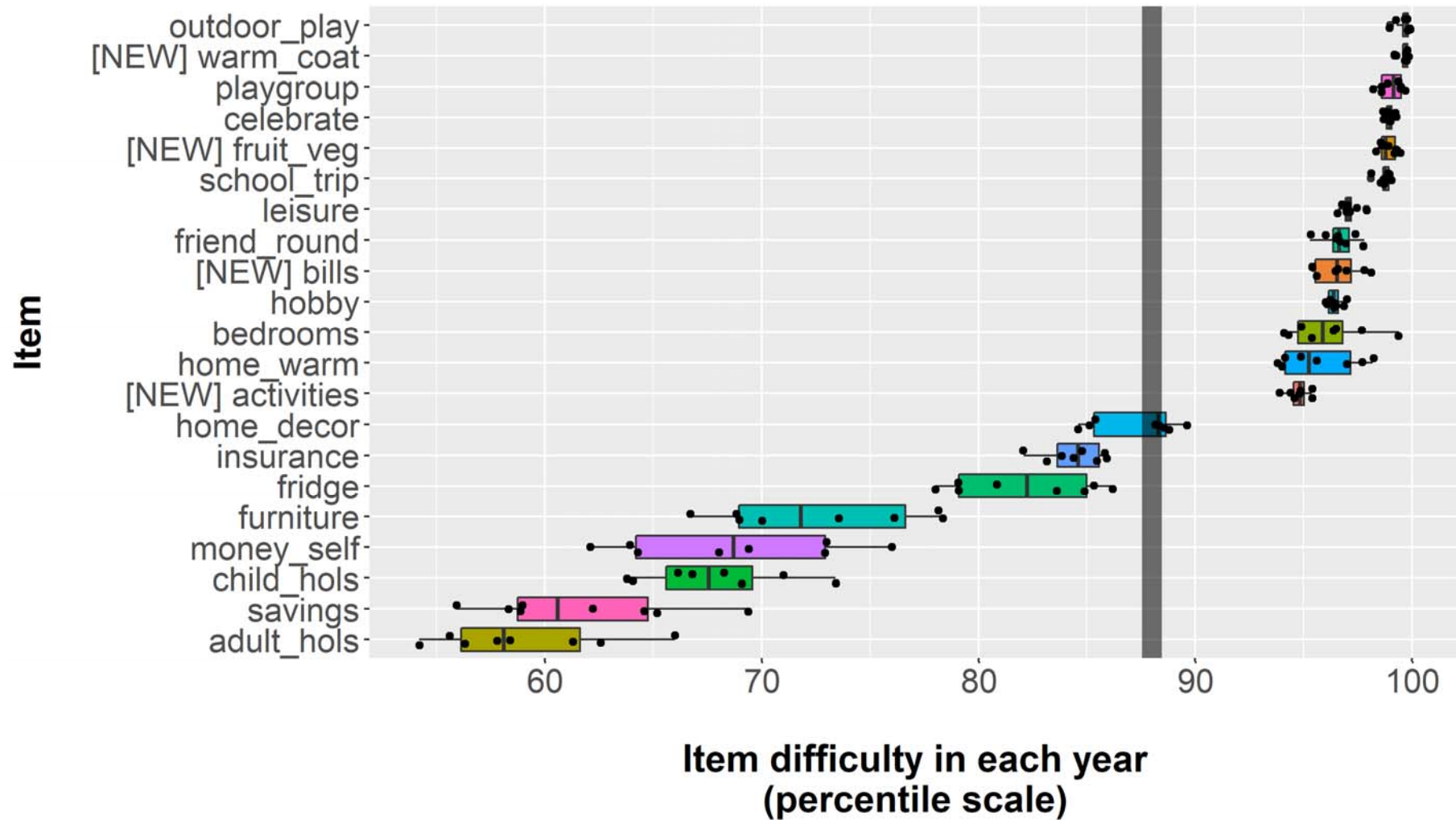
## Item Response Theory (IRT) and adaptive testing

- ***Adaptive testing:*** tailor the questions asked based on initial responses to get the most information

- ***Adaptive deprivation scale:*** stop asking questions where we know from initial responses that they are very unlikely to produce any useful information

- Three questions:
  - What design, i.e. how many questions & when stop?
  - How much time saving?
  - How much information lost?

- Order by items by difficulty/severity

- Start with least difficult/severe items
  - i.e. most likely to be lacked

- Ask an initial group of questions
  - e.g. from 3 to 8 qns

- Decide whether to continue or stop based on responses to those
  - e.g. where lack none of the first N questions

One-step adaptive test

Figure 5: Items lacked overall when lacking none of the first N items – 2017/18

If lack none of first 5 items:

- 90% lack no items

- <1% lack 3+ items

- <0.1% lacks 4+ items
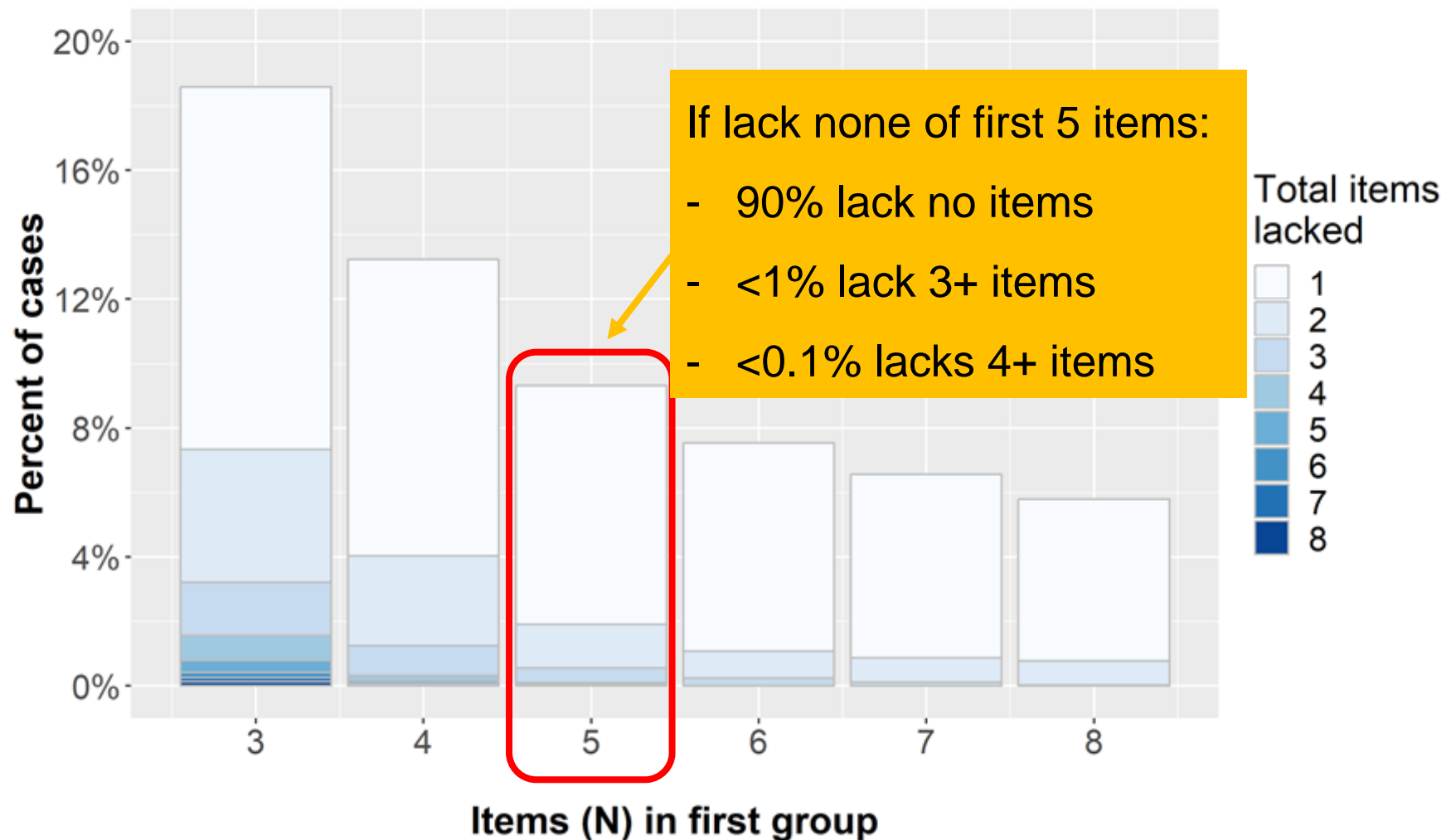
One-step adaptive test

- **Time saving** = % of cases where stop x
  % of qns not asked

- **Information loss** = % of cases 'deprived' on
  full measure but not 'deprived' on adaptive

One-step adaptive test
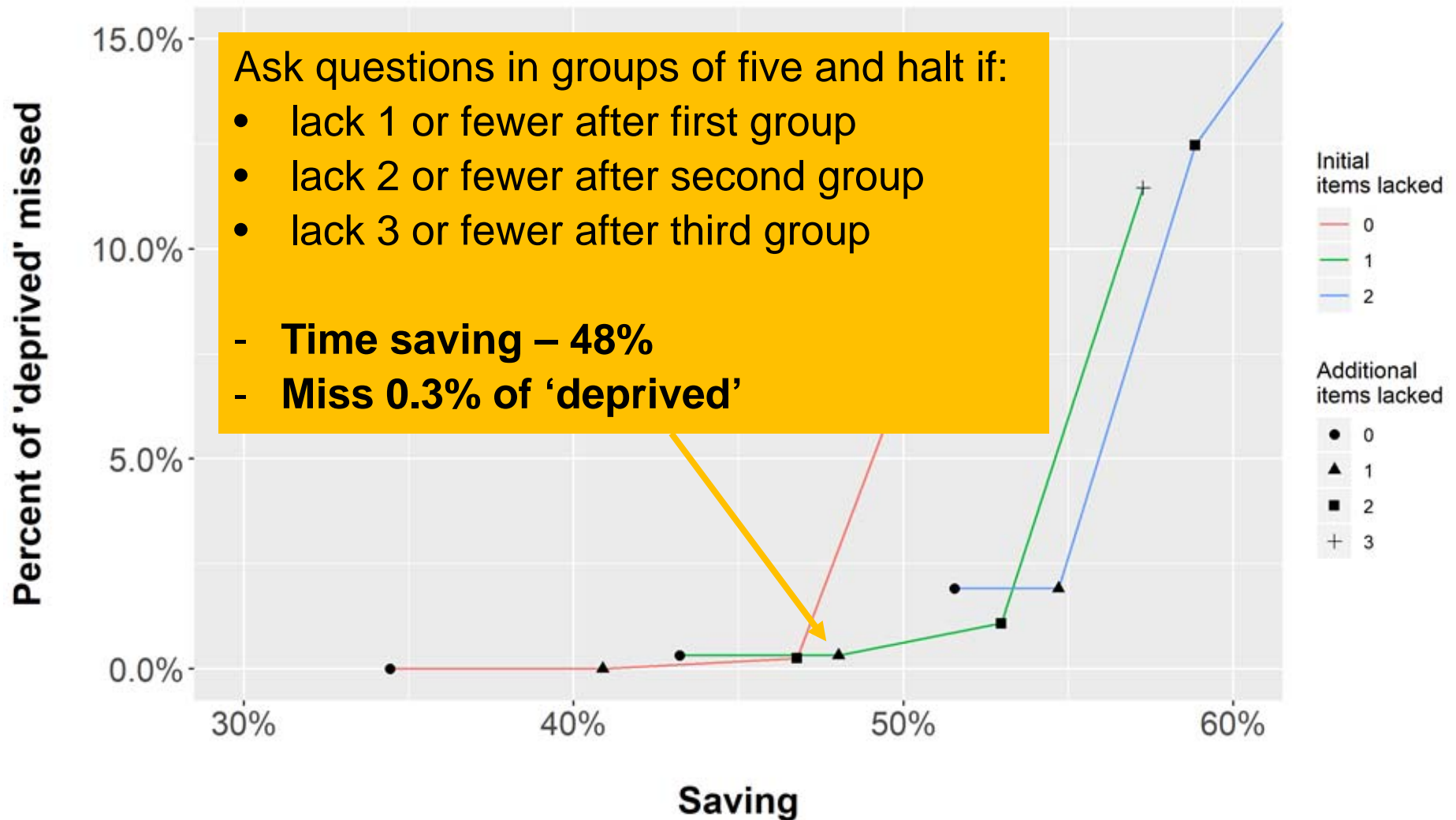
Items in initial group	Percent of cases lacking no items in initial group	Survey time saving	Percent 'deprived' missed (>= 25/100)
3	50%	43%	0.4%
4	47%	38%	0.1%
5	45%	34%	0%
6	44%	32%	0%
7	44%	29%	0%
8	43%	27%	0%

Save 1/3 of survey time

Lose no information!
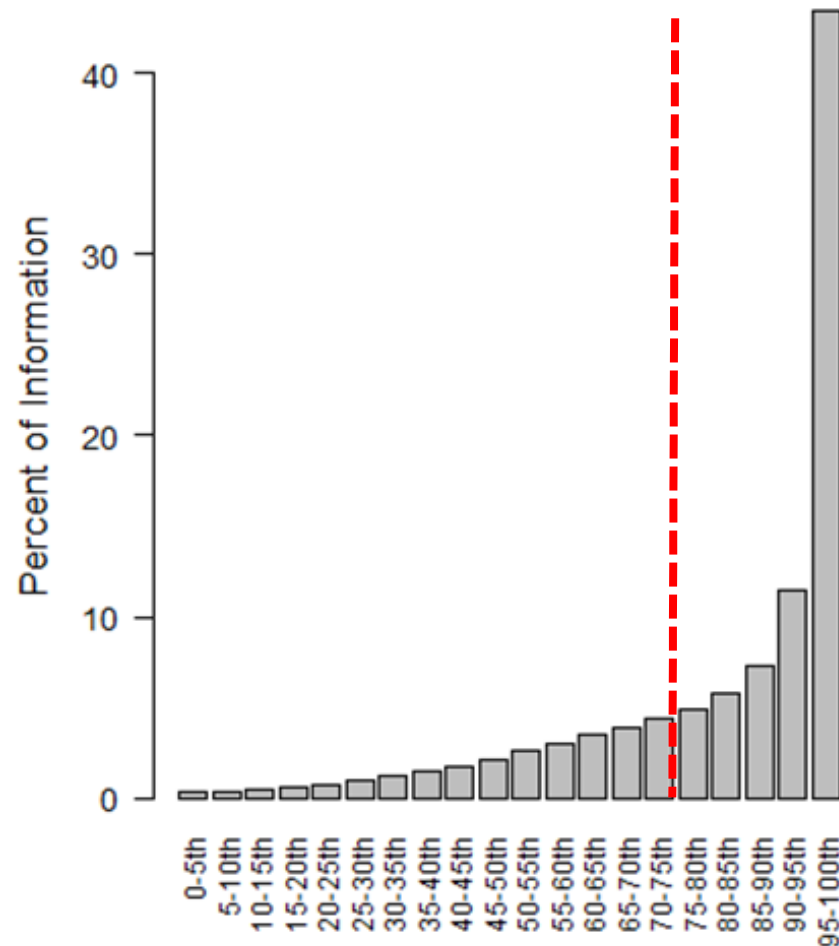
Multi-step adaptive test

- Order by items by difficulty/severity

- Start with least difficult/severe items

- Ask an initial group of questions and decide whether to continue or stop

- If continuing, ask next group and decide whether to continue or stop

- Use higher threshold for stopping each time

Ask questions in groups of five and halt if:
- lack 1 or fewer after first group
- lack 2 or fewer after second group
- lack 3 or fewer after third group

- **Time saving – 48%**
- **Miss 0.3% of 'deprived'**

Percent of 'deprived' missed

Saving

Initial items lacked
— 0
— 1
— 2

Additional items lacked
● 0
▲ 1
■ 2
+ 3

Deprivation scale information curves

(ii) Information by percentile

- Almost half the infor-mation from deprivation scale concentrated into most deprived 5 per cent [!]

- Too many items at highest difficulty levels

- E.g. 'warm coat' (added in 2010/11)
  - If drop question, still capture 999-in-1000 of 'deprived'

Figure 3: Impact of dropping items from scale on proportion of deprived identified – 2017/18

Omit 'warm coat':

- Save 5% of survey time
- Miss 1-in-1000 deprived
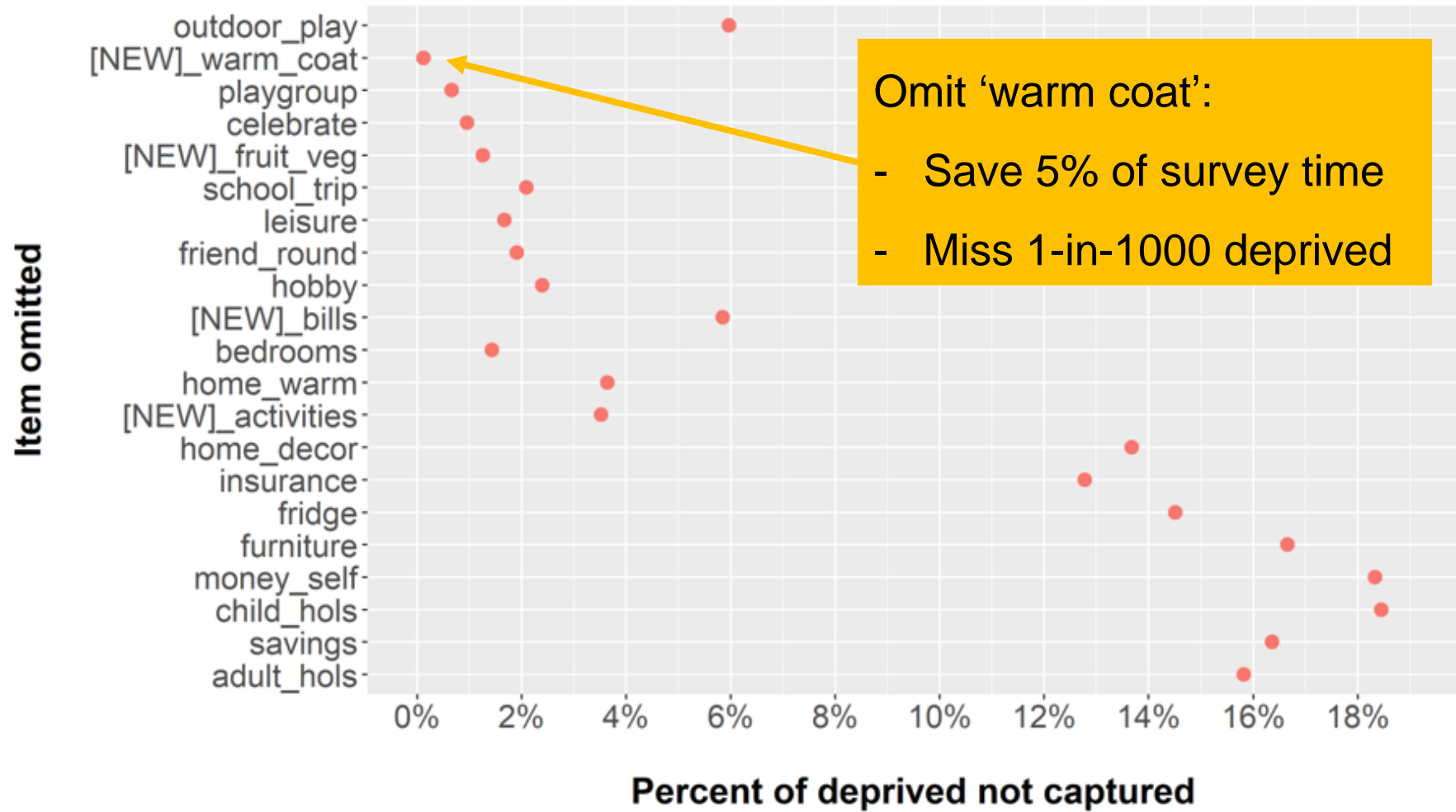
- ## Use adaptive deprivation scales
  - – Get same information in less time
  - – Or get more information in same time

- ## Update the set of items to deliver more information at the levels where policy most interested

- ## Stop using prevalence weighting
  - – Theoretically wrong and empirically unnecessary

Acknowledgements

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- None of above responsible for analysis or interpretation

References

DWP (2018) *Households Below Average Income (HBAI) quality and methodology information report 2016/17.* London: DWP.

Guio, A.-C., Marlier, E., Gordon, D., Fahmy, E., Nandy, S., and Pomati, M. (2016) Improving the measurement of material deprivation at the European Union level, *Journal of European Social Policy* 26 (3): 219-333.

McKay, S. (2011) *Review of the child material deprivation items in the Family Resources Survey. Research Report 746.* Sheffield: DWP.