

# prenatal androgens & gender-related play: different results using different methods

debra spencer, vickie pasterski, sharon neufeld, vivette glover, thomas o'connor, peter hindmarsh, ieuan hughes, carlo acerini & melissa hines

## introduction

- 1

  - On average, girls and boys express different play preferences:
    - Boys prefer to play with toys such as vehicles and weapons
    - Girls prefer to play with toys such as dolls and tea sets
- 2

  - Influences on gendered development, including play preferences, include:
    - genetic information on the sex chromosomes
    - fetal and neonatal concentrations of testosterone and other hormones
    - socialization by parents, peers, teachers and others
    - self-socialization based on cognitive developmental processes associated with gender
- 3

  - Prior research studying girls with congenital adrenal hyperplasia (CAH), who have been exposed to high concentrations of androgens prenatally due to a genetic condition, show increased male-typical and reduced female-typical play
- 4

  - Studies of typically-developing children that use a single sample of amniotic fluid to measure testosterone (T) prenatally, however, have produced mixed results:
    - Two studies have found no relationship between T concentrations and gender-related play
    - One study has found the predicted relationship in girls and in boys
- 5

  - We examined the possibility that methodological differences might explain these inconsistent findings

## methods & design

- 1

  - We conducted two studies:
    - One involving children with CAH
    - One involving typically developing children for whom T had been measured in amniotic fluid
- 2

  - The studies aimed to determine if the increased male-typical toy preferences seen in girls exposed to high levels of androgens, because of CAH, would be mirrored by correlations between amniotic fluid T and toy preferences in typically-developing children
- 3

  - The CAH study compared toy preferences for 43 girls and 38 boys, aged 4 to 11 years, with classic CAH to those of similarly-aged, unaffected relatives (41 girls, 31 boys)
- 4

  - The amniotic T study examined the relationship between concentrations of T in amniotic fluid, obtained for clinical purposes, and toy preferences in typically developing children (50 girls and 45 boys) aged 3 to 5 years
    - Amniotic fluid samples were obtained between gestational weeks 15 and 25 ( $M = 16.93$  weeks,  $SD = 2.01$ )
    - Total T in amniotic fluid was measured using radioimmunoassay after solvent extraction and concentration
- 5

  - For both studies, toy preferences were assessed using behavioural observation, researcher-led interviews with parents and children, and a parent-report questionnaire

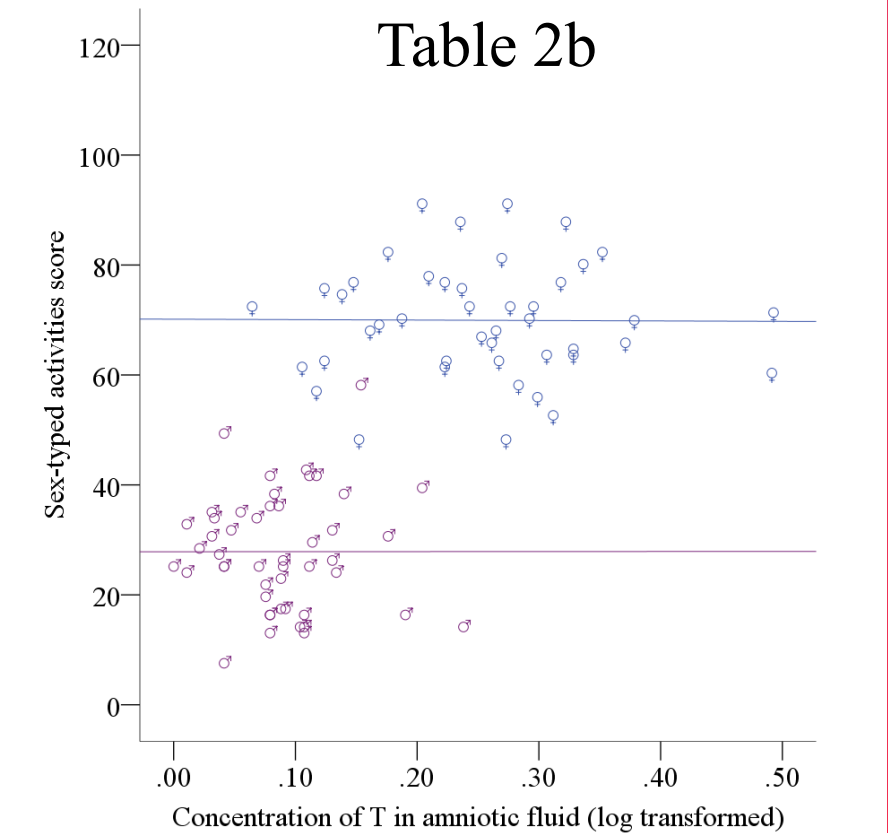
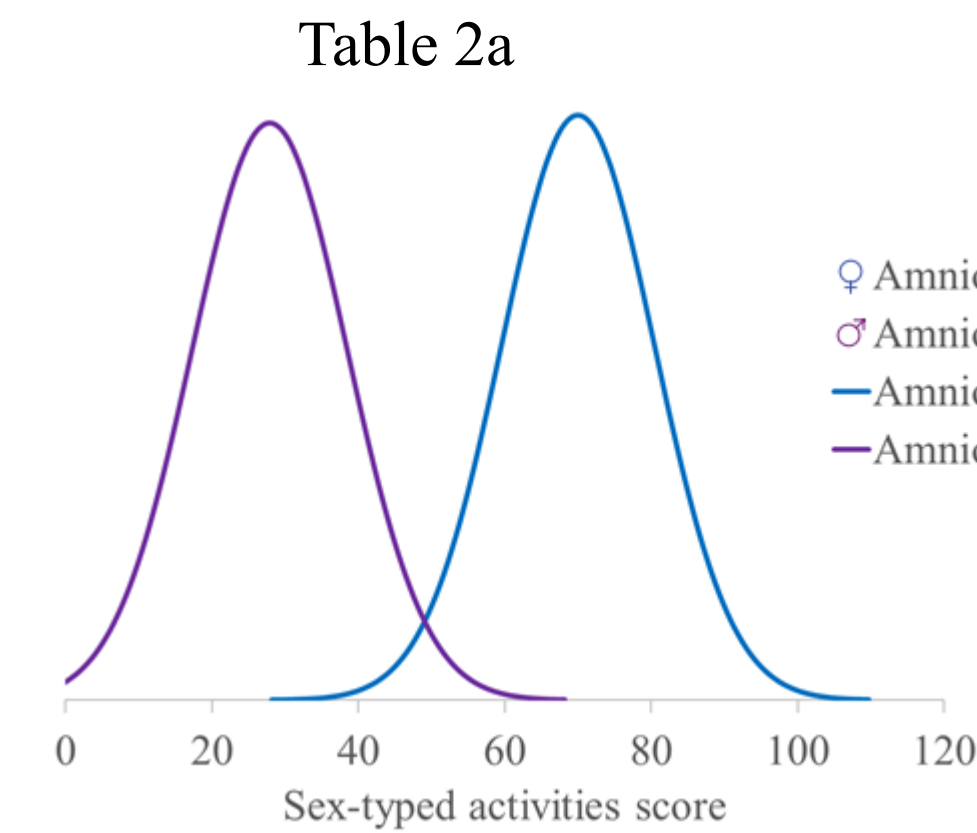
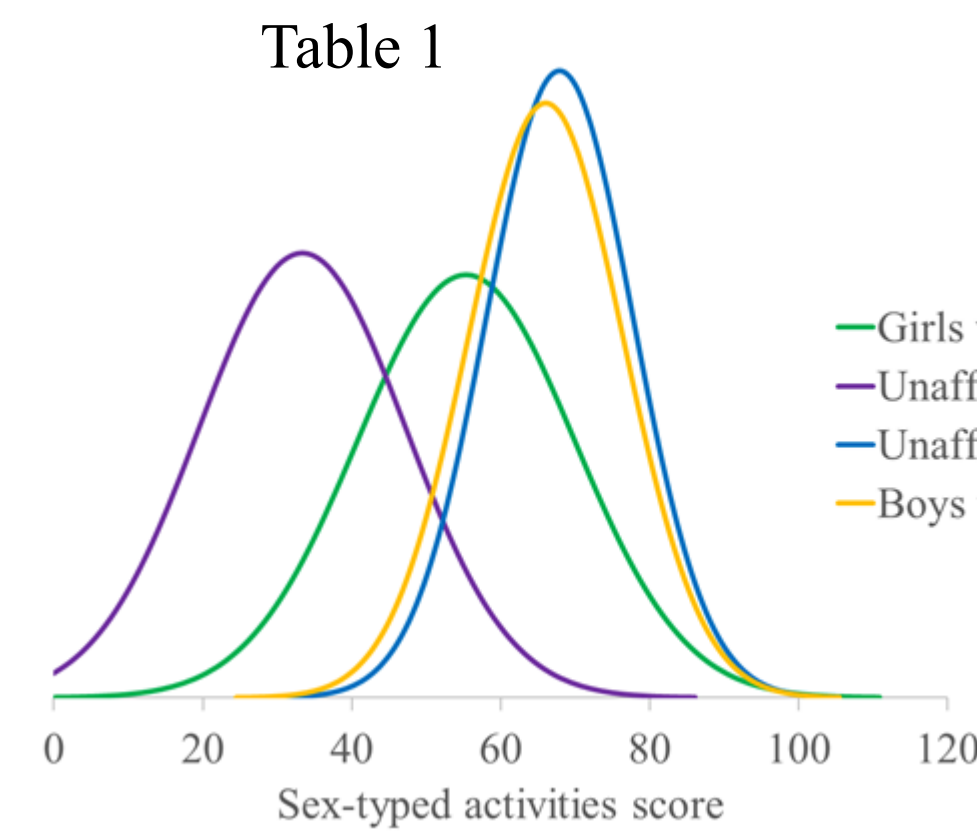
## results

|   |  | Group averages              |                             |                            |                             |                             |                             | Effect sizes for group comparisons |                         |                         |                  | Relation with measure of amniotic T |               |
|---|--|-----------------------------|-----------------------------|----------------------------|-----------------------------|-----------------------------|-----------------------------|------------------------------------|-------------------------|-------------------------|------------------|-------------------------------------|---------------|
|   |  | CAH study                   |                             |                            |                             | Amniotic T study            |                             | CAH study                          |                         |                         | Amniotic T study | Boys                                | Girls         |
| Measure   | Type of measure  | Girls with CAH<br>n = 43    | Unaffected girls<br>n = 41  | Unaffected boys<br>n = 31  | Boys with CAH<br>n = 38     | Boys<br>n = 45              | Girls<br>n = 50             | Girls with & without CAH           | Unaffected boys & girls | Boys with & without CAH | Boys and girls   |                                     |               |
| Sex-typed activities<br>Higher scores indicate more male-typical behaviour                      | Parent (4 to 6 year olds) or child report (7+ year olds) | $M = 55.30$<br>$SD = 14.61$ | $M = 33.39$<br>$SD = 13.88$ | $M = 67.89$<br>$SD = 9.85$ | $M = 66.03$<br>$SD = 10.38$ | $M = 69.94$<br>$SD = 10.46$ | $M = 27.85$<br>$SD = 10.60$ | $d = 1.54^{***}$                   | $d = 2.87^{***}$        | $d = 0.18$              | $d = 4.00^{***}$ | $r = -.01$                          | $r = .00$     |
| Gender typicality of 3 favourite toys<br>Higher scores indicate more female-typical preferences | Child interview  | $Mdn = 3.72$                | $Mdn = 4.19$                | $Mdn = 3.32$               | $Mdn = 3.30$                | $M = 3.13$<br>$SD = 0.51$   | $M = 4.44$<br>$SD = 0.59$   | $r = .61^{***}$                    | $r = .79^{***}$         | $r = .03$               | $d = 2.37^{***}$ | $r = -.06$                          | $r = .16$     |
| Gender typicality of 3 favourite toys<br>Higher scores indicate more female-typical preferences | Parent interview   | $Mdn = 3.57$                | $Mdn = 4.69$                | $Mdn = 3.18$               | $Mdn = 3.26$                | $M = 3.08$<br>$SD = 0.40$   | $M = 4.66$<br>$SD = 0.53$   | $r = .60^{***}$                    | $r = .78^{***}$         | $r = .01$               | $d = 3.37^{***}$ | $r = .29$                           | $r = -.07$    |
| Play with boy-typical toys<br>Higher scores indicate more time spent                            | Behavioural observation                                  | $Mdn = .43$                 | $Mdn = .04$                 | $Mdn = .81$                | $Mdn = .65$                 | $Mdn = .66$                 | $Mdn = .06$                 | $r = .42^{***}$                    | $r = .65^{***}$         | $r = .16$               | $r = .72^{***}$  | $r_S = .00$                         | $r_S = -.27$  |
| Play with girl-typical toys<br>Higher scores indicate more time spent                           | Behavioural observation                                  | $Mdn = .08$                 | $Mdn = .44$                 | $Mdn = .01$                | $Mdn = .00$                 | $Mdn = .12$                 | $Mdn = .65$                 | $r = .37^{***}$                    | $r = .54^{***}$         | $r = .14$               | $r = .70^{***}$  | $r_S = -.09$                        | $r_S = .29^*$ |

\*  $p \leq .05$ ; \*\*  $p \leq .01$ ; \*\*\*  $p \leq .001$

**Taking a closer look...**

- For both studies, the measure of sex-typed activities showed the largest sex difference:  $d = 2.87$  for the CAH study and  $d = 4.00$  for the amniotic T study
- Typically-developing boys in both studies showed more male-typical behaviour than typically-developing girls (see **Tables 1** and **2a** for visual depictions)
- The effect size for the difference between girls with CAH and unaffected girls (depicted in **Table 1**) was larger than the effect sizes for the other four gender-related play measures that we employed
- However, as depicted in **Table 2b** for the amniotic T study, the relation between sex-typed activities scores and T concentrations was negligible for boys,  $r = -.01$ , and for girls,  $r = .00$ .



## discussion & conclusions

- 1

  - Our findings for the children in the CAH study were in the predicted direction
    - We found the predicted sex difference for all measures of gender-related play
    - Girls with CAH showed increased male-typical and also decreased female-typical play compared to unaffected girls
    - Gender-related play in boys with and without CAH did not differ
- 2

  - Our finding, that girls with CAH are more likely than unaffected girls to prefer toys that boys usually prefer, resembles those of prior research (e.g., Berenbaum & Hines, 1992; Berenbaum & Snyder, 1995; Nordenstrom et al., 2002; Pasterski et al., 2011)
- 3

  - Our finding of no relationship between T measured in amniotic fluid and later gender-related play behaviour may, initially, seem surprising
    - However, prior studies relating amniotic T to later gender-related play behaviour also have produced largely negative results:
      - One prior study found the predicted relations (Auyeung et al., 2009) but two others did not (Knickmeyer et al., 2005; van de Beek et al., 2009)
- 4

  - Our finding, that amniotic fluid T does not appear to relate to gender-typed play behaviours that show large and consistent sex differences, may suggest that the androgenic effects seen in clinical conditions such as CAH do not translate to typical human development
    - Alternatively, amniotic fluid T may be a relatively insensitive measure of prenatal androgen exposure (Constantinescu & Hines, 2012)
- 5

  - Research on typically developing children, using a more sensitive measure of prenatal androgen exposure than that provided by amniotic fluid, is needed