INDIVIDUAL DIFFERENCES IN NEURAL ALCOHOL CUE-REACTIVITY ARE SHAPED BY HEAVY EPISODIC DRINKING

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INFLUENTIAL THEORY OF ADDICTION

The incentive-sensitization theory of addiction (Berridge & Robinson, 1993) posits that cues signaling drug availability take on incentive value of the drugs themselves.

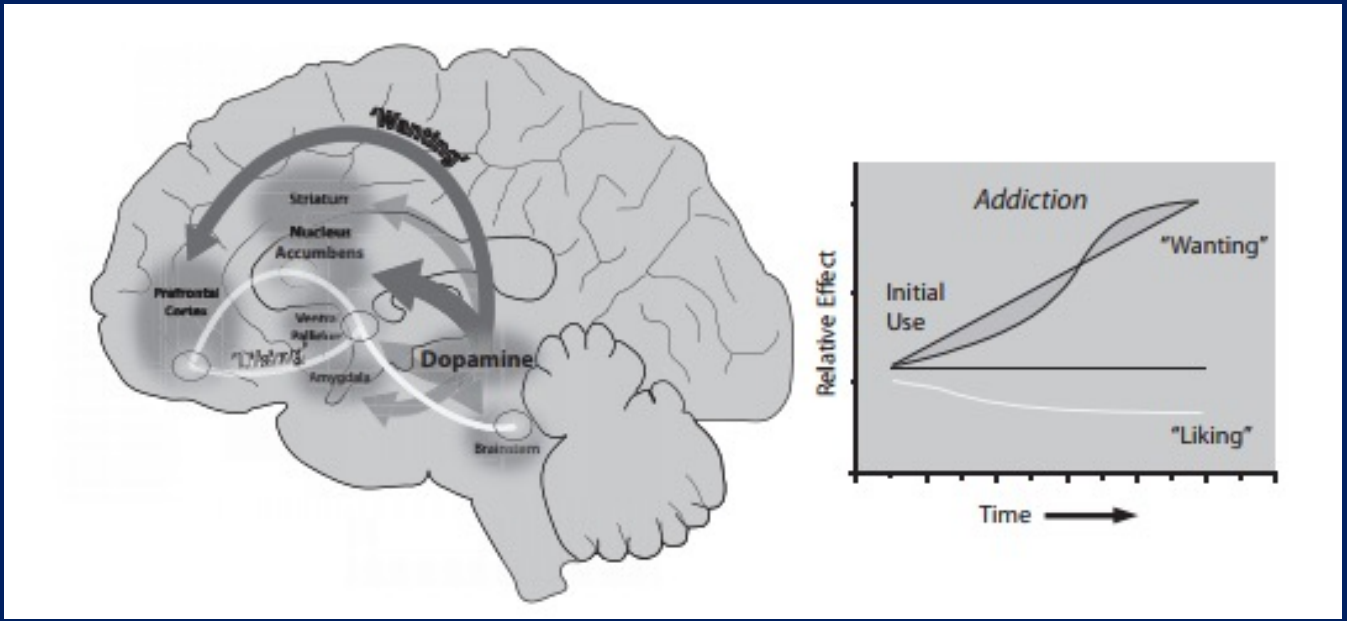
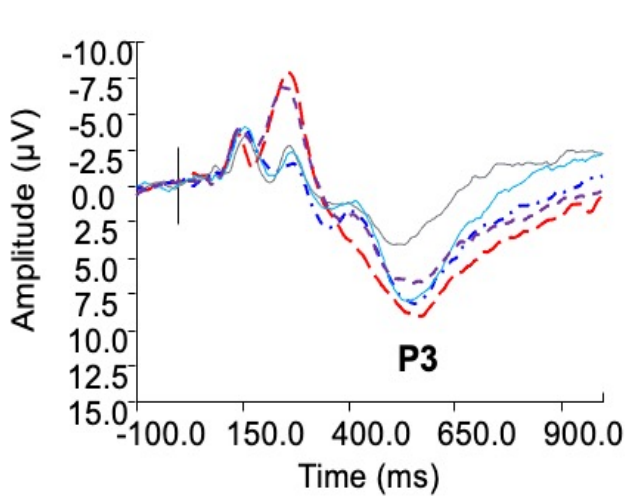
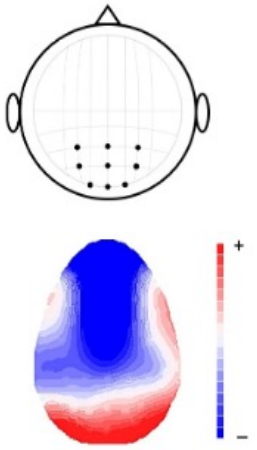


Image taken from Berridge, K. C., & Robinson, T. E. (2016). Liking, wanting, and the incentive-sensitization theory of addiction. *American Psychologist*, *71*(8), 670.

SIGNATURE OF INCENTIVE SALIENCE

Bioelectrical signature of salience or motivational significance



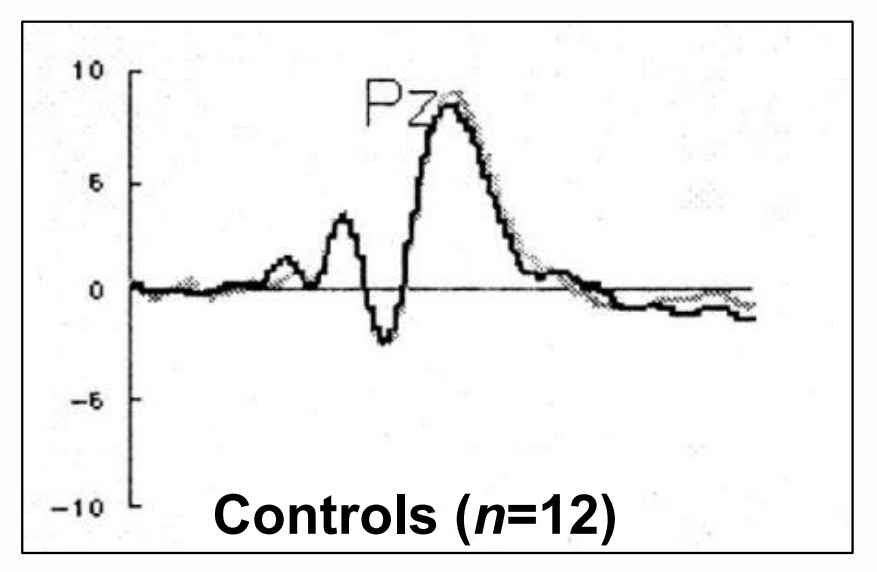


Source: http://www.hanix.net/En/Products/info/id/100.html

" (…) variability in the amplitude of the P3/LPP reflects stimulus significance and associated activation of motivational circuits." (Hajcak & Foti, 2020)

ENHANCED P3 REACTIVITY TO ALCOHOL CUES

Enhanced P3 reactivity to alcohol cues has been shown to be present among alcoholics and heavy drinkers.



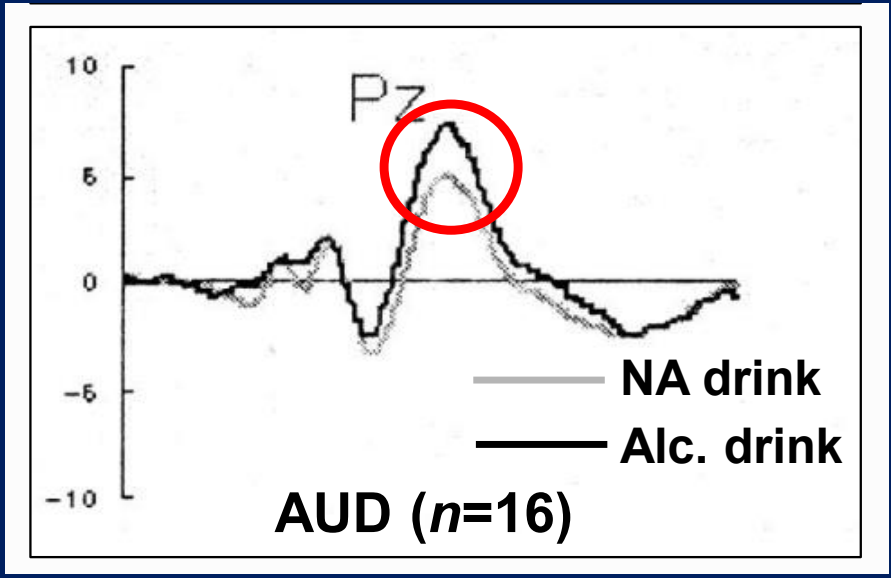
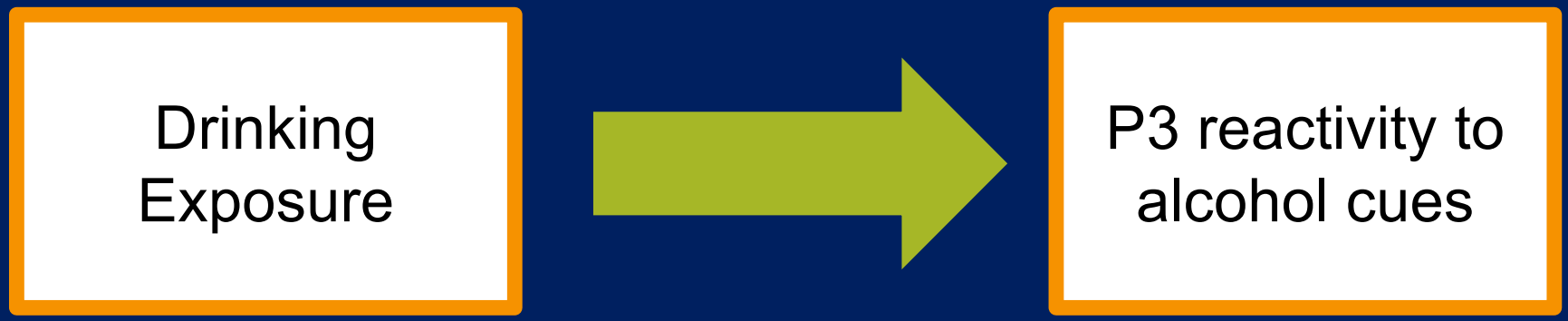


Image taken from Namkoong, K., et al. (2004). Increased P3 amplitudes induced by alcohol-related pictures in patients with alcohol dependence. *Alcoholism: Clinical and Experimental Research*, 28(9), 1317-1323.

DRINKING → P3 REACTIVITY TO ALCOHOL CUES

In theory, P3 reactivity to alcohol cues is shaped by drinking experiences, but research to date has not demonstrated a role for individual drinking experiences in determining ACR-P3 amplitude

In this study, we used a longitudinal and genetically informed design



PARTICIPANTS

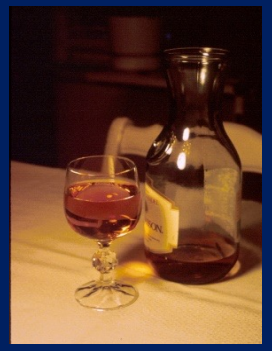
173 twins were longitudinally followed from age 12 to 18

- (44 Mz pairs/53 DZ pairs, 49% females, and 86% White)

Alcohol use was assessed annually with structured clinical interviews.

Picture-viewing task while EEG was recorded (at age 18 or 20)

- Stimuli = alcohol beverages, nonalcohol beverages, and neutral



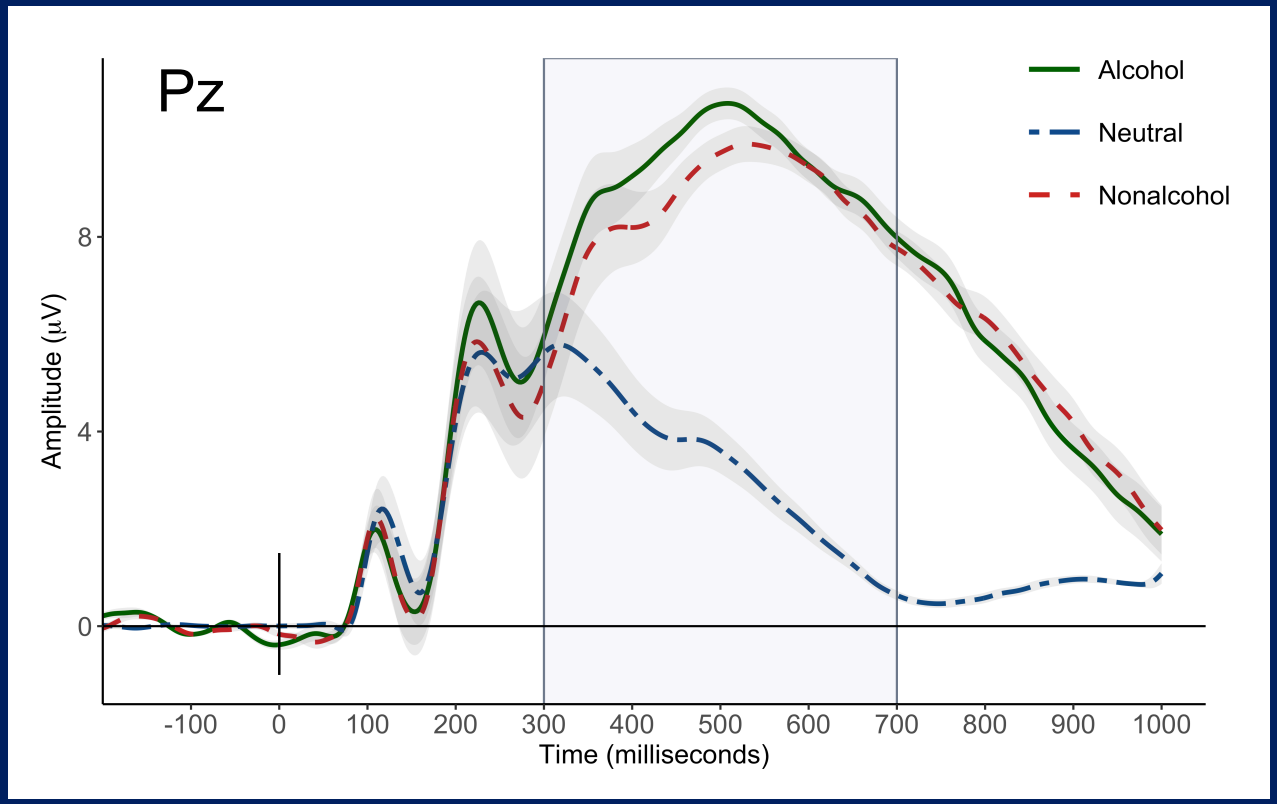
Alcohol

Nonalcohol

Neutral

ERP WAVEFORMS

Grand-averaged, stimulus-locked waveforms:

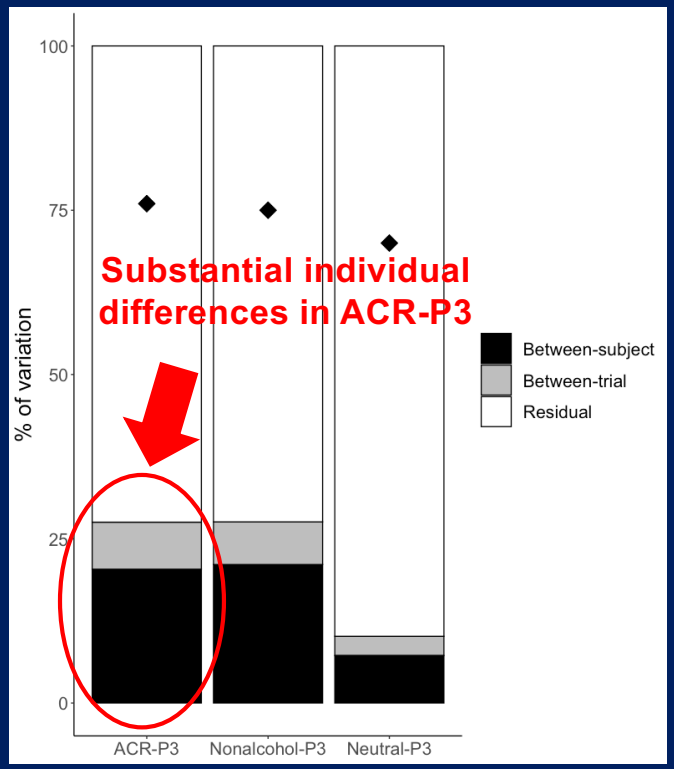


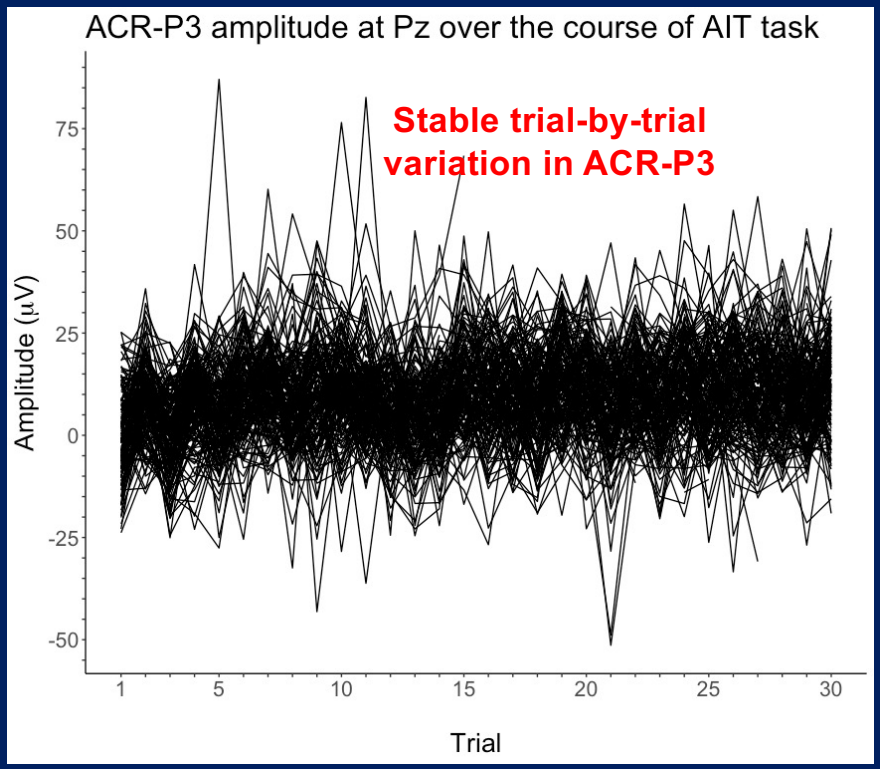
P3 ERP measures:

- P3 elicited by alcohol cues
  => ACR-P3
- P3 elicited by nonalcohol cues
  => Nonalc-P3
- P3 elicited by neutral cues
  => Neutral-P3

INDIVIDUAL DIFFERENCES IN ACR-P3

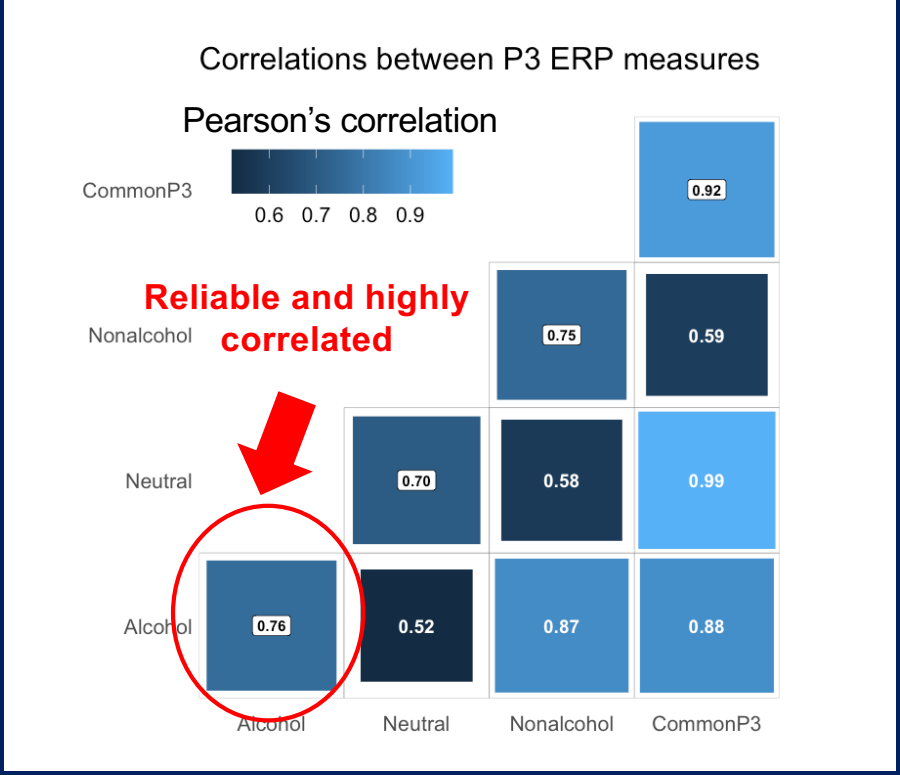
Individual differences in ACR-P3 were quantified using ICC from a random intercept-only multilevel model

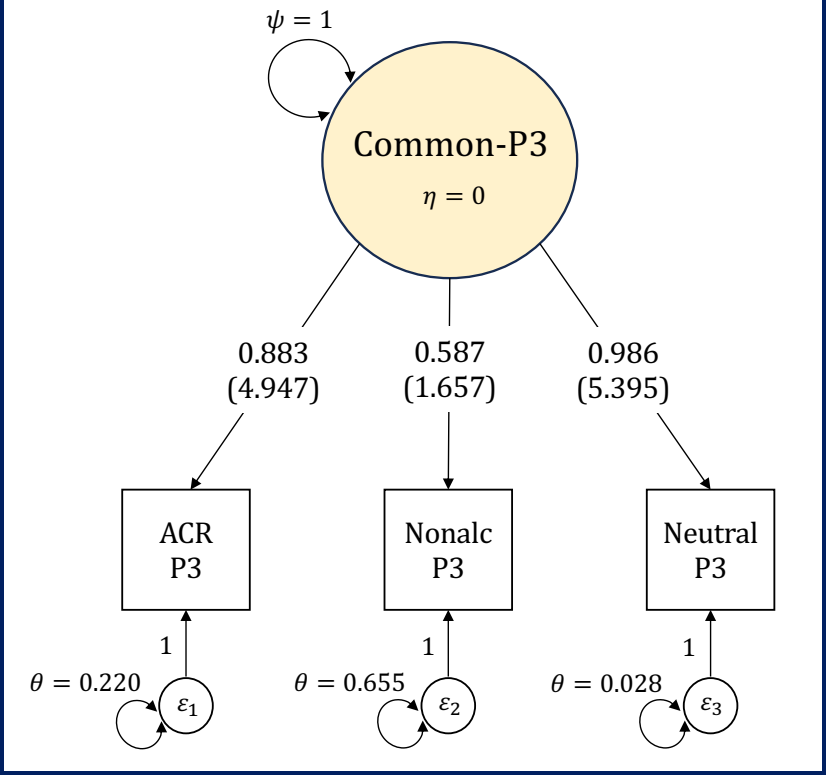




INDIVIDUAL DIFFERENCES IN ACR-P3

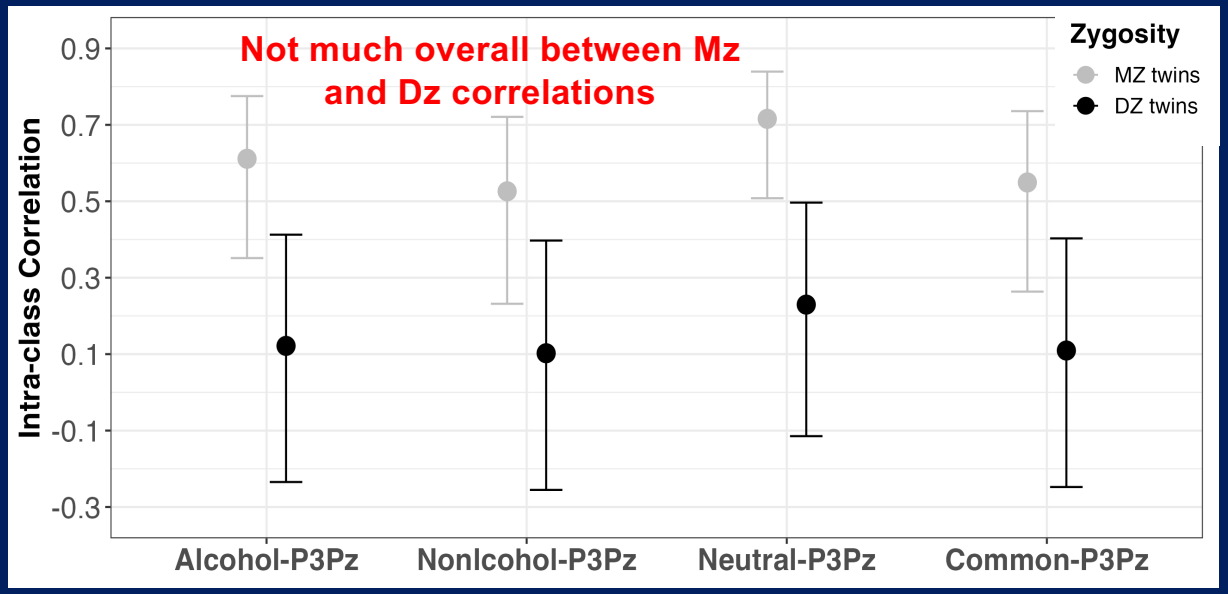
Individual differences in P3 reactivity are reliable and highly correlated (i.e., high commonality across P3 ERP measures)

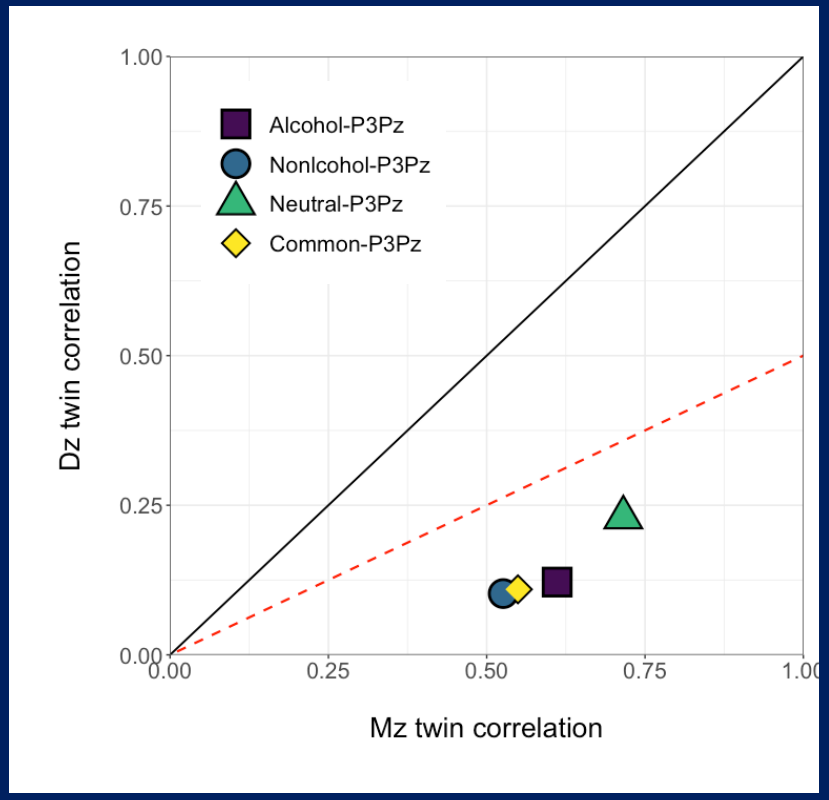




ORIGINS OF VARIABILITY IN ACR-P3

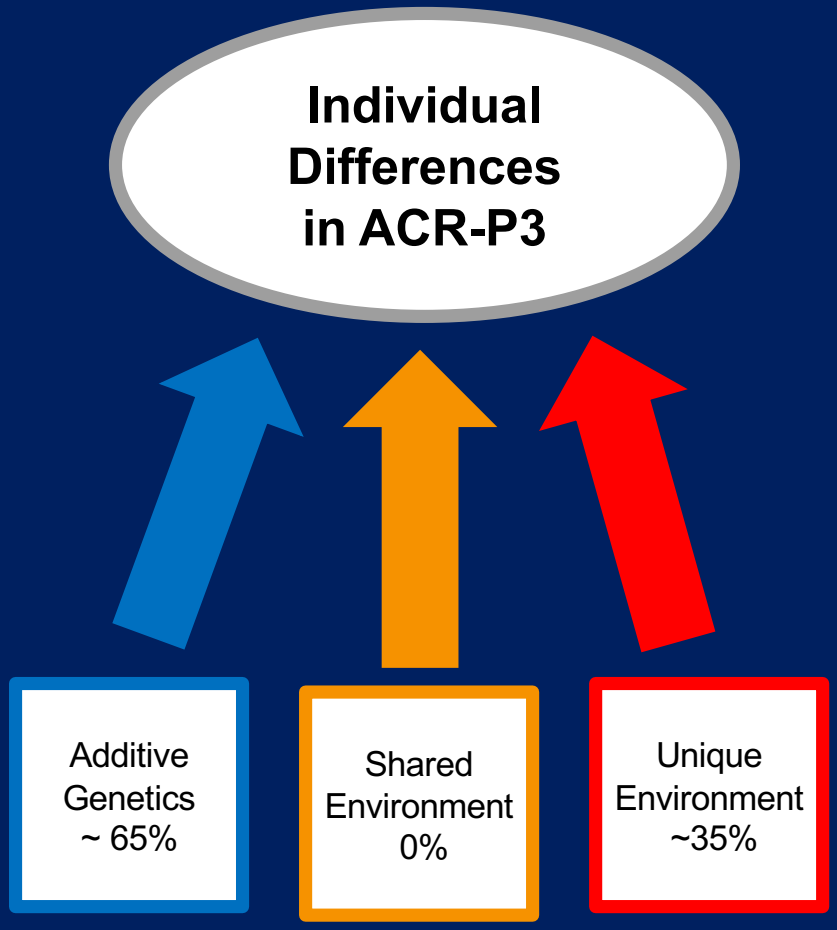
Small overlap between Mz and Dz correlations indicates strong genetic contributions to individual differences in ACR-P3

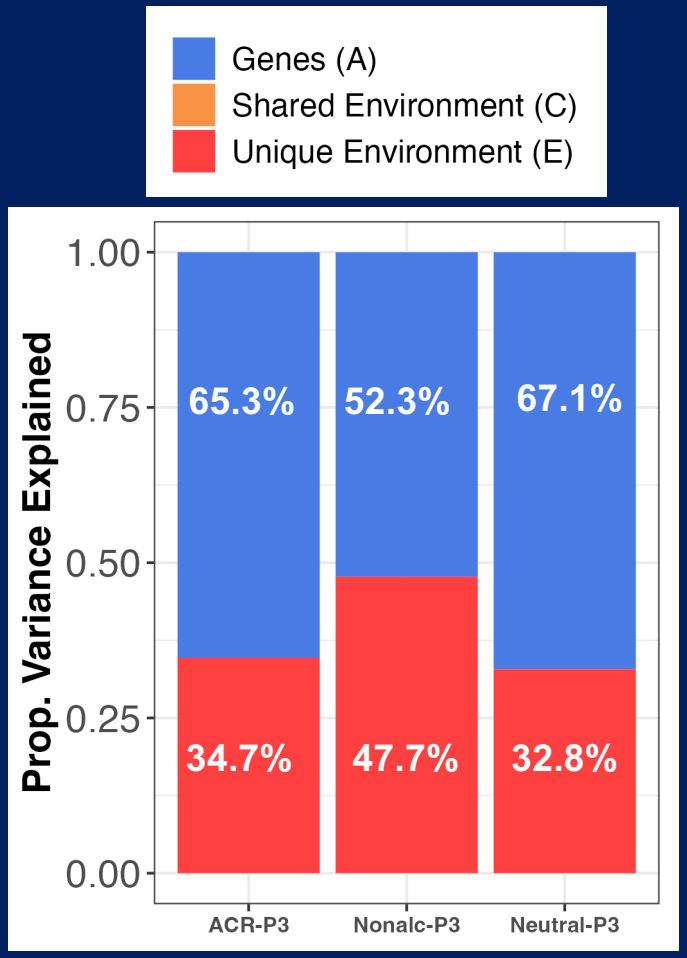




GENETIC AND ENVIRONMENTAL CONTRIBUTIONS

Univariate ACE twin model (and best-fitting AE model):





HEAVY EPISODIC DRINKING INFLUENCES ACR-P3

B_B = shared liability = genes & rearing environment

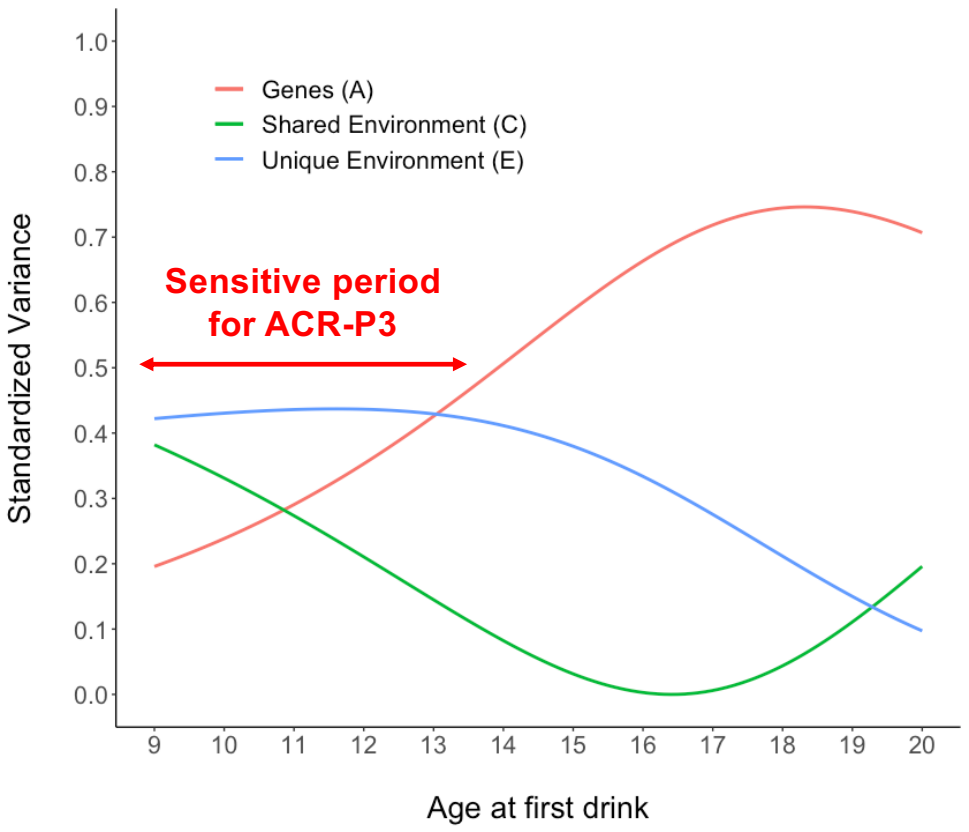
B_W = nonshared = unique environmental contribution

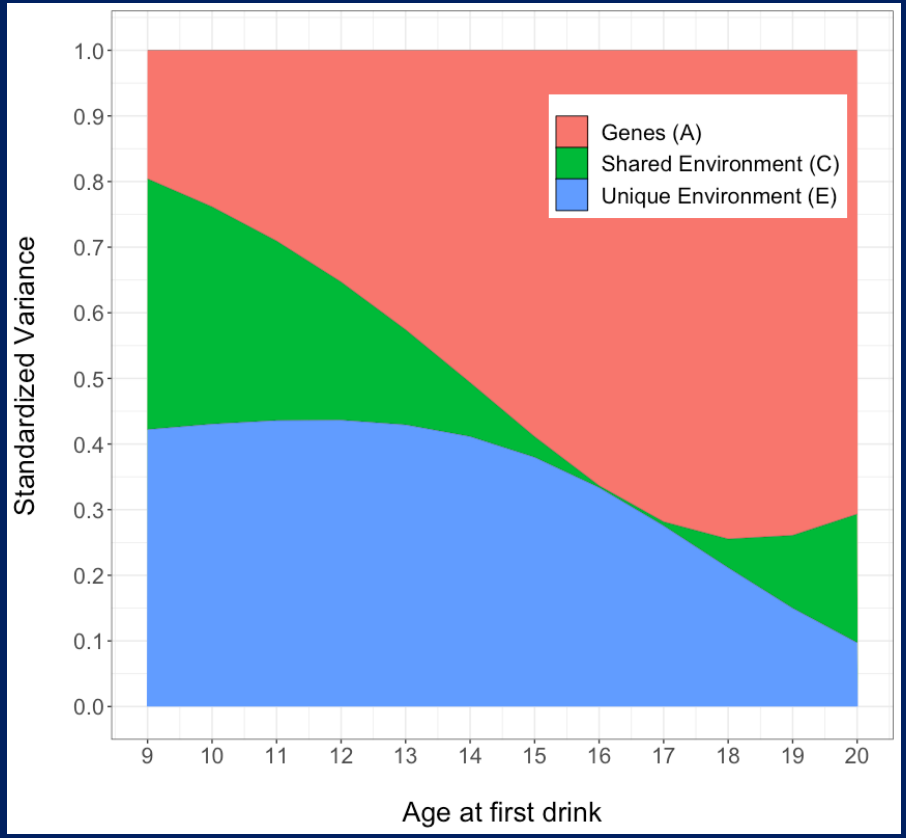
$$Y_{ij} = B_{00} + (B_B \times \bar{X}_{0j}) + (B_W \times (X_{ij} - \bar{X}_{0j})) + (B_{03} \times ZYG) + (B_{04} \times ZYG \times (X_{ij} - \bar{X}_{0j})) + u_{0j} + e_{ij}$$

	Age at first drink		QF alcohol use		Heavy drinking	
DV:ACR-P3	*b*	P-value	*b*	P-value	*b*	P-value
Sex	**2.74**	**0.0435**	**2.92**	**0.0416**	2.42	0.0938
Within-twin (B_W)	0.12	0.6512	–0.02	0.2404	**0.28**	**0.0335**
Between-twin (B_B)	0.30	0.3389	0.005	0.2469	–0.06	0.6293
DV: Nonalc-P3						
Sex	**2.98**	**0.028**	**2.93**	**0.0407**	2.29	0.1203
Within-twin (B_W)	0.21	0.118	–0.03	0.0903	0.28	0.0698
Between-twin (B_B)	0.49	0.466	0.005	0.3080	–0.16	0.1940

MODERATION BY AGE AT FIRST DRINK

Moderated ACE model on ACR-P3 (age at first drink as moderator):





TAKE HOME MESSAGES

- ACR-P3 amplitude can be attributed to genetic factors and non-shared environmental effects:
  - ACR-P3 amplitude is highly heritable (~65%), it also is influenced by unique, non-shared environmental experiences (~35%)
- Controlling for genetic and shared environmental liability, heavy episodic drinking prospectively predicted increased ACR-P3
  - ACR-P3 is an acquired marker of risk that reflects acquisition of incentive salience for alcohol cues due to heavy drinking.
- Early adolescence emerges as a sensitive period for the influence of the environmental experiences on ACR-P3, with environmental influences playing a substantial role during this developmental phase

ACKNOWLEDGMENTS

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Ispa Instituto Universitário de Ciências Psicológicas, Sociais e da Vida

WJCR WILLIAM JAMES CENTER FOR RESEARCH

FCT Fundação para a Ciência e a Tecnologia

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NIH National Institute on Alcohol Abuse and Alcoholism