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Within-Room & Within-Building Spatial & Temporal Variations in PBDEs in Indoor Dust

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INTRODUCTION

- Well established that PBDEs are present at elevated levels in indoor dust
- Moreover, strong evidence that ingestion of such dust is an important pathway of human exposure to PBDEs
- To date, exposure assessment based on analysis of single samples taken from one location at one point in time
- The validity of exposure assessments based on such single point samples depends on the extent to which concentrations vary in space and time – i.e. spatial and temporal variability

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INTRODUCTION

- Specific issues are:
- Will PBDE content of samples taken from same location at one point in time match that taken from same location at a later date?
- Will PBDE content of dust sampled from one point in a room that is closer to a putative source differ significantly from that in dust from an area more distant from the source(s)
- In both cases, if such variations are substantial, this has implications for the accuracy of exposure assessment
- In latter instance, a toddler's playpen may be located in an area of higher contamination (close to a source)
- May also inform sampling protocols – may need to sample at more than one point in time, and sample the most-frequented parts of a room in order to get the most biologically-relevant measure of dust contamination

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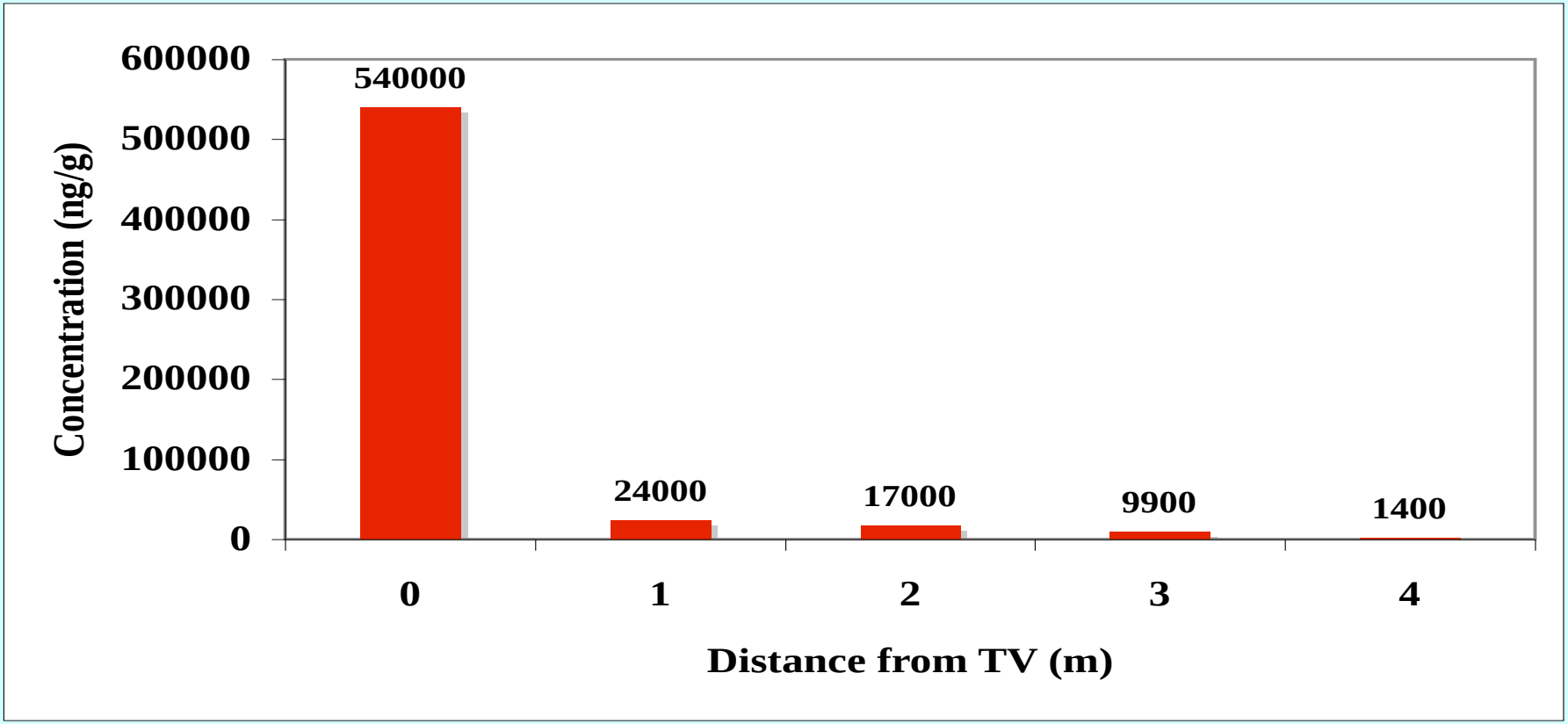
ATTENUATION OF ΣHBCDs IN DUST WITH DISTANCE FROM A TV



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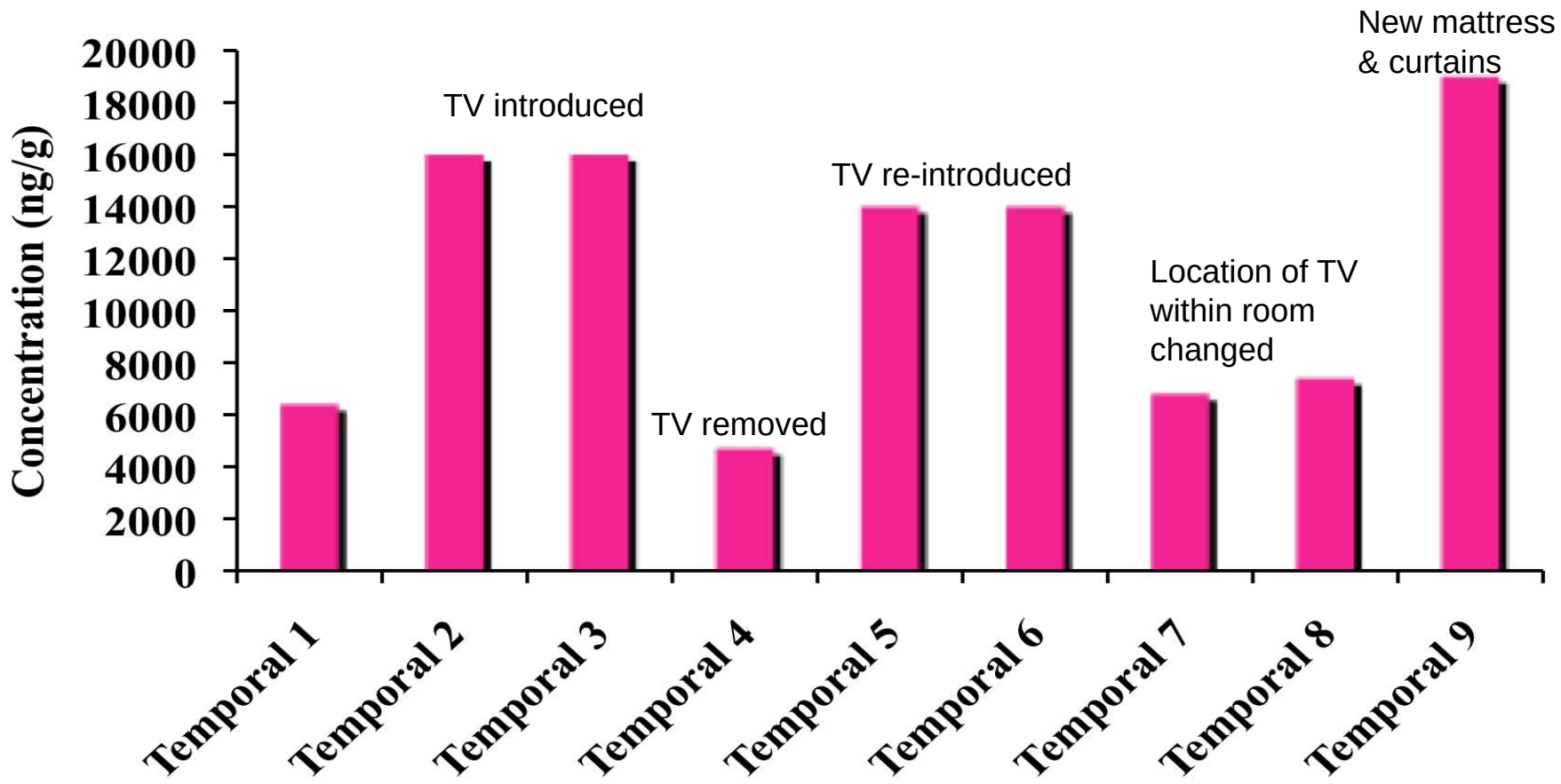
TEMPORAL VARIATION IN ΣHBCDs



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STUDY DESIGN

- Dust samples taken from:
- Four rooms in house 1 & two rooms in house 2 (within-building spatial variation)
- Up to four different 1 m^2 areas of each individual room (within-room spatial variation)
- Samples taken from each area on eight occasions at monthly intervals (within-room temporal variability)

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METHODS - SAMPLING

- Samples collected using a Nilfisk Sprint Plus 1600W vacuum cleaner
- Dust retained within a nylon “sock” fitted within the furniture attachment

- 1 m^2 floor sampled for 2 min if carpeted, or 4 m^2 sampled for 4 min if bare floor

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ANALYSIS

- Samples extracted using PLE, followed by SPE and GC-EI MS using DB5 column
- Target congeners are: PBDEs 28, 47, 66, 85, 99, 100, 153, & 154
- Method accuracy and precision evaluated by replicate (n=12) analysis of indoor dust reference material SRM2585

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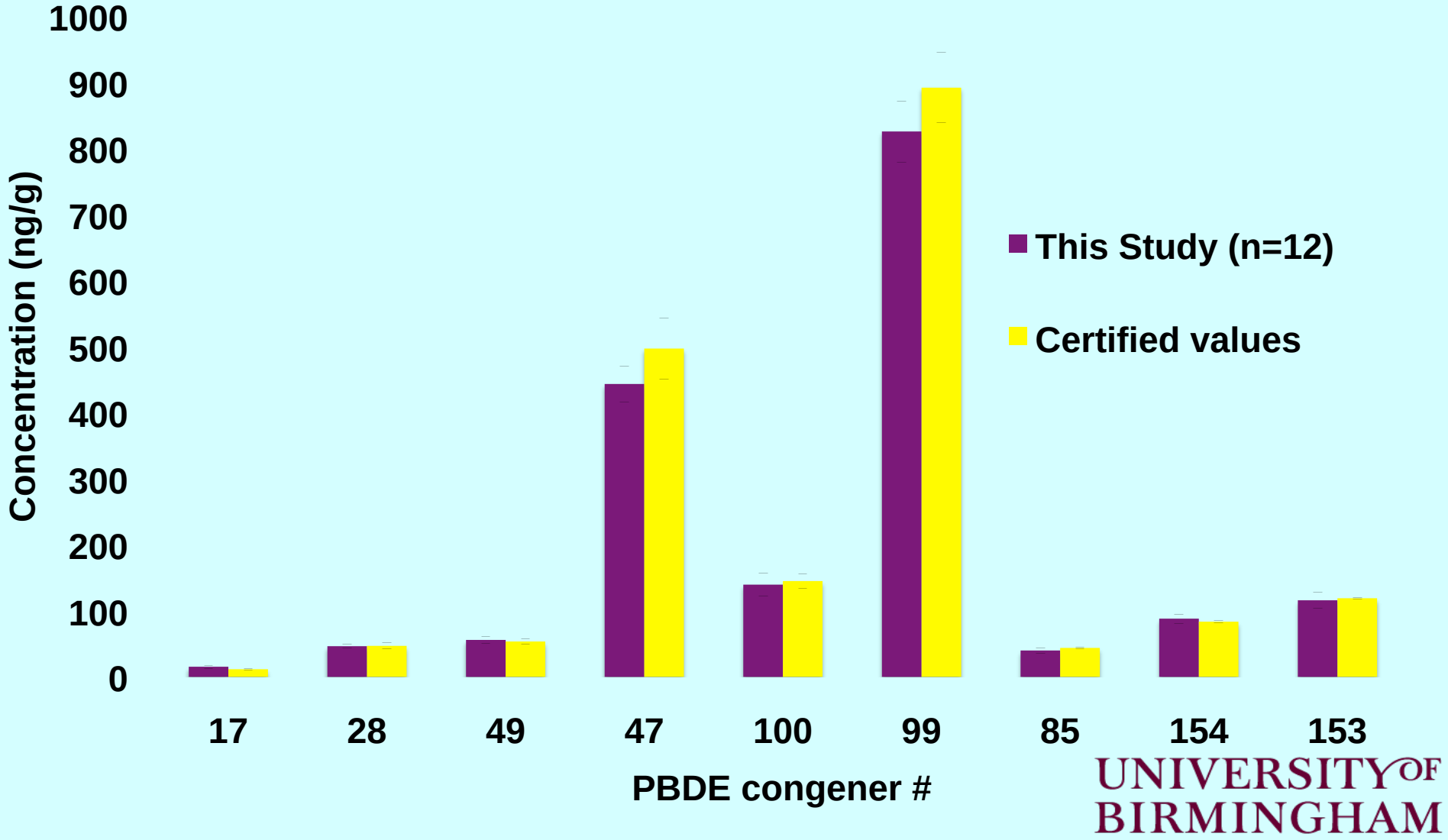
REPLICATE ANALYSES OF SRM2585



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RESULTS

- Concentrations in the 14 areas studied summarised overleaf (BDEs 99 and 47 predominate)
- In general concentrations fall within the range reported previously for the UK, BUT…
- Concentrations in some samples from bedroom 1 in house 2 are to our knowledge the highest reported in house dust outside North America (Σtri-hexa-BDEs 320-1,000 ng/g)

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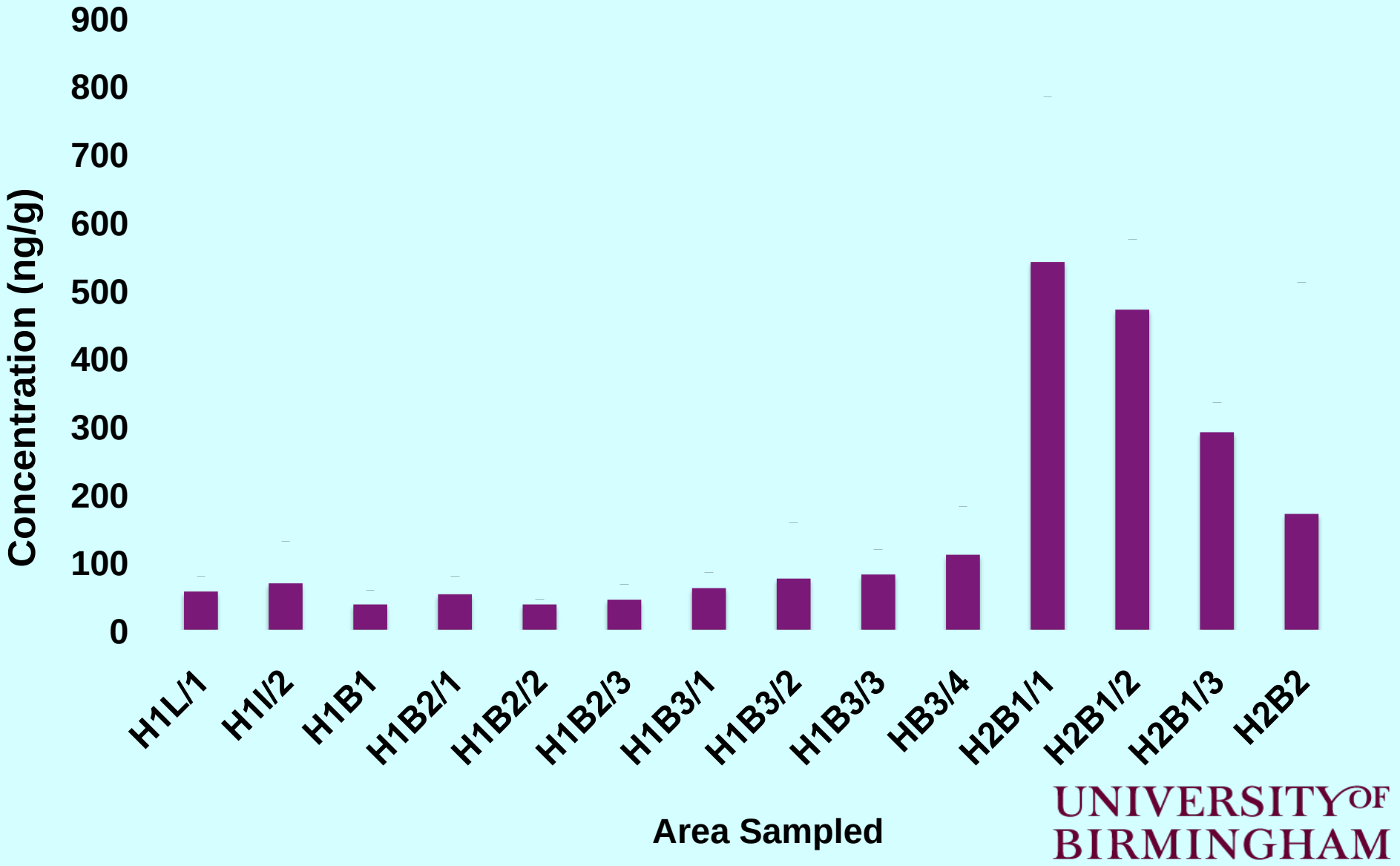
AVERAGE±SD CONCENTRATIONS



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WITHIN-ROOM SPATIAL VARIABILITY

- NO significant ($p>0.05$) differences between concentrations in different areas of same room
- EXCEPT in H2B1
- Here, concentrations of BDEs 47, 99, 100, 153, 154 and ΣBDEs significantly higher in area 1 than area 3
- Area 1 located close to putative sources (TV, laptop, chair and sofa)
- Area 3, two metres distant
- Concentrations in area 2 while not significantly different from those in areas 1 & 2 are intermediate

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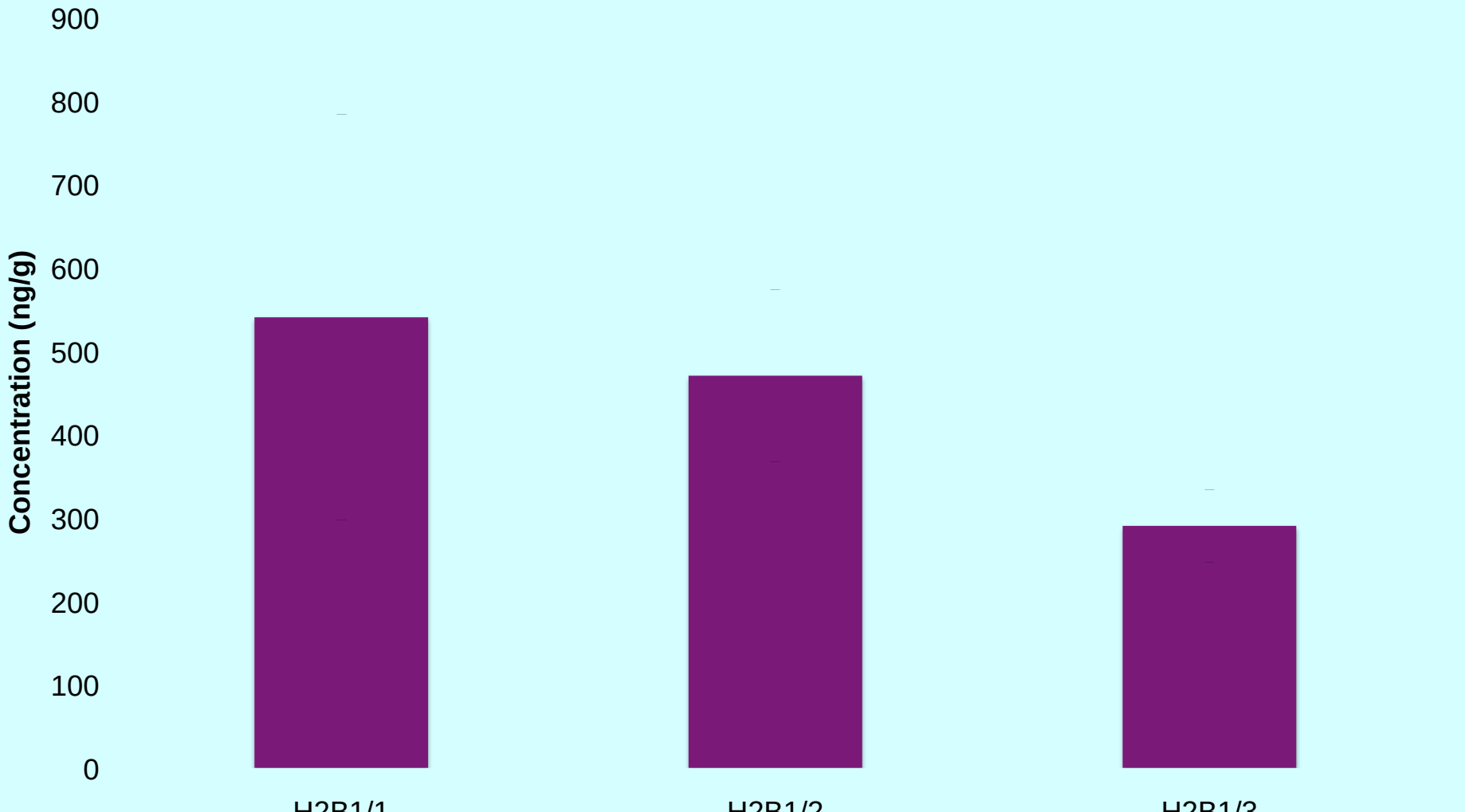
SPATIAL VARIABILITY WITHIN H2B1



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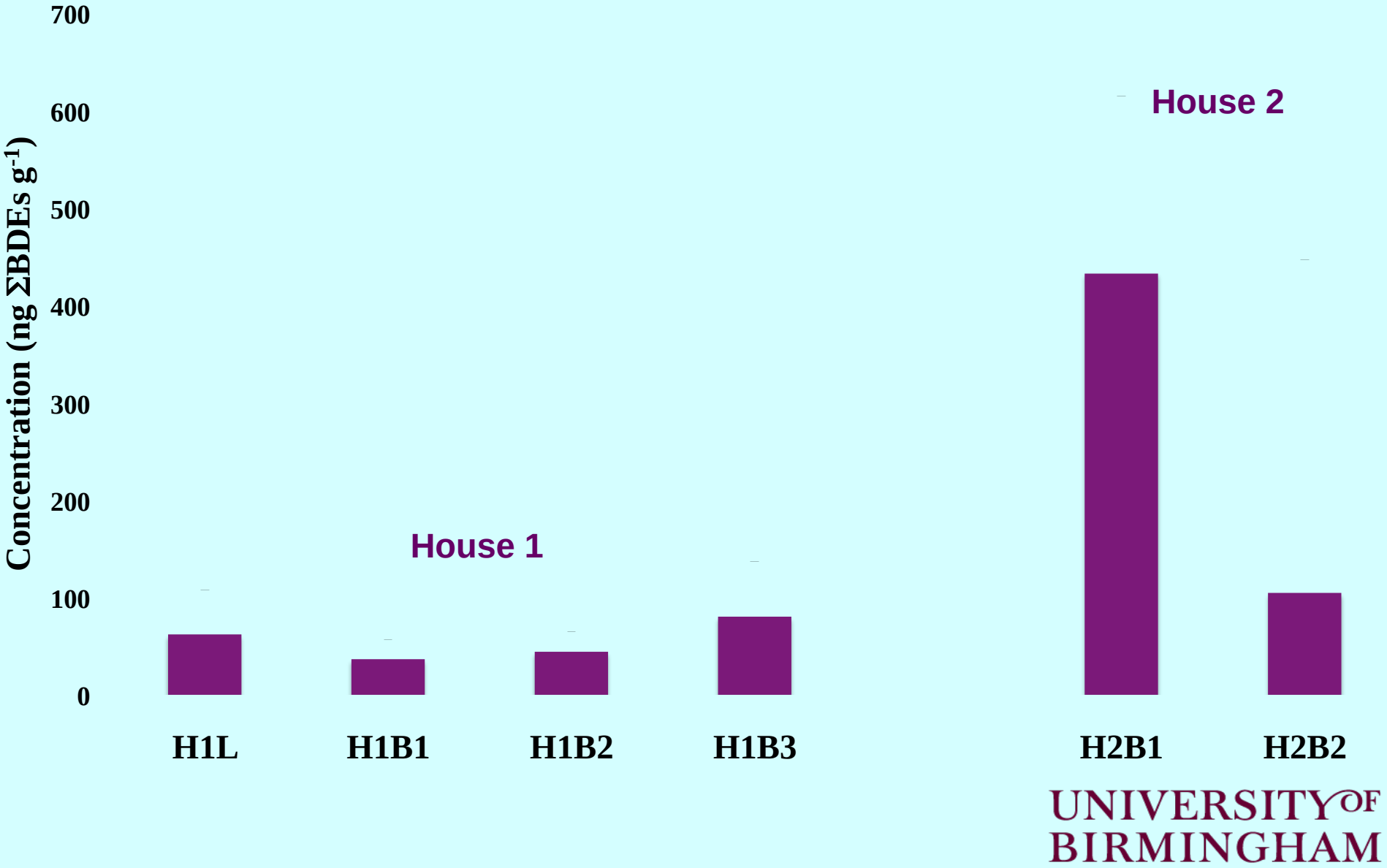
WITHIN-BUILDING SPATIAL VARIABILITY



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WITHIN-BUILDING SPATIAL VARIABILITY

- Range in house 1 (four rooms) is substantial (21 to 280 ng/g ΣBDEs)
- Exceeded by variability in house 2 (two rooms) where ΣBDEs ranged from 20 to 1,000 ng/g
- H2B1>H2B2 (former is carpeted & has other sources as shown by within-room spatial variability)
- H1B3>H1B1 (no obvious explanation)
- Clearly, where & when a dust sample is taken in a house can influence potential exposure substantially
- Exposure to BDE-99 in house 2 of a 10 kg toddler ingesting 50 mg dust/d, will range from 0.055 ng to 2.8 ng/kg bw/d
- Compare to HBLV of 0.23-0.30 ng/kg bw/d

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WITHIN-ROOM TEMPORAL VARIABILITY

- RSD values for the 14 individual areas sampled monthly for 8 months range between 16 & 61% (BDE-47) and 17 & 120% (BDE-99)
- These exceed those for replicate SRM2585 analysis of 9.3% & 5.9% for BDEs-47 & 99
- Potential source-related influences in 3 rooms

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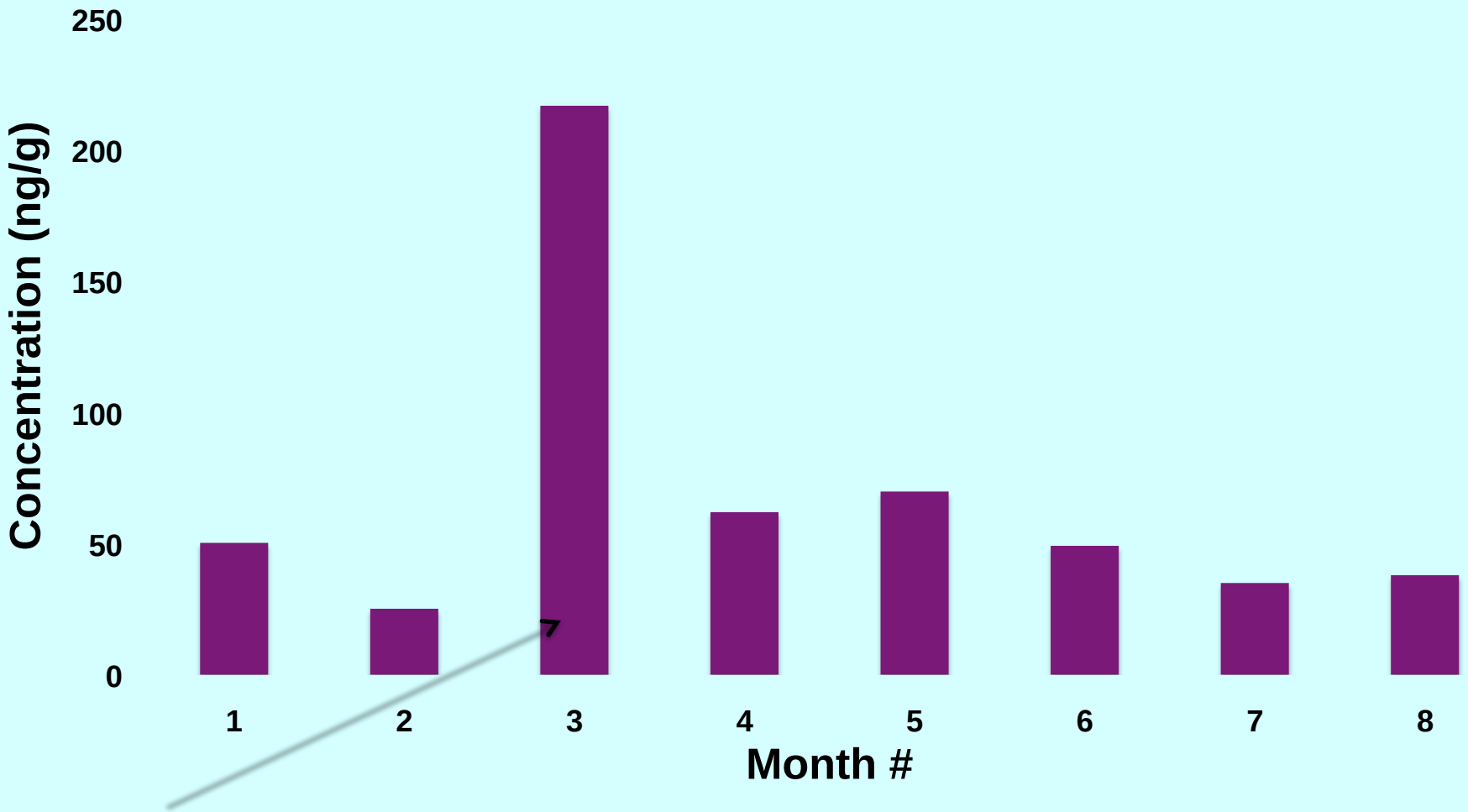
TEMPORAL VARIABILITY H1 LIVING ROOM AREA 2



- TV present in room in month 3 only

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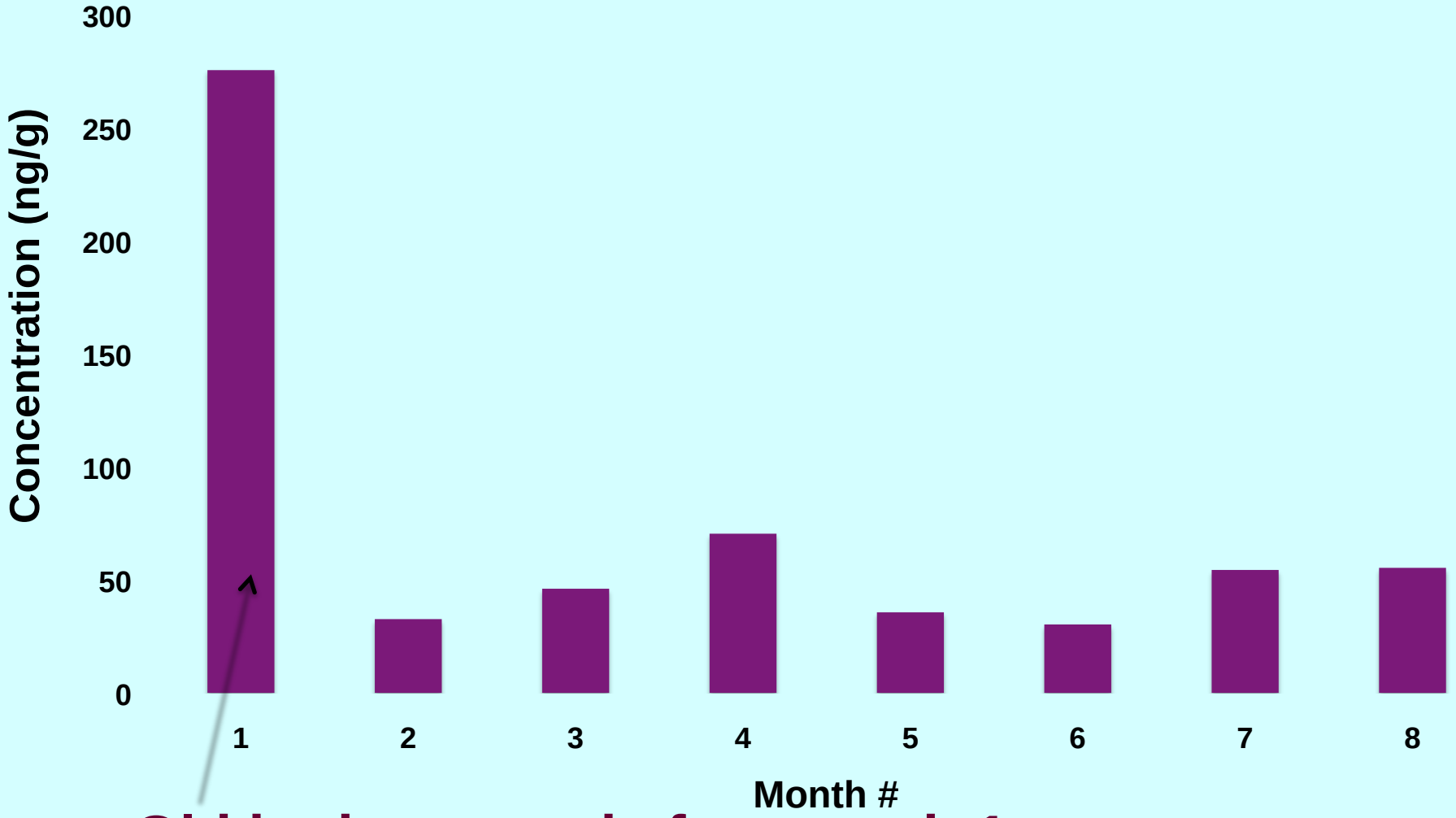
TEMPORAL VARIABILITY H1, BEDROOM 3, AREA 2



- Old bed removed after month 1

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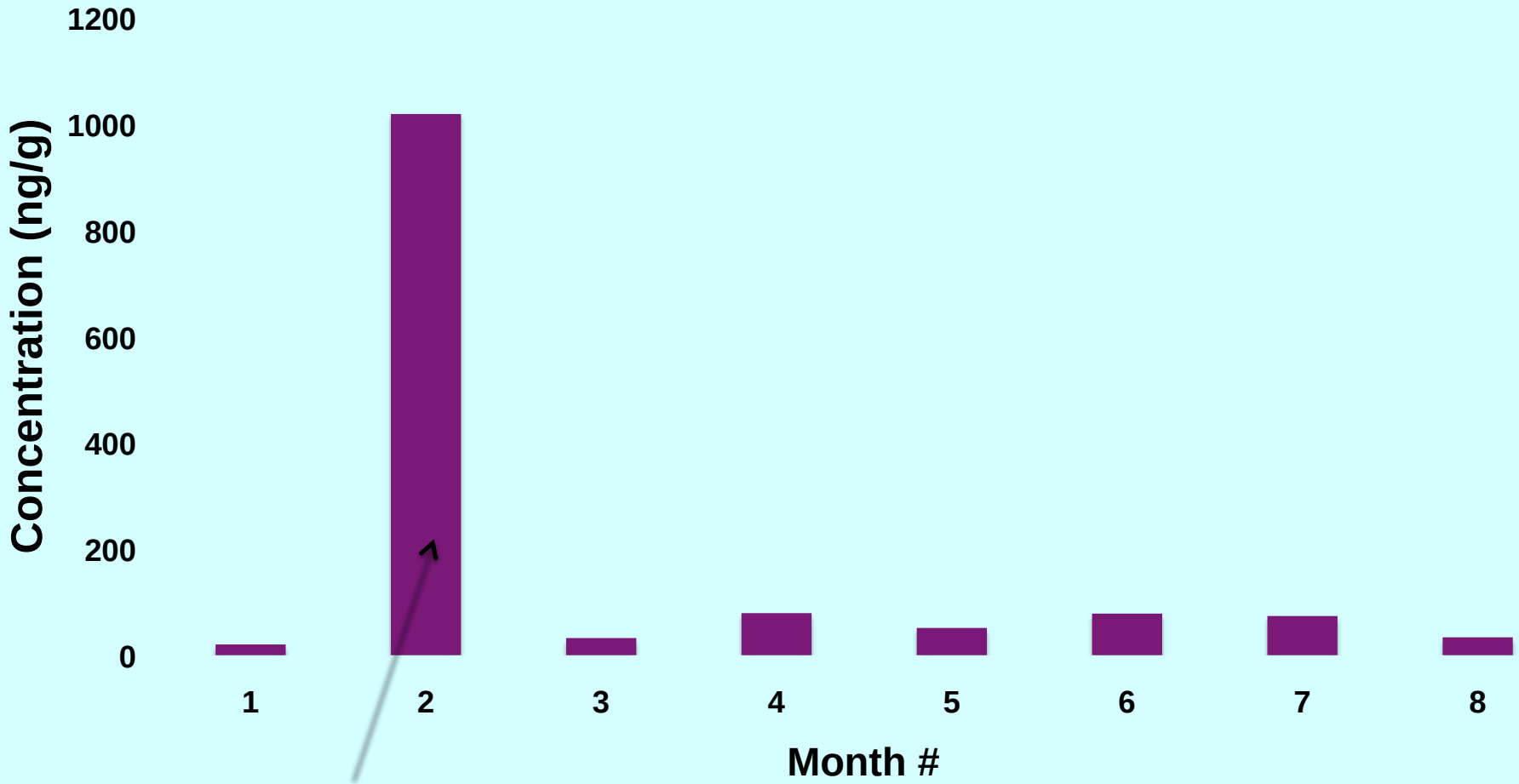
TEMPORAL VARIABILITY IN H2, BEDROOM 2



- In month 2, two laptops used, nearly all of increment is BDEs-153 & 154 with ratio ~3:1
- Octa-BDE?

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SEASONAL VARIABILITY

- Compared concentrations in colder half with warmer half of year in each area sampled
- No significant differences ($p>0.05$) detected
- Indeed, in 7 areas sampled, concentrations higher in colder months
- This confirms previous observations that indoor seasonality does not mirror that seen outdoors
- Greater volatile emissions in warmer period offset by enhanced ventilation &…
- Smaller seasonal temperature variation indoors &…
- Higher indoor temperatures will increase PBDE partitioning to air rather than dust

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SUMMARY

- PBDE concentrations in indoor dust vary over space and time
- Where and when a sample is taken can influence concentration detected & thus exposure
- More data needed to evaluate fully whether such variability needs to be taken into account in future monitoring of dust for exposure assessment purposes
- Both spatial and temporal variability studies offer valuable insights into sources of PBDEs to indoor dust

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ACKNOWLEDGEMENTS

- The Royal Thai government for funding DM
- Occupants for allowing their rooms to be sampled

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