

## INTRODUCTION

- We have previously reported that children with FAS and PFAS made more errors than heavily exposed nonsyndromal and control children on the **Reading the Mind in the Eyes** test, in which the participant is asked to identify the emotion portrayed in the eye expressions (Kilchenmann et al., ACER 2012).
- From a comprehensive Theory of Mind test battery administered at 11 yr, Reading the Mind in the Eyes was the only test in which effect of alcohol was still highly significant after controlling for WISC IQ, executive function tests, and potential confounding variables, including sex, age at testing, maternal smoking and education and social economic status (SES).
- This robust finding suggested that children with FASD have difficulty reading people's emotions and social cues.
- Diwadkar has developed an fMRI paradigm for assessing the neural bases of affective appraisal of faces, using an *n*-back format, in which the participant must assess whether the face displayed on the screen shows the same or different affect as the previous one.
- The purpose of this study was to examine the relation of prenatal alcohol exposure to behavioural performance on this task
  - Successful performance on the task depends on both affective appraisal and working memory skills.
  - Because working memory has been shown to be impaired in alcohol-exposed children, we also investigated the degree to which a working memory deficit makes it more difficult for prenatally exposed children to successfully process affective faces showing differently valenced emotions on this task.

## METHODS

### SAMPLE

- 88 Cape Coloured (mixed ancestry) 9- to 12-year-old children who are participating in the Cape Town Longitudinal Cohort study on fetal alcohol spectrum disorders (FASD) in Cape Town, South Africa (Jacobson et al., 2008)—12 with fetal alcohol syndrome (FAS), 11 with Partial FAS (PFAS), 27 nonsyndromal heavy exposed (HE), and 38 typically developing controls (**Table 1**).

### Prenatal alcohol exposure

- Timeline follow-back interviews were administered to the mother twice during pregnancy and at 1-month postpartum to reflect the latter part of the pregnancy
- Volume of each type of beverage (beer, wine, liquor, cider) consumed each day during the pregnancy was converted to oz of absolute alcohol (AA)
- Children born to women who reported drinking at least 14 drinks/week (1.0 oz AA/day) on average or engaging in binge drinking (4 or more drinks/occasion) were considered heavily exposed
- Children whose mothers drank < 0.5 oz AA/day and did not binge drink participated as controls

### FAS/PFAS diagnoses

- At age 5 years, children were examined by three expert dysmorphologists, for alcohol-related anomalies and growth, using a standard diagnostic protocol (Hoyme et al., 2005), (see Jacobson et al., 2008). Case conferences were held to reach consensus regarding diagnosis.
- FAS—characterised by distinctive craniofacial dysmorphology, including short palpebral fissures, thin upper lip and flat or smooth philtrum; small head circumference; and growth retardation.
- PFAS—at least two of the three facial anomalies plus small head circumference, growth retardation, or cognitive/behavioural abnormalities.
- Heavily exposed (HE) nonsyndromal—heavily exposed children who lack the distinctive alcohol-related facial features but may demonstrate significant neurobehavioural and cognitive deficits

### OUTCOME MEASURES

- Working memory** assessed using the *n*-back task.
  - Individual letters displayed sequentially
  - Child indicates whether the letter displayed is the same as the previous one (1-back) or the same as the one prior to the previous one (2-back).
- Affective appraisal** assessed during same visit using an affective appraisal task based on *n*-back principle.
  - Photos of faces displaying different emotions (neutral, happy, sad, angry, or fearful) presented sequentially.
  - Child indicates by pressing a button whether the face currently displayed shows the same or different affect as the previous one.
- The main behavioural outcome variable generated by these tasks is *d*-prime, which measures a participant's correct number of button presses, adjusting for false alarm presses. The number of correct button presses (hit rate) and false alarm presses (false alarm rate) were also recorded and examined separately.

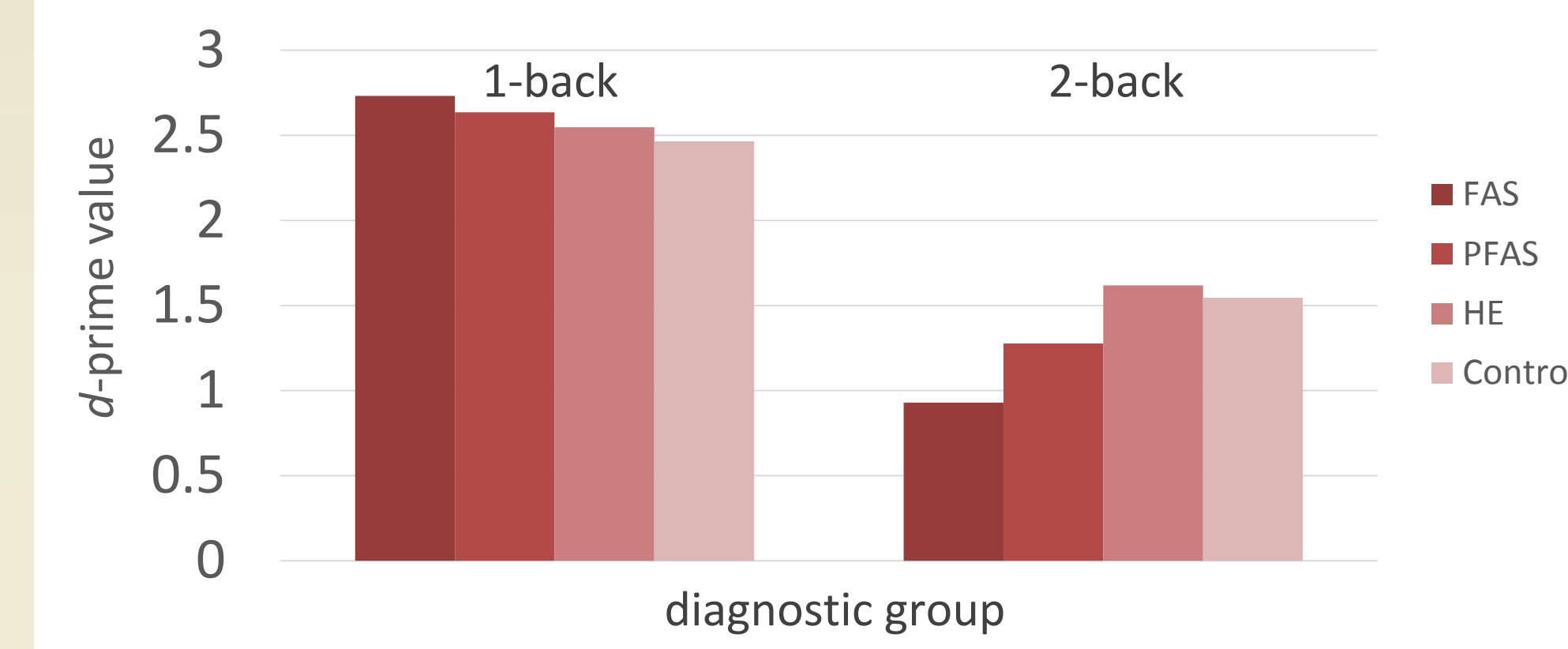


## RESULTS

Table 1. Sample Characteristics (N=88)

	Mean or %	SD	Range
<b>Maternal</b>			
Age at delivery (years)	26.5	6.2	18.6 – 43.8
Marital status (% married)	43.2 %		
Education (years)	9.4	2.3	0.0 – 16.0
<b>Prenatal exposure (consumers only)</b>			
oz absolute alcohol per day	1.1	1.0	0.0 – 5.0
oz absolute alcohol per drinking day	4.3	2.5	1.3 – 15.4
Frequency (drinking days/week)	0.2	0.2	0.0 – 0.7
Cigarettes (n=61; number/day)	5.0	5.5	0.0 – 20.0
Marijuana use (n=10; days/month)	0.4	1.2	0.0 – 7.0
<b>Child</b>			
Age at testing (years)	11.2	1.27	9.9 – 14.2
Gender (% male)	45.5 %		

Fig. 1. Performance on *n*-back working memory task by diagnostic group



### Working memory (Fig. 1)

- No between-group differences on 1-back working memory task ( $F(3,77)=0.26, p>0.20$ ), indicating that all four groups demonstrated the ability to meet the working memory demands of the affective processing task
- By contrast, FASD diagnosis was associated with poorer performance on the 2-back task ( $F(3,70)=2.98, p=.037$ ); the children with FAS performed more poorly than the HE ( $p=0.008$ ) and control ( $p=0.013$ ) groups
- There was a moderate correlation between the 1-back and 2-back tasks ( $r=.50, p<.001$ ), but neither was related to affective appraisal ( $r_s=.06-.08$ ), indicating that working memory *per se* did not influence performance on the affective appraisal task.

### Affective appraisal

- No group differences were found on the affective appraisal task, ( $F(3,80)=0.16, p>0.20$ ) (**Fig. 2**).
  - However, the PFAS group exhibited a higher false alarm rate than the FAS ( $p=0.008$ ), HE ( $p=0.098$ ), and control groups ( $p=0.074$ ) (**Fig. 3**), suggesting greater impulsivity, and
  - The FAS group had a higher rate of correct rejections than the PFAS ( $p=0.007$ ), HE ( $p=0.086$ ), and control groups ( $p=0.058$ ) (**Fig. 4**), possibly due to their slower response rates.
- The only emotion on which the groups differed consistently was appraisal of angry faces. The PFAS group was less likely to correctly identify an angry face than the FAS, HE, and control groups.
  - False alarms (failure to recognise an angry face as angry): PFAS > FAS ( $p=0.004$ ), HE ( $p=0.023$ ), controls ( $p=0.031$ ).
  - Correct rejection (recognition of an angry face as angry): PFAS < FAS ( $p=0.010$ ), HE ( $p=0.039$ ), controls ( $p=0.058$ ).
- Affective appraisal was moderately related to Reading the Mind in the Eyes ( $r=.47, p<.001$ ) (**Fig. 5**), indicating measurement of a common domain.

## DISCUSSION

- All diagnostic groups were able to successfully complete a 1-back working memory task, confirming their ability to retain the information needed to perform the affective appraisal task.
- Consistent with previous literature, as complexity increased at the 2-back level, children with FAS performed significantly worse than the other groups.
- Overall, no group differences were found on the affective appraisal task.
- However, differences between the FAS and PFAS groups suggested that the PFAS group responded more impulsively and less accurately, especially when comparing angry and nonangry faces.

## CONCLUSIONS

- Our previous findings using the Reading the Mind in the Eyes test demonstrated that prenatal alcohol exposure is associated with impairment in the ability to appraise emotional state, but that test is not appropriate for use in the MR scanner, given the large between-group differences in behavioural performance.
- Although there was a moderate relation between the 1- and 2-back tasks, neither was related to affective appraisal, indicating that working memory did not influence affective appraisal task performance.
- By contrast, the simpler affective appraisal task reflects the same functional domain as Reading the Eyes in the Mind but is more suitable for examining effects of prenatal alcohol exposure on cortico-limbic activation in the scanner since all four diagnostic groups are able to perform it successfully.

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$r=.47, p<.001$