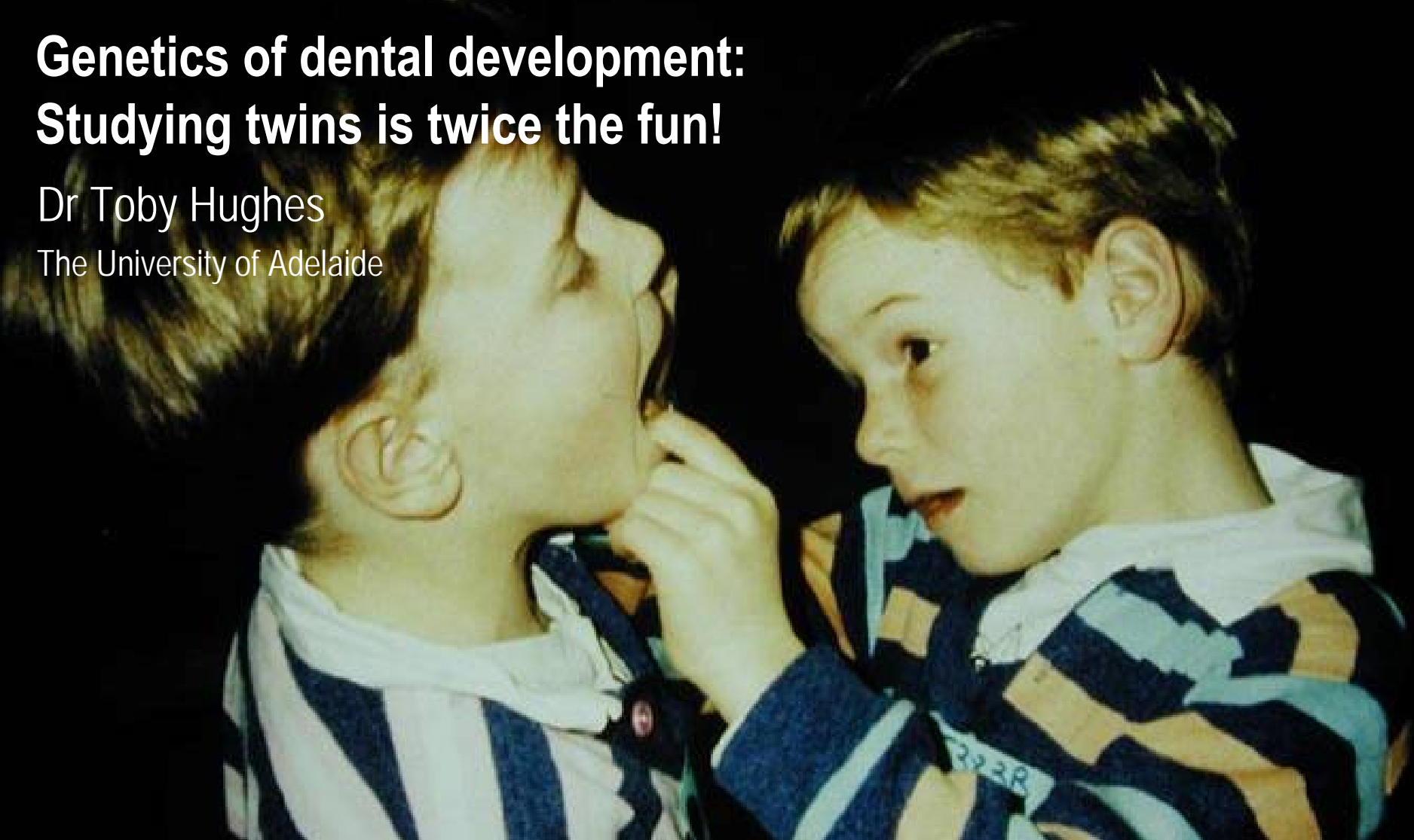




## Genetics of dental development: Studying twins is twice the fun!

Dr Toby Hughes

The University of Adelaide



## ....a bit of background on me

- lecturer in basic sciences, Dental School
- research focus – dental genetics
- main interests include
  - craniofacial growth and development of children
  - genetics of tooth emergence and development
  - genotype x genotype interactions
  - working with families of twins, triplets, etc...





## ....a bit of background on today's presentation

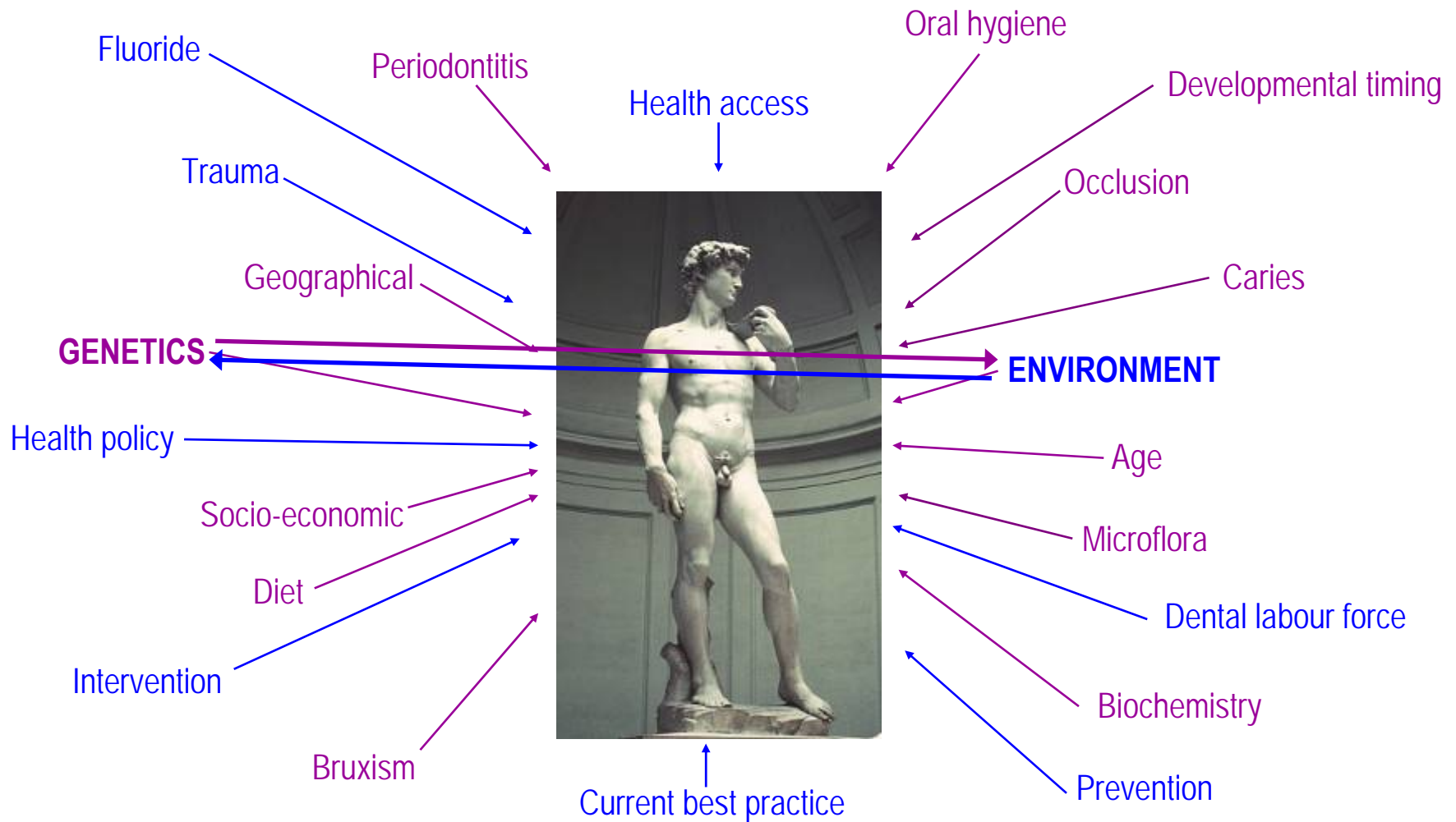
- Why are we interested in teeth?
- How can twins help us understand dental development?
- What do we already know about dental genetics?
- What are we trying to achieve with our new study?
- Initial findings
- What are our future goals?



## Why are we studying teeth?

- Oral health in children is a significant component of overall health
  - quality of life, links with other pathologies (e.g. heart disease)
- Flow on effects for adult oral health
- Geography, socio-economic status, predisposing illness
- Costs – individual/community; access...
- Move to 'preventative' – e.g. fluoridation
- Little is known about the genetic basis to many common oral health issues....

# Craniofacial Biology Research Group Dental School





## Increasing levels of complexity



developmental  
timing

dental  
tissues

dental  
crowns

dental  
arches

opposing  
arches

craniofacial  
relationships

## Factors contributing to variability



intrinsic genetic  
effects

maternal  
effects

epigenetic  
effects

environmental  
effects

## How are twins helping us?



MZ ♂

MZ ♀



DZ ♂

DZ ♀



OS



## Twin model

- Studying large numbers of identical or monozygotic twin pairs (who develop from a single egg and share the same genes) and comparing them with non identical or dizygotic twin pairs (who develop from separate eggs and only share half their genes on average).





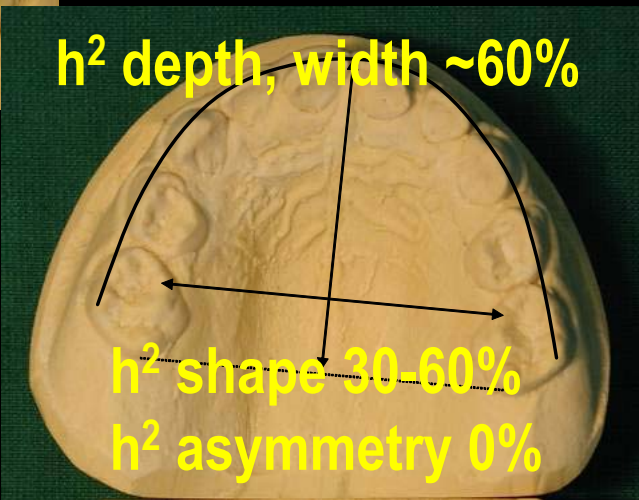
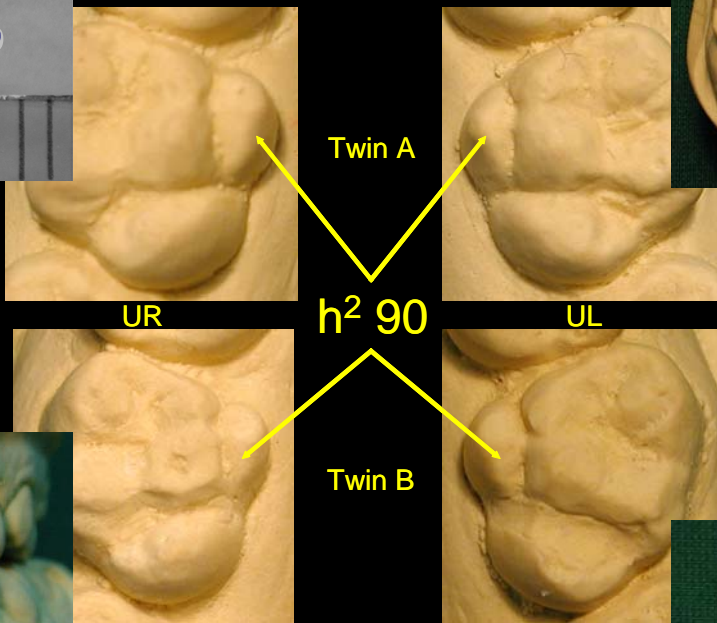
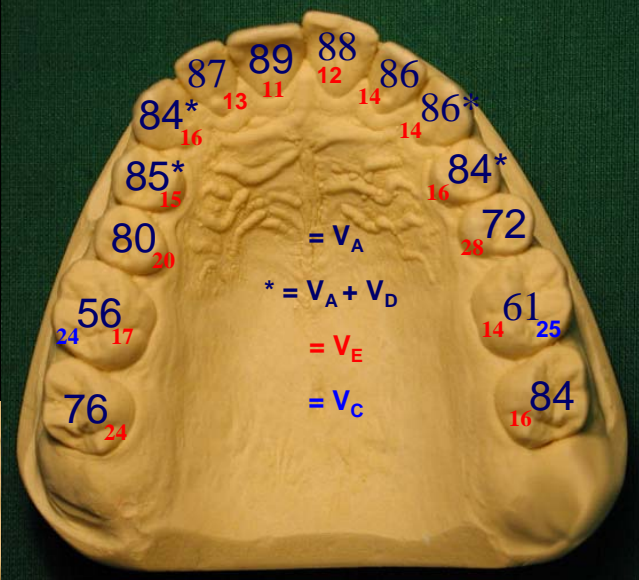
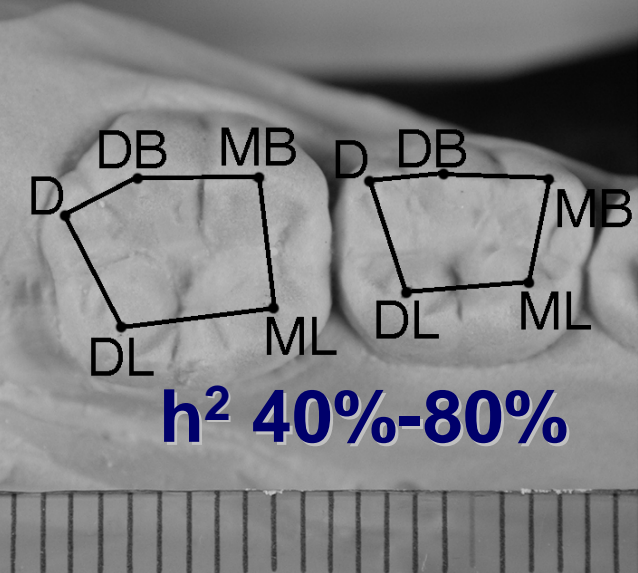
## Three cohorts of twins

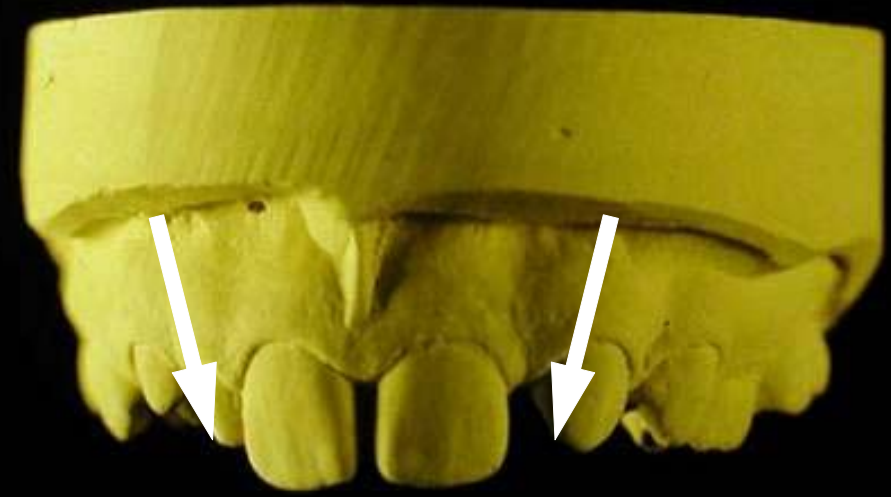
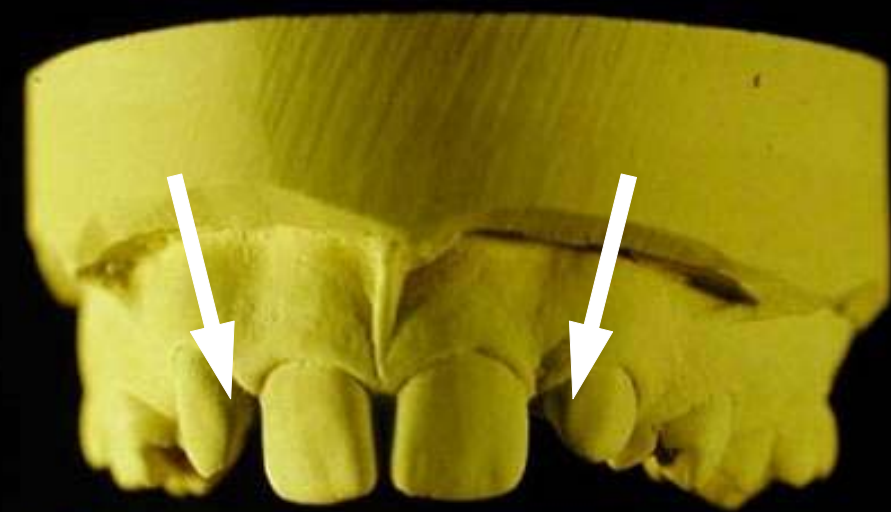
- Cohort 1: Approximately 300 pairs of teenage twins
  - dental and facial morphology
- Cohort 2: Longitudinal study of approximately 300 twin pairs and their relatives
  - dento-facial growth and development
- Cohort 3: Over 620 pairs of twins and family members
  - tooth emergence and oral health

## Types of records collected

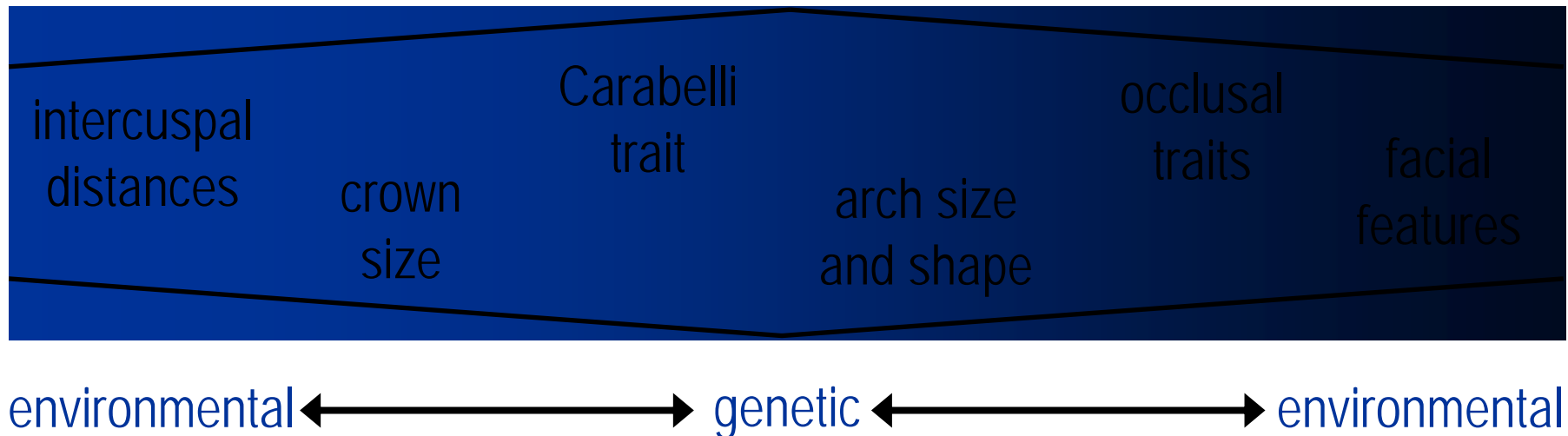
- oral examinations
- dental models
- intra-oral photographs
- mono- and stereo-photographs
- palm- and finger-prints
- blood/cheek cells for zygosity determination
- medical histories
- laterality tests
- tooth emergence data
- microbiological tests







## Different amounts of genetic contribution to variation



## Dental development and oral health in families with multiple births





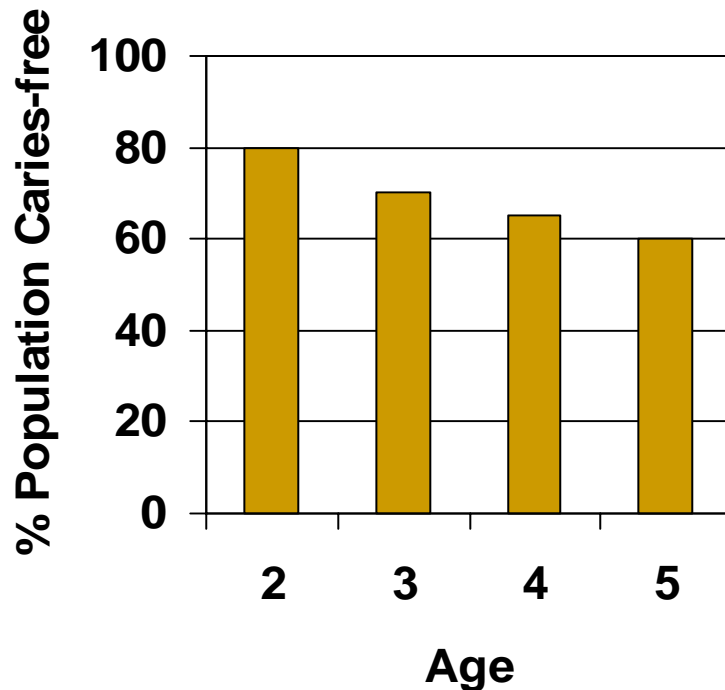
## Emergence of the primary dentition

- Also referred to as deciduous or 'milk' teeth.
- Normally appear in the mouth between 6 months and 2.5 years, but there is considerable variation.
- 20 primary teeth, 10 in each arch.
- Arranged symmetrically around the midline, 2 incisors (central and lateral), a canine, and 2 molars.
- No premolars – primary molars are replaced by permanent premolars.





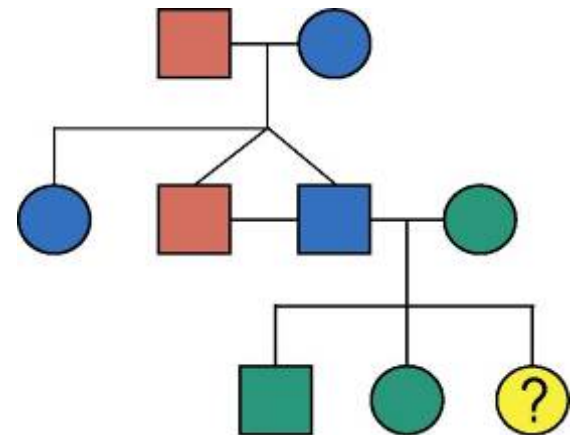
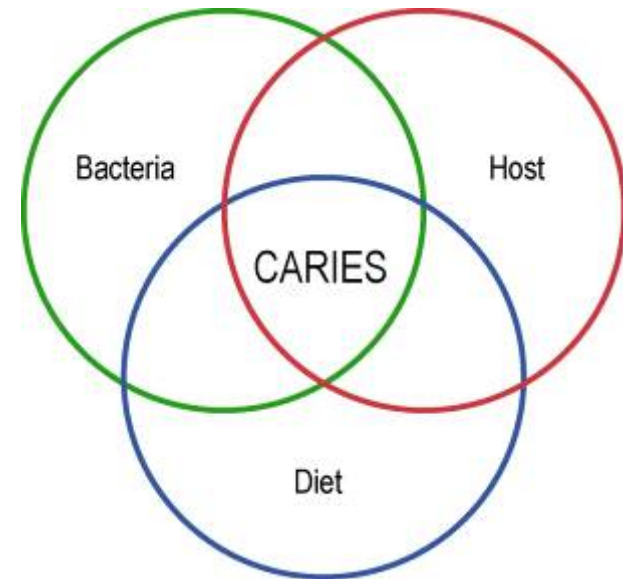
## Caries in Australian children



- Although prevalence of dental decay has decreased since introduction of fluoride into the water supply, there is evidence of increasing problems in younger children.
- In South Australia, one in eight 5-year-olds have decay in 25% of their teeth
- Increase in decay is probably linked to lifestyle and dietary sugar intake.

## Oral health - microflora

- One aspect of our study is to look at the colonization of bacteria that cause dental decay (caries) in twins.
  - When does colonization occur?
  - Is there evidence of transmission between family members or other individuals?
  - If colonization occurs early, are the children more prone to decay?



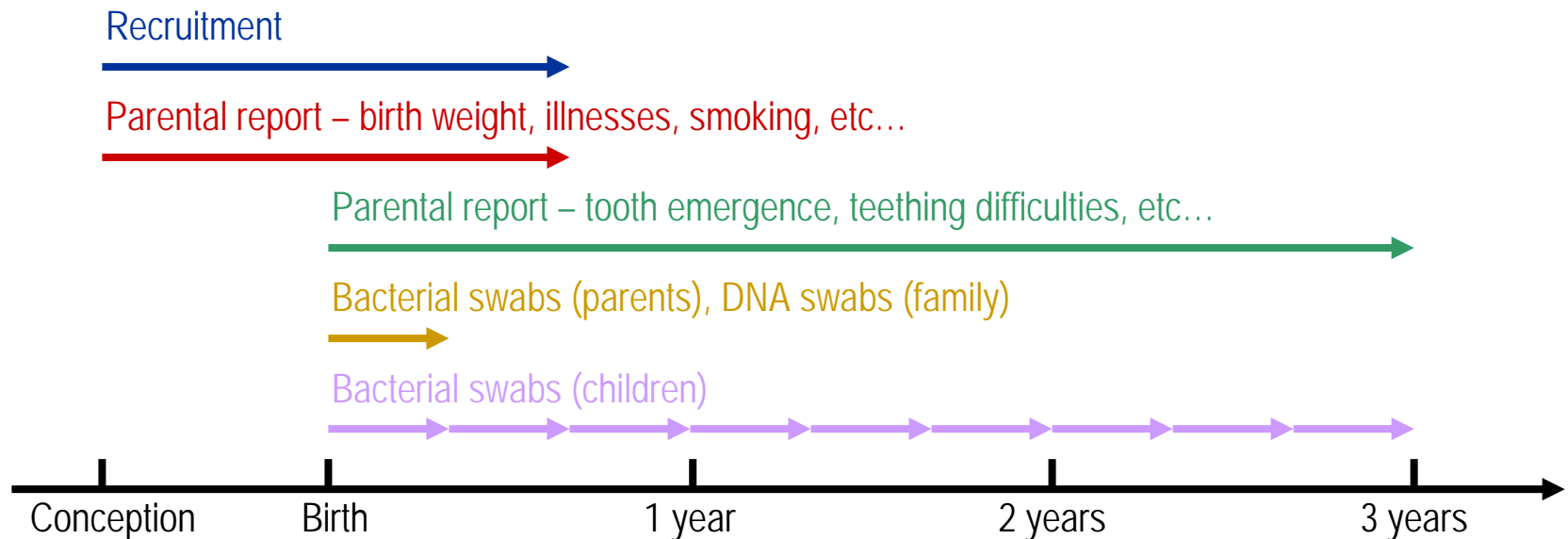


## Emergence & colonization

- There is evidence that teeth, both primary and permanent, may be emerging later in Australian children than previously.
- Could this altered 'window of infectivity' be influencing subsequent caries experience?

## Research plan

- Recruit 600 families over 2-3 years, follow children (twins, triplets etc...) for 3 years to determine when the baby teeth appear.

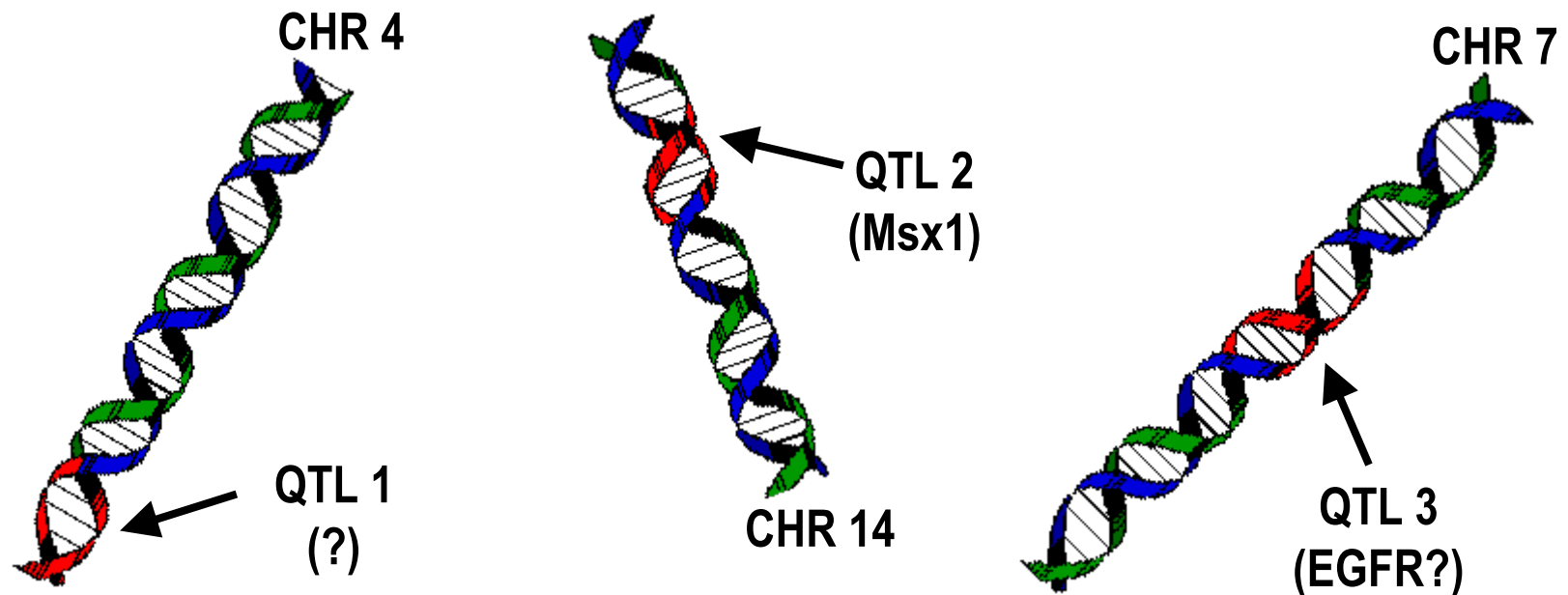


## Preliminary results

- Incisor emergence order varies considerably
- Usually, corresponding teeth on the right and left sides of the arch appear at about the same time
  - 14% same day
  - 19% >30 days difference
  - directional asymmetry in lower laterals (left before right)
- Boys and girls tend to get their primary incisors at about the same time (c.f. permanent teeth).
- Mutans colonization is earlier and more variable than first thought
- Heritability ( $A \div A+D+C+E$ )
  - incisor emergence high (82%-94% males; 71-96% in females)
  - colonization time high (82%)
  - shared genetic liability???

## Opportunities

- We are collecting buccal cells to help us determine twin zygosity (i.e. whether they are MZ or DZ). We also plan to use the DNA for genotyping to enable us to detect which genes are involved in dental development.



## The future....

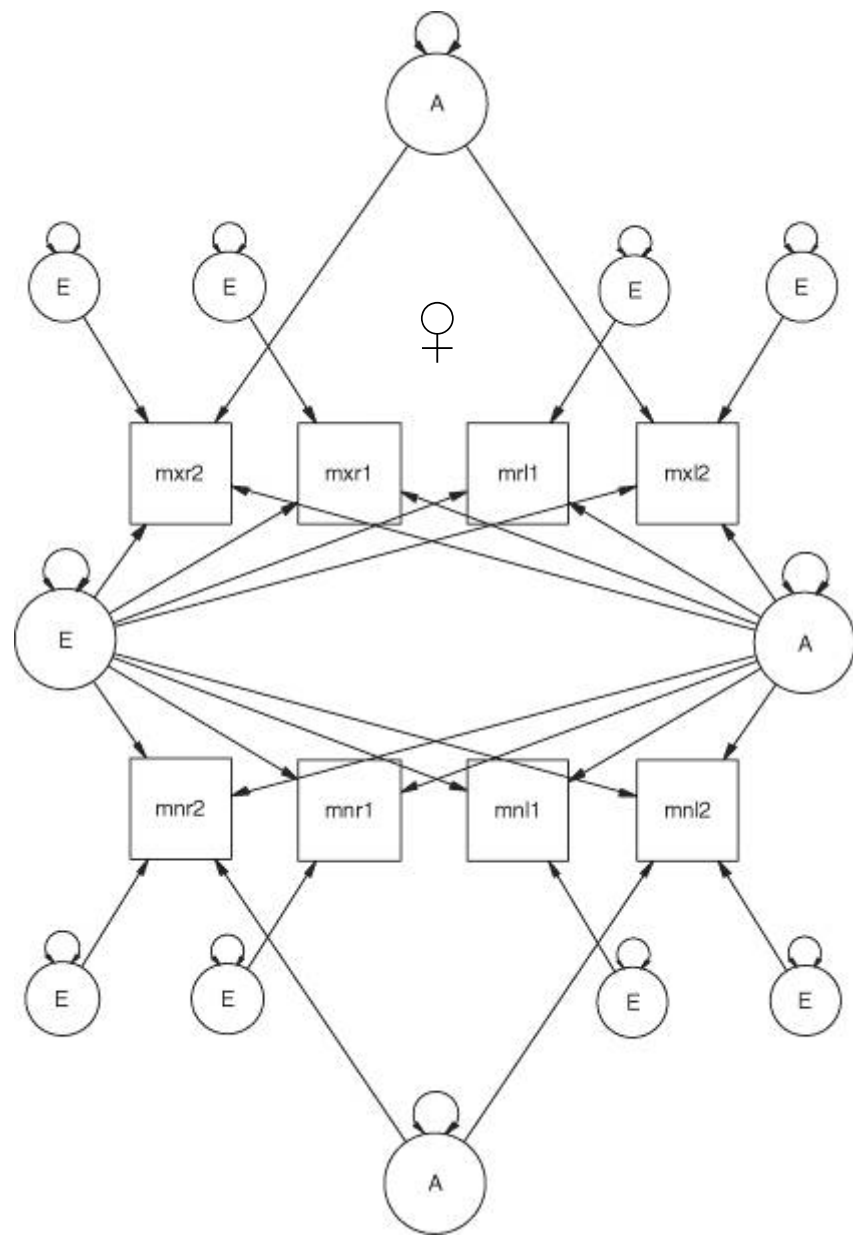
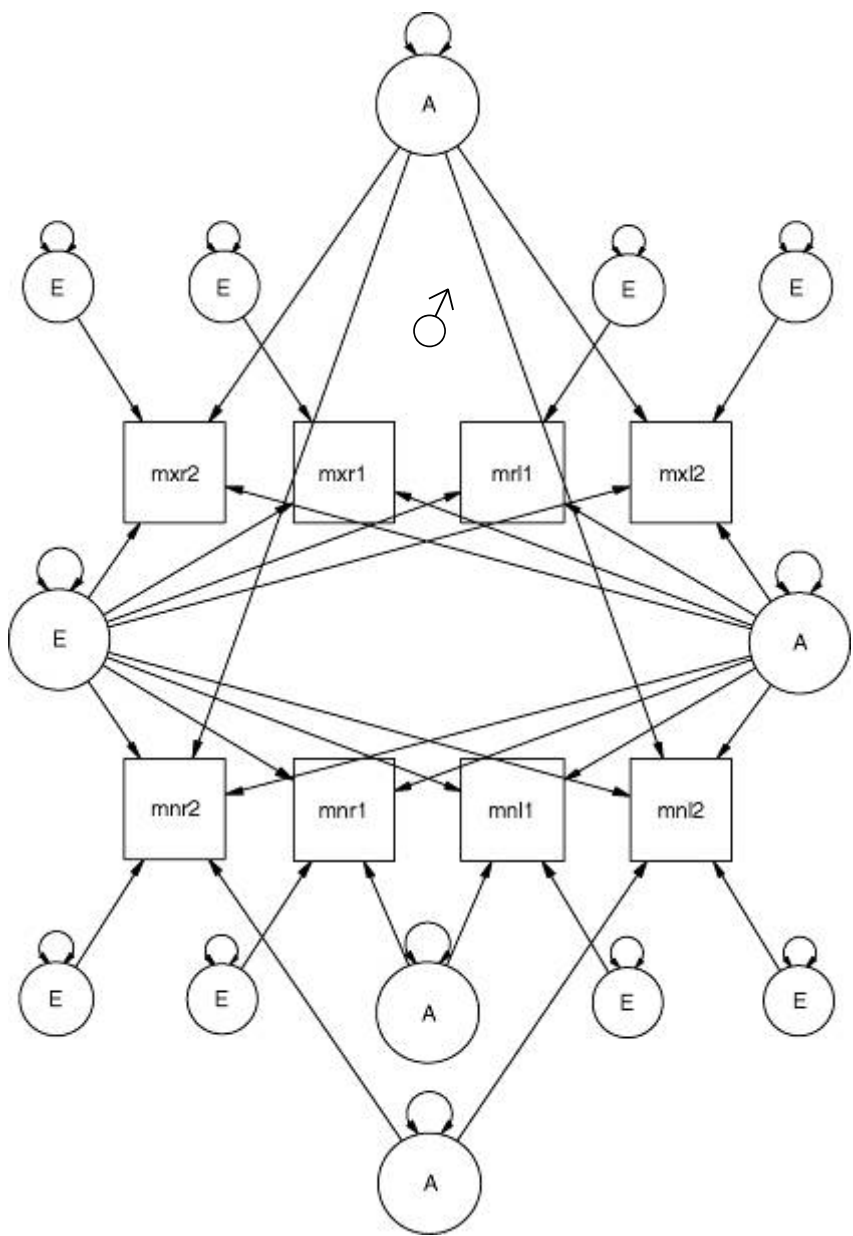
- Complete recruitment & data collection for current cohort
- Follow twins from 3-6 years of age to ascertain caries development in primary teeth
- Genetic liability for oral health in Aussie kids
  - how/when to apply it in the clinic???
  - association with other systemic diseases???



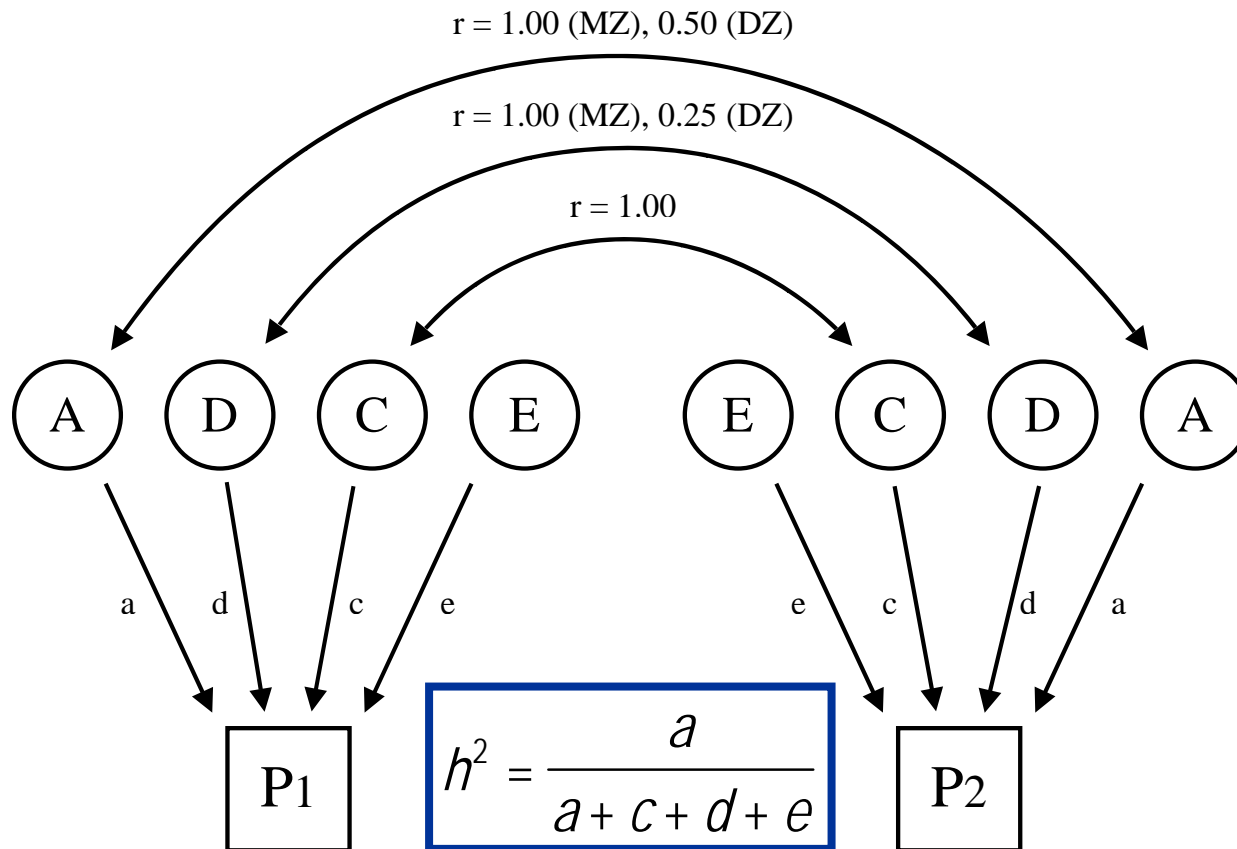
**Thanks to all  
the twins and  
their families.**

**Thanks to the  
NHMRC and  
ADRF for  
financial  
support**





## Heritability ( $h^2$ ) – amount of variation due to genetic factors





- By gaining a better understanding of the early colonisation of decay-producing bacteria in the mouth, there is the possibility of developing new strategies to prevent development of caries. These include:
  - Introducing bacteria into the mouth early on that don't produce decay and prevent MS from colonizing.
  - Using a vaccine very early on (e.g. nasal spray) to stimulate antibodies to MS and prevent colonization.
- Targeted vaccines hold some promise for a safe and efficient method of caries prevention in developing countries – in China, 75% of 5-year-olds have significant dental decay.