Eating behavior across the lifespan

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How Nutrition and Health Change Over a Person's Life Course
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JOHNS HOPKINS MEDICINE

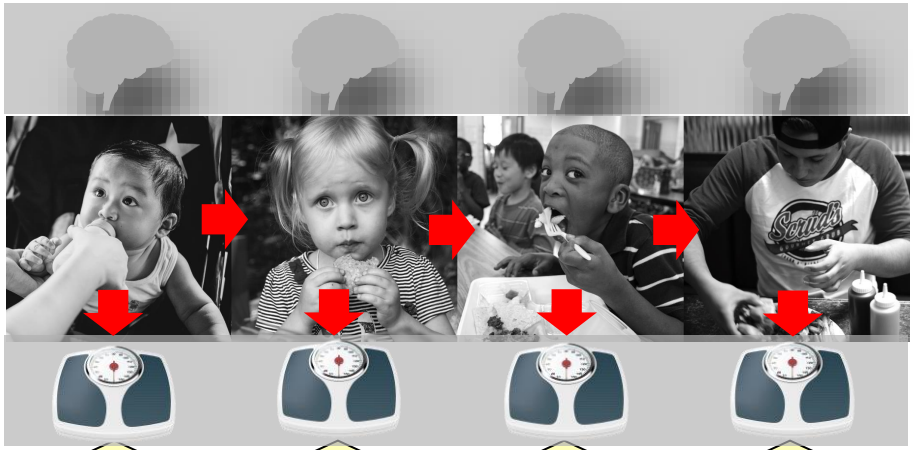
Nutrition >> Eating behavior (enduring traits/styles)

Nutrition and health through the lifespan >> eating behavior-weight relationships from infancy through adulthood

Rainier Ridao / Ekaterina Shakharova / CDC on Unsplash

Eating behavior from infancy through adulthood

Obesity-associated genes (e.g. *FTO*, polygenic obesity risk)



Normative eating behavior, e.g. FR, SR, EOE, FF

Disordered eating behavior, e.g. AN, BED/LOC

SDoH (e.g. SES indicators, food parenting)

Rainier Ridao / Ekaterina Shakharova / CDC on Unsplash

Satiety responsiveness/Slowness in eating[a] (Factor 1; 28% variance)	
My child gets full up easily	.71
My child has a big appeitite	.57
My child leaves food on his/her plate at the end of a meal	.66
My child gets full before his/her meal is finished	.72
My child cannot eat a meal if s/he has had a snack just before	.59
My child eats slowly	.78
My child takes more than 30 minutes to finish a meal	.71
My child finishes his/her meal very quickly	.72
My child eats more and more slowly during the course of a meal	.77
Fussiness (Factor 2; 13% variance)	
My child enjoys tasting new foods	.88
My child enjoys a wide variety of foods	.74
My child is interested in tasting food s/he hasn't tasted before	.84
My child refuses new foods at first	.85
My child decides that s/he doesn't like food, even without tasting it	.82
My child is difficult to please with meals	.64
Food responsiveness (Factor 3; 9% variance)	
My child's always asking for food	.65
If given the chance, my child would always have food in his/her mouth	.79
Given the choice, my child would eat most of the time	.81
If allowed to, my child would eat too much	.71
Even if my child is full up, s/he finds room to eat his/her favourite food	.56

Enjoyment of food (Factor 4; 7% variance)	
My child enjoys eating	.68
My child loves food	.64
My child is interested in food	.57
My child looks forward to mealtimes	.62
Desire to drink (Factor 5; 5% variance)	
If given the chance, my child would always be having a drink	.89
If given the chance, my child would drink continuously throughout the day	.90
My child is always asking for a drink	.88
Emotional undereating (Factor 6; 4% variance)	
My child eats less when s/he is upset	.84
My child eats less when s/he is angry	.73
My child eats less when s/he is tired	.60
My child eats more when s/he is happy	.70
Emotional overeating (Factor 7; 3% variance)	
My child eats more when anxious	.85
My child eats more when annoyed	.71
My child eats more when worried	.79
My child eats more when s/he has nothing else to do	.28[b]

FOOD AVOIDANT

FOOD APPROACH

Child Eating Behavior Questionnaire (CEBQ)

Wardle et al, 2001 J Child Psychol & Psychia; Carnell & Wardle, 2007 Appetite

1 'Enjoyment of food'	My baby seemed contented while feeding My baby enjoyed feeding time My baby loved milk My baby became distressed while feeding (R)
2 'Food responsiveness'	If given the chance my baby would always be feeding Even when my baby had just eaten well s/he was happy to feed again if offered My baby could easily take a feed within 30 minutes of the last one My baby was always demanding a feed If allowed to my baby would take too much milk My baby frequently wanted more milk than I provided
3 'Slowness in eating'	My baby fed slowly My baby finished feeding quickly (R) My baby took more than 30 minutes to finish feeding My baby sucked more and more slowly during the course of a feed
4 'Satiety responsiveness'	My baby got full up easily My baby got full before taking all the milk I thought s/he should have My baby found it difficult to manage a complete feed
	My baby had a big appetite

Baby Eating Behavior Questionnaire (BEBQ)

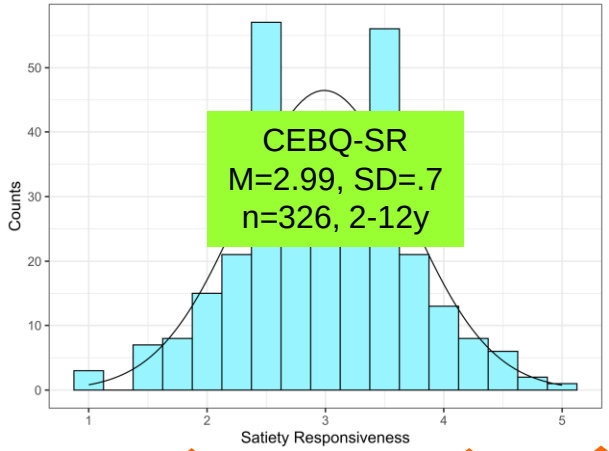
Llewellyn, van Jaarsveld, Johnson, Carnell & Wardle, 2011 Appetite

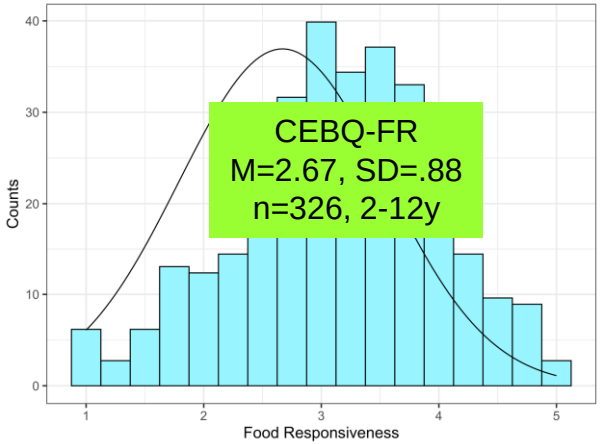
AEBQ scales	Internal reliability (n = 954)
Hunger[a]	0.751
Food responsiveness[a]	0.753
Emotional over-eating[a]	0.904
Enjoyment of food[a]	0.859
Satiety responsiveness[b]	0.753
Emotional under-eating[b]	0.896
Food fussiness[b]	0.877
Slowness in eating[b]	0.884

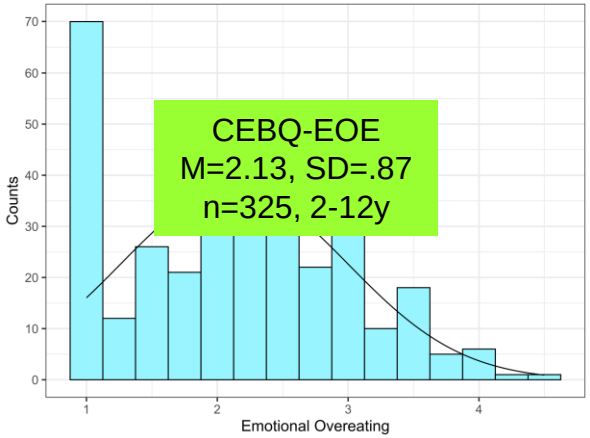
Adult Eating Behavior Questionnaire (AEBQ)

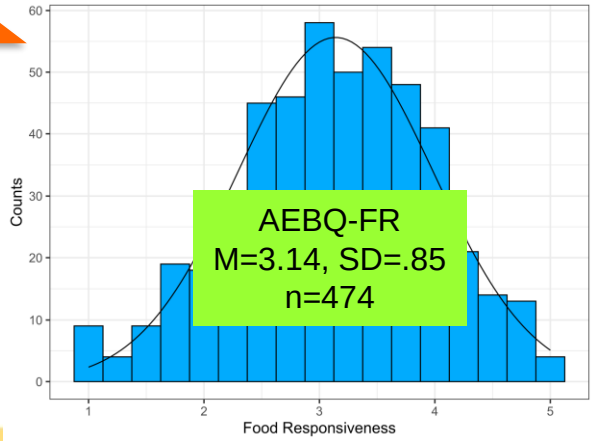
Hunot et al, 2016 Appetite

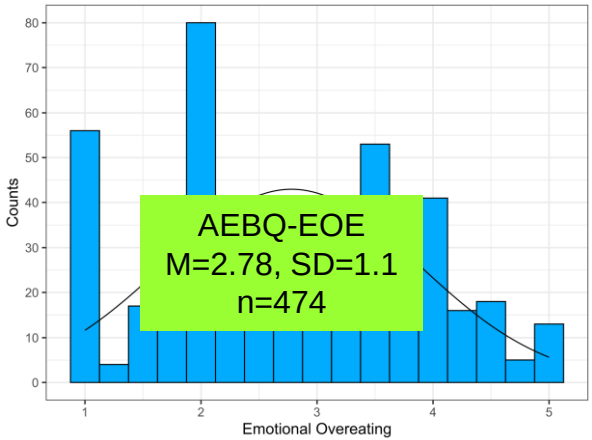
Eating behaviors in children vs. adults



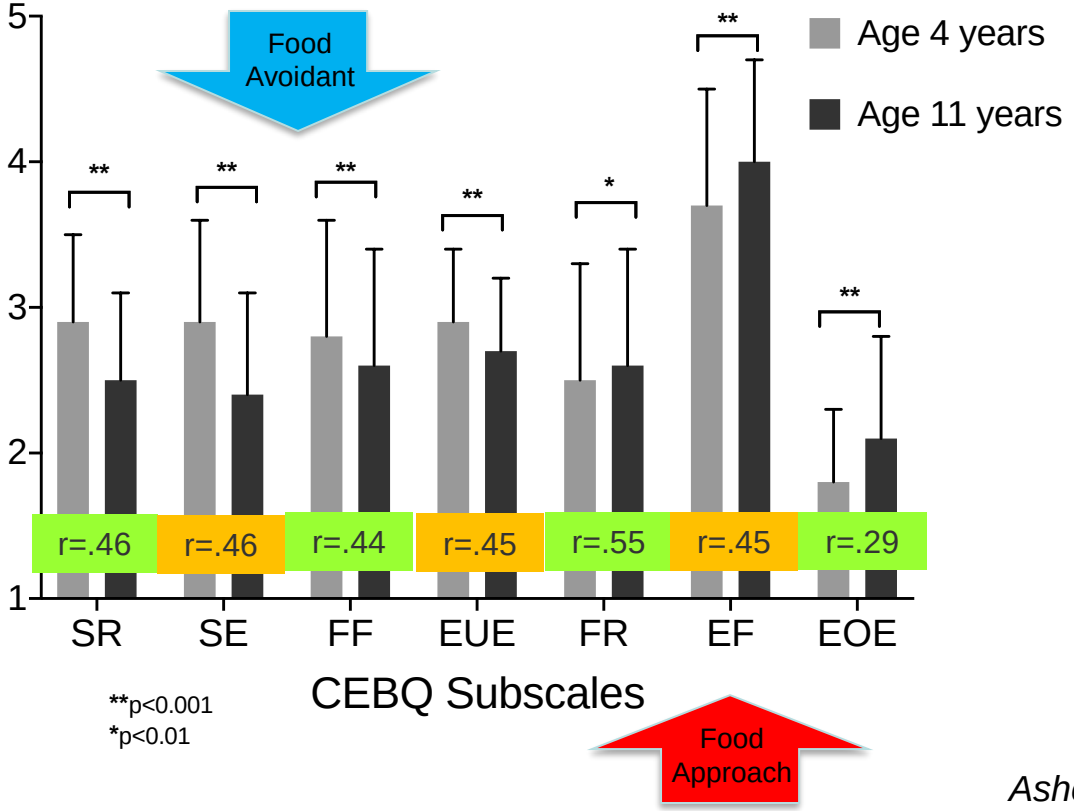






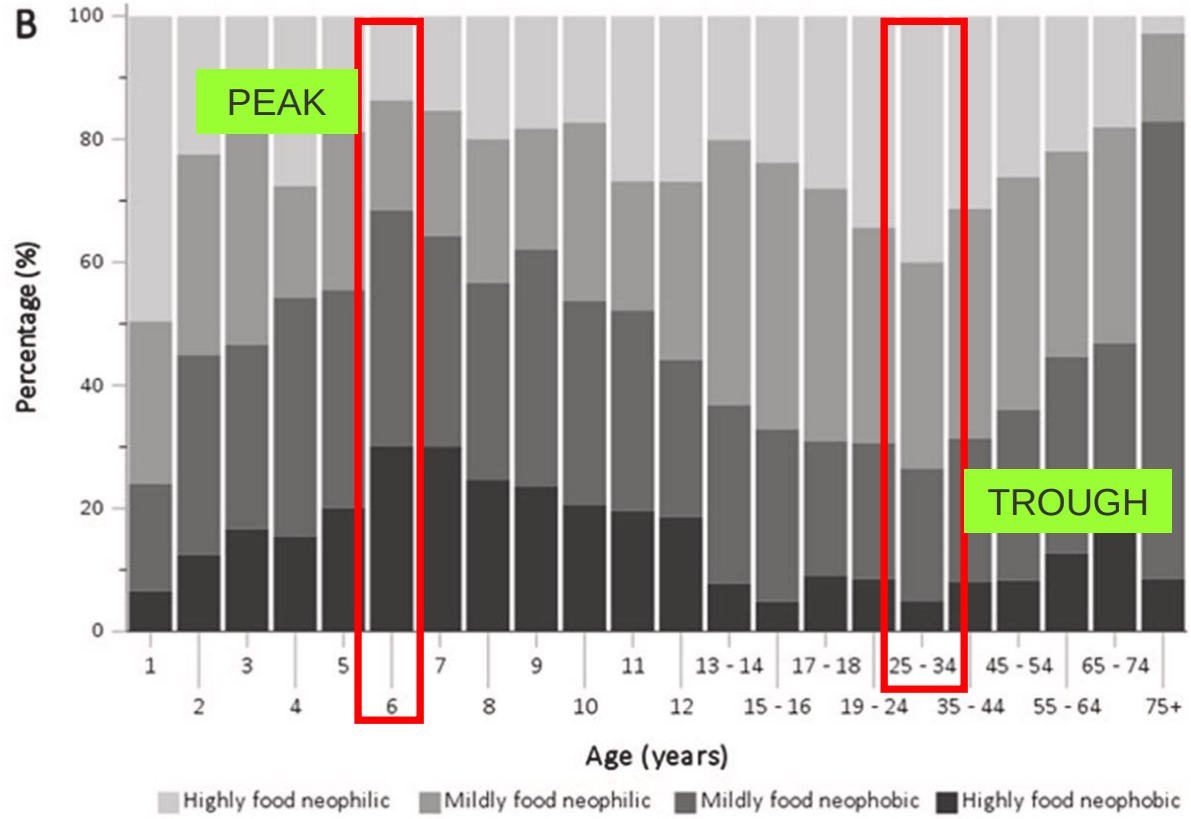


Development of eating behaviors through childhood



Ashcroft et al, 2008 EJCN

Food neophobia across the lifespan

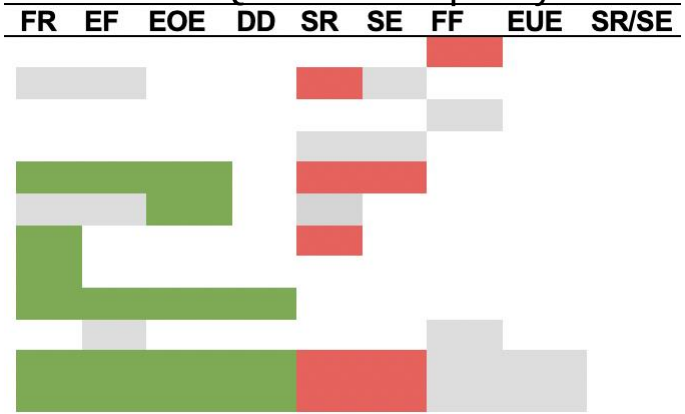


Hazley et al, 2022 Appetite

Eating behaviors – Relationships with weight/adiposity

- Systematic review and meta-analysis in children aged 1-18y
- 20 countries, 14 languages, 314 full-text articles
- 57 (46 cross-sectional, 11 longitudinal) met inclusion criteria (measure fidelity, non-overlap in samples) = n=36,535 1-14y
- Cross-sectional data – robust associations w adiposity
  - Food approach, +ve (FR **r=0.22**; EF r=0.17; EOE r=0.15; DD r=0.10)
  - Food avoidant, -ve (SR **r=-0.21**; SE r=-0.15; FF r=-0.08; EUE r=-0.09)

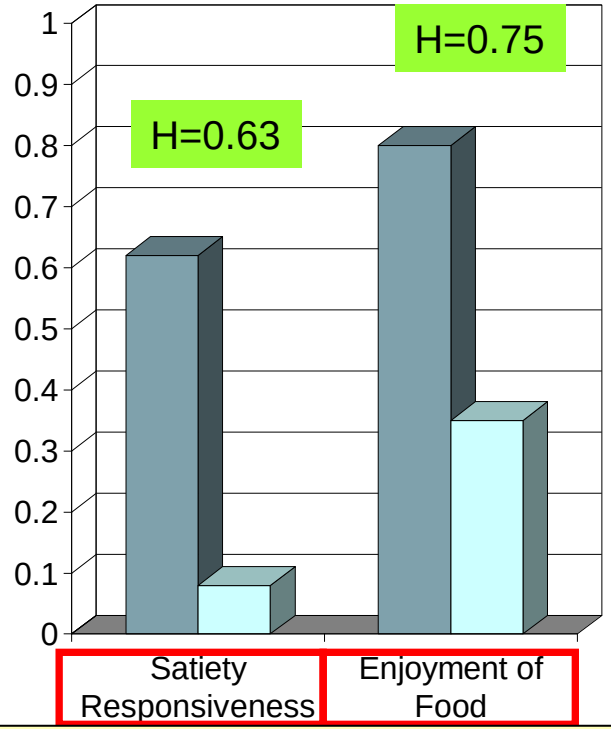
CEBQ>> later adiposity



BEBQ>>later adiposity

Kininmonth, Smith et al, 2020 Ob Revs

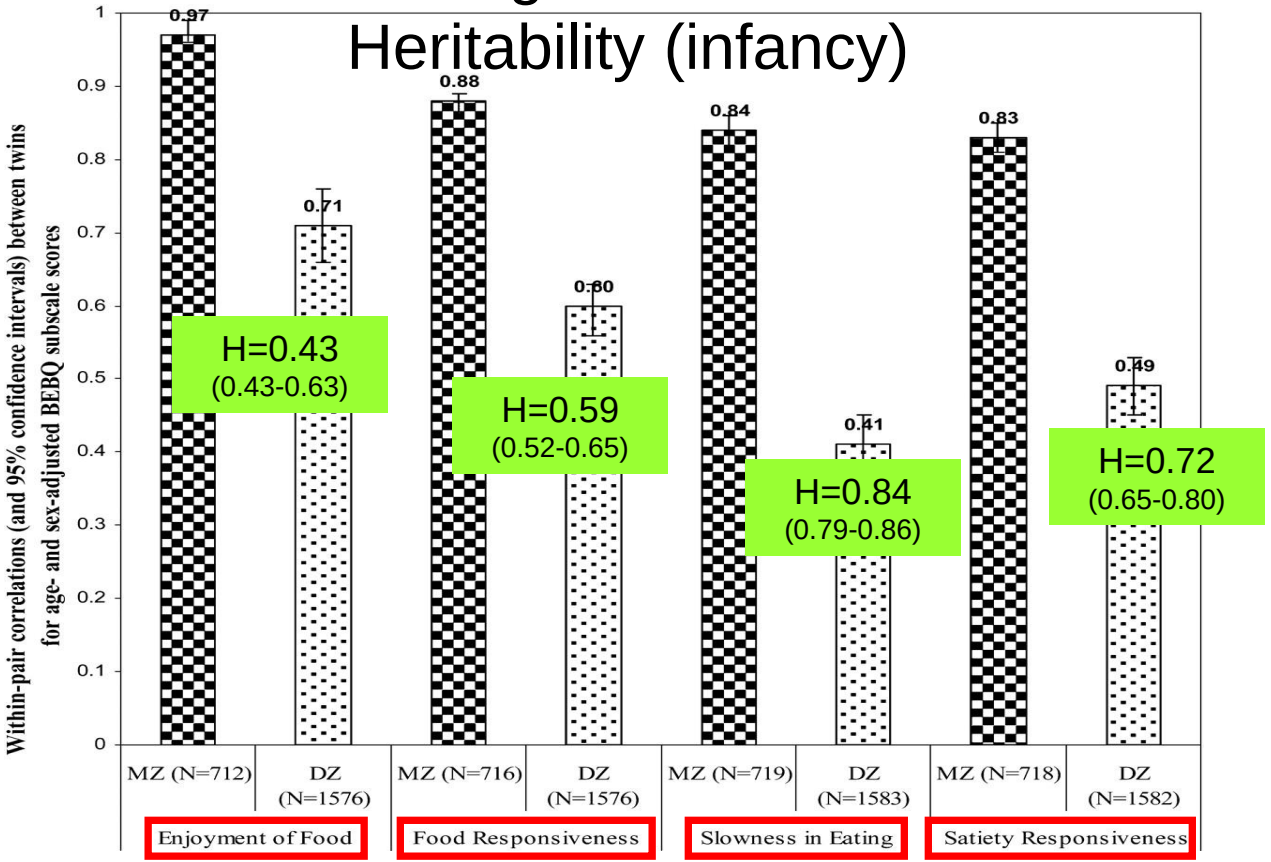
Eating behaviors – Heritability (8-11y)



Carnell & Wardle, 2008 Int J Obesity

FF similarly heritable (3y) (*Smith et al, 2018*)
but EOE and EUE show more environmental influence (4y) (*Herle et al, 2018*).

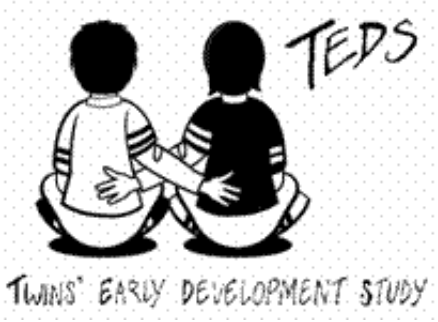
Eating behaviors – Heritability (infancy)

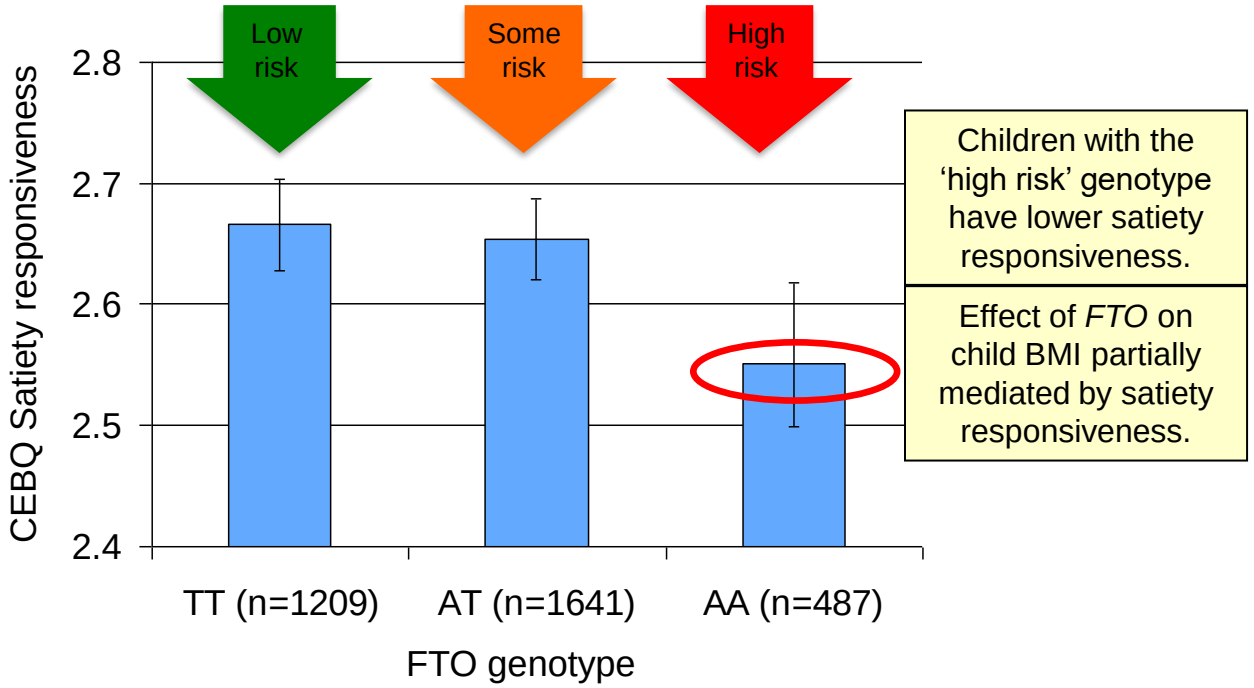


Llewellyn, van Jaarsveld, Johnson, Carnell & Wardle, 2010 AJCN

Genetic association studies:

FTO rs9939609 & appetite

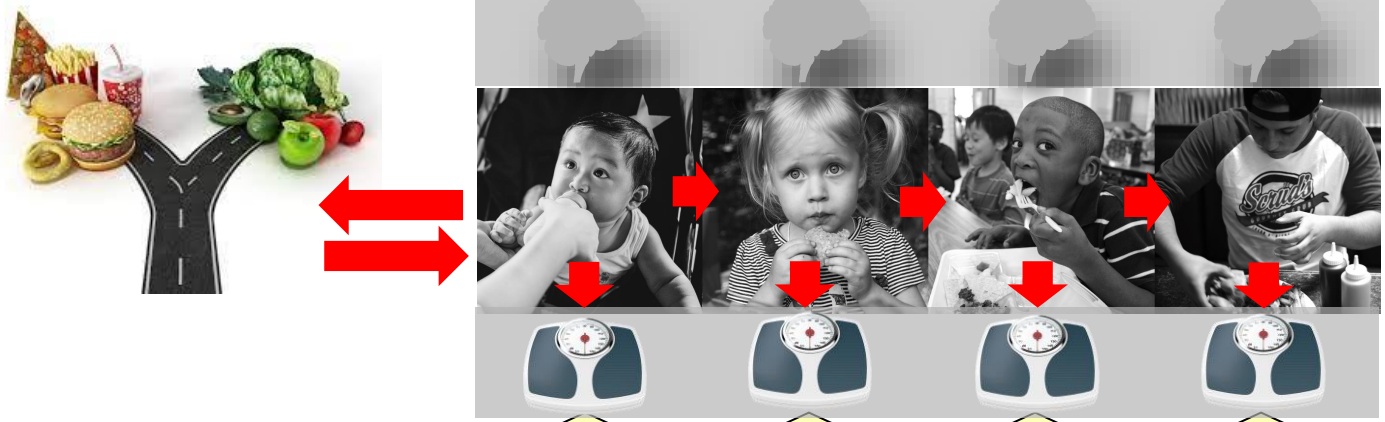




Wardle, Carnell et al, 2008 JCEM

Eating behavior from infancy through adulthood

Obesity-associated genes (e.g. *FTO*, polygenic obesity risk)



Normative eating behavior, e.g. FR, SR, EOE, FF

Disordered eating behavior, e.g. AN, BED/LOC

SDoH (e.g. SES indicators, food parenting)

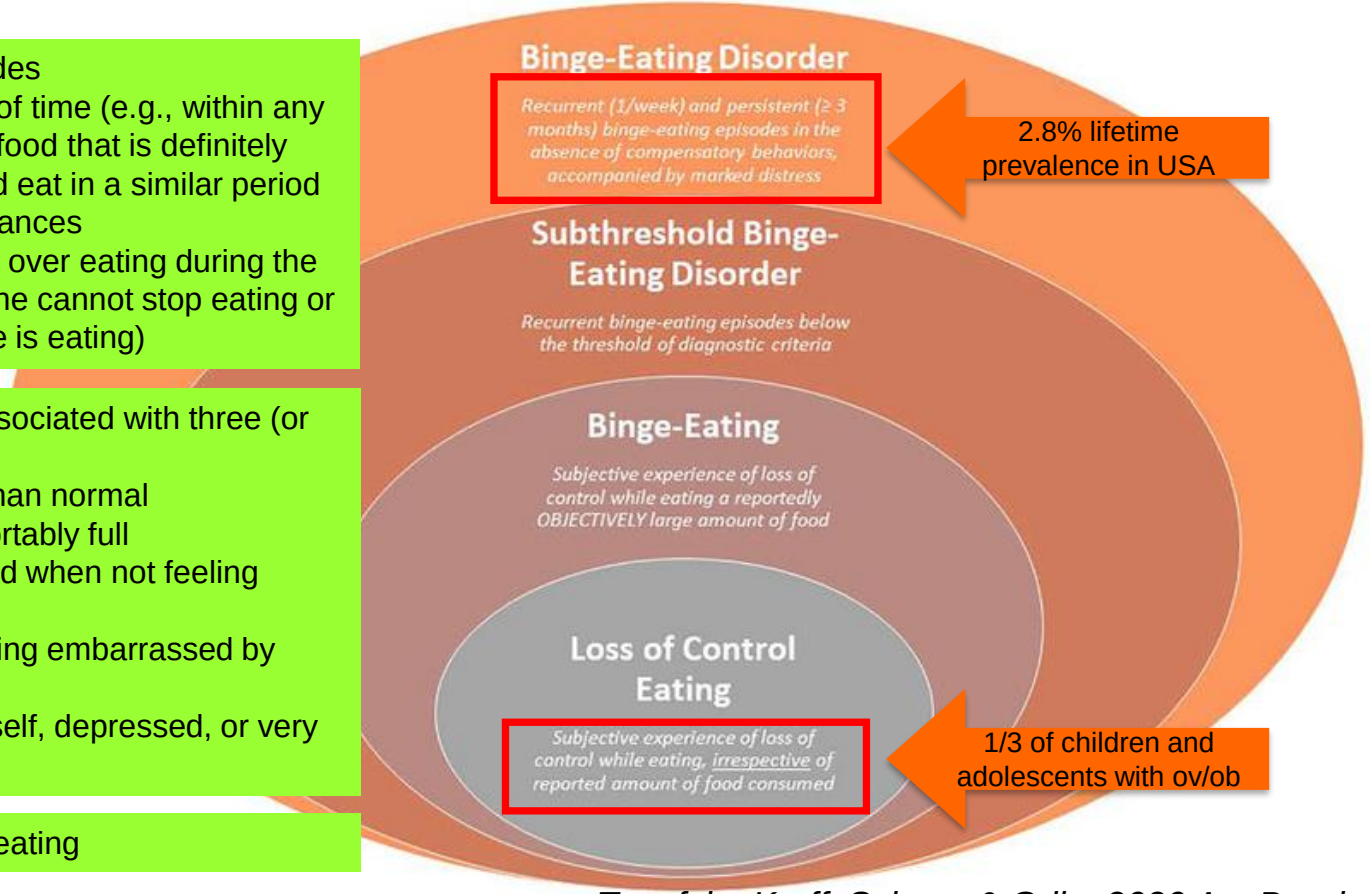
Rainier Ridao / Ekaterina Shakharova / CDC on Unsplash

Binge eating

Recurrent binge eating episodes
1.Eating, in a discrete period of time (e.g., within any 2-hour period), an amount of food that is definitely larger than most people would eat in a similar period of time under similar circumstances
2.The sense of lack of control over eating during the episode (e.g., a feeling that one cannot stop eating or control what or how much one is eating)

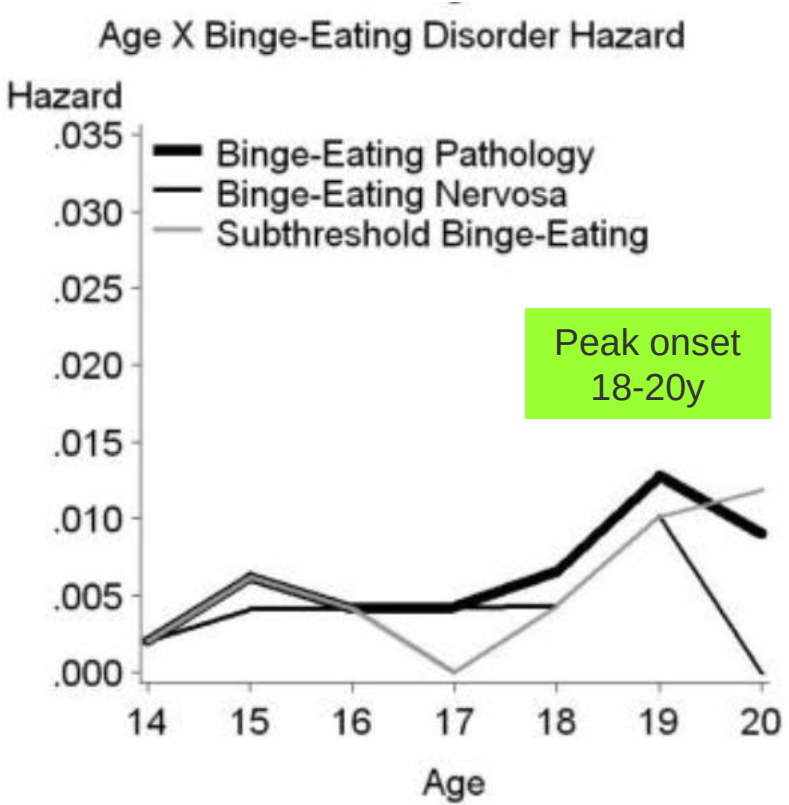
Binge-eating episodes are associated with three (or more) of the following:
1.Eating much more rapidly than normal
2.Eating until feeling uncomfortably full
3.Eating large amounts of food when not feeling physically hungry
4.Eating alone because of being embarrassed by how much one is eating
5.Feeling disgusted with oneself, depressed, or very guilty after overeating

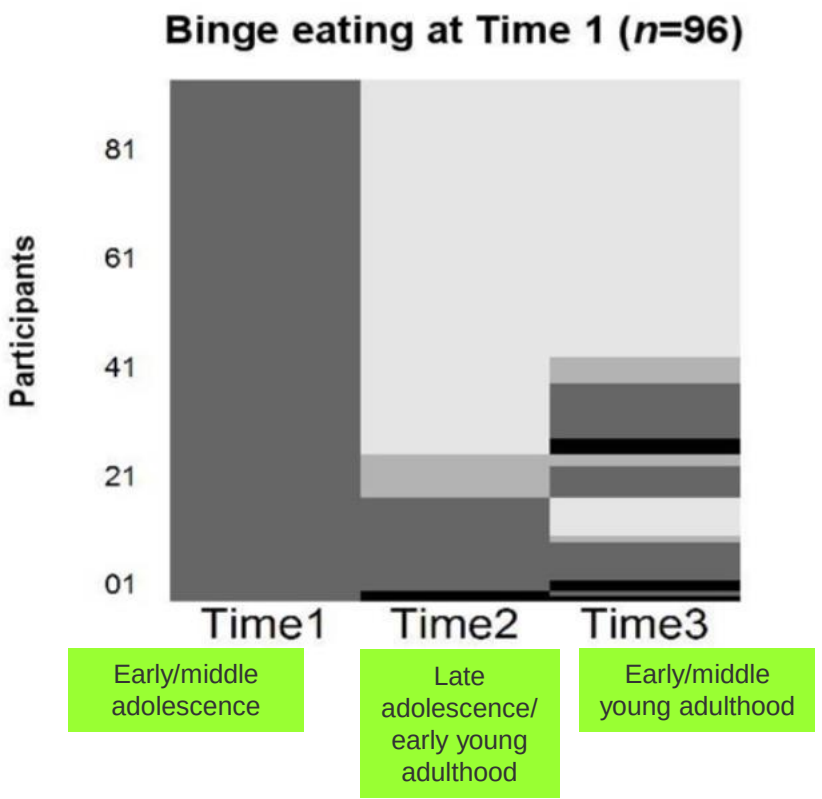
Marked distress about binge eating



Tanofsky-Kraff, Schvey & Grilo, 2020 Am Psychol

Binge eating through the lifespan

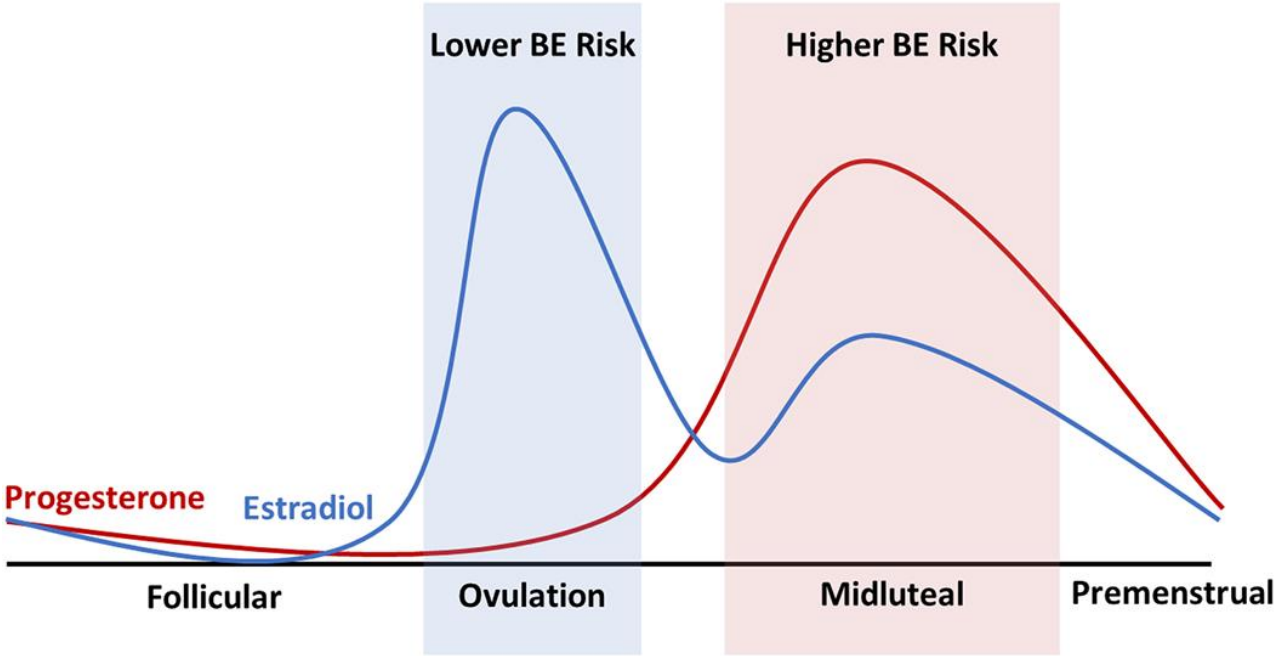




Stice et al, 2013 J Abnorm Psychol

Goldschmidt et al, 2016 Dev Psychol

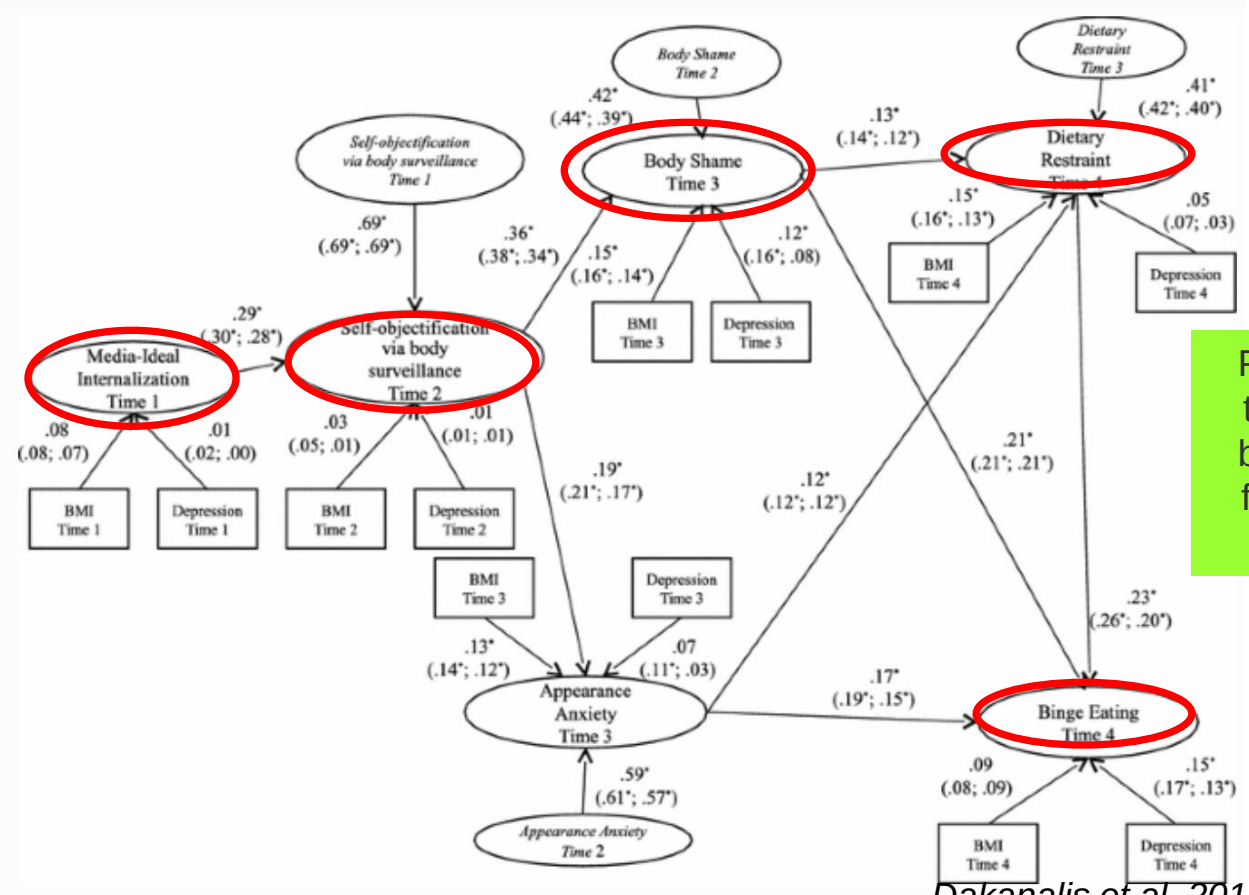
Binge eating – hormonal influences



Mikhail et al, 2021 Curr Psychia Rep

Also evidence that lower estradiol levels during early puberty may be associated with lower risk of developing later binge eating (organizational as well as activational effects of hormones).

Binge eating – psychosocial influences



Prospective evidence that internalization of body ideals promotes future binge eating in 14-15 y adolescents

Dakanalis et al, 2015 Eur Ch & Adol Psychia

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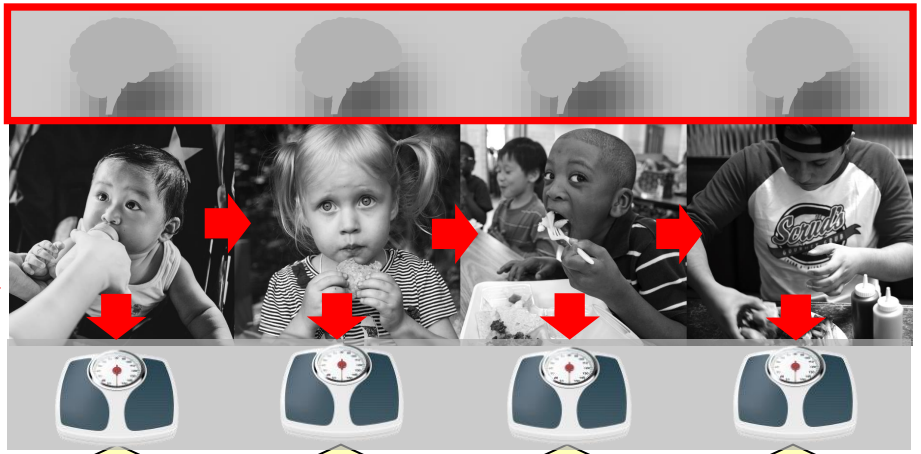
Obesity-associated genes (e.g. *FTO*, polygenic obesity risk)



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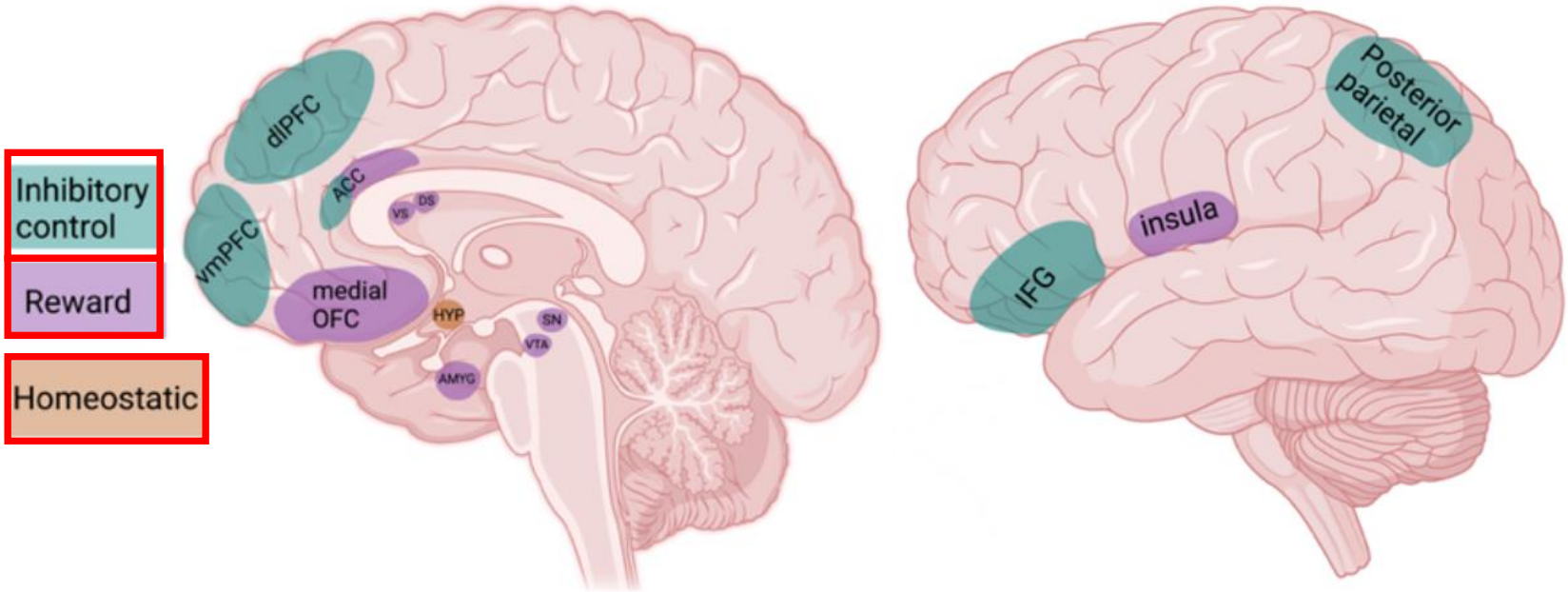
Brain appetite circuits

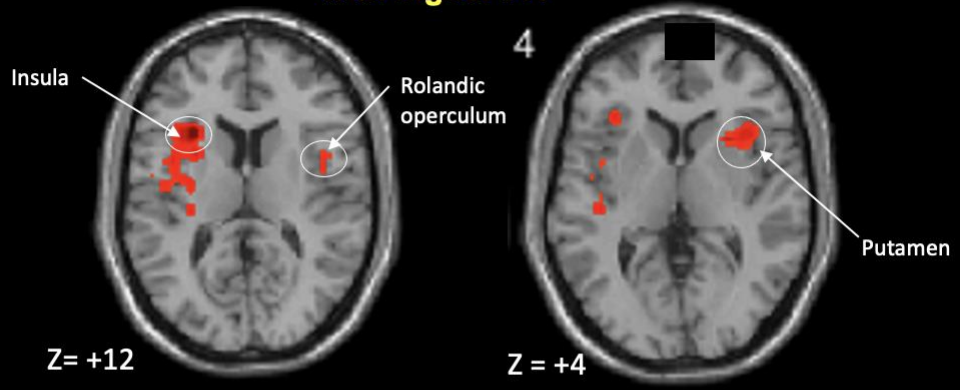


Reward regions – increased activation

Liuyi Chen

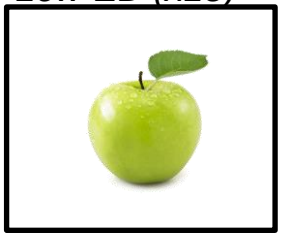
Gita Thapaliya

Greater activation to High-ED vs. Low-ED (fasted condition) with higher FR



High-ED (x15)

Low-ED (x15)

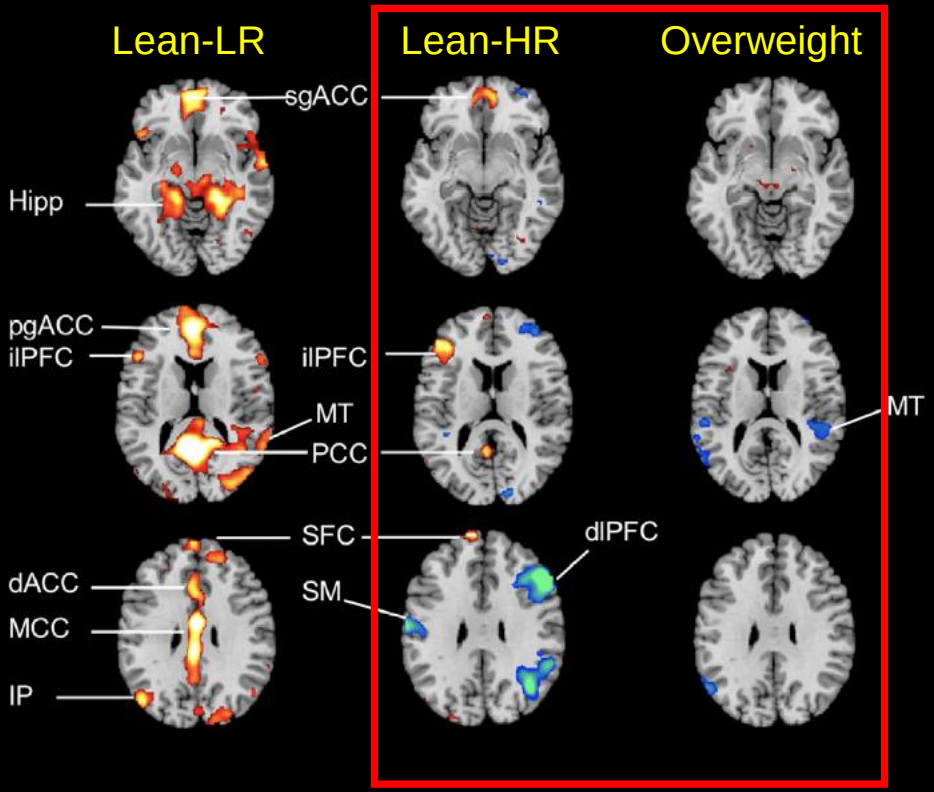


Chen et al, 2022 In prep

Inhibitory circuits – altered activation

High-ED vs. low-ED food cues, 14-18y

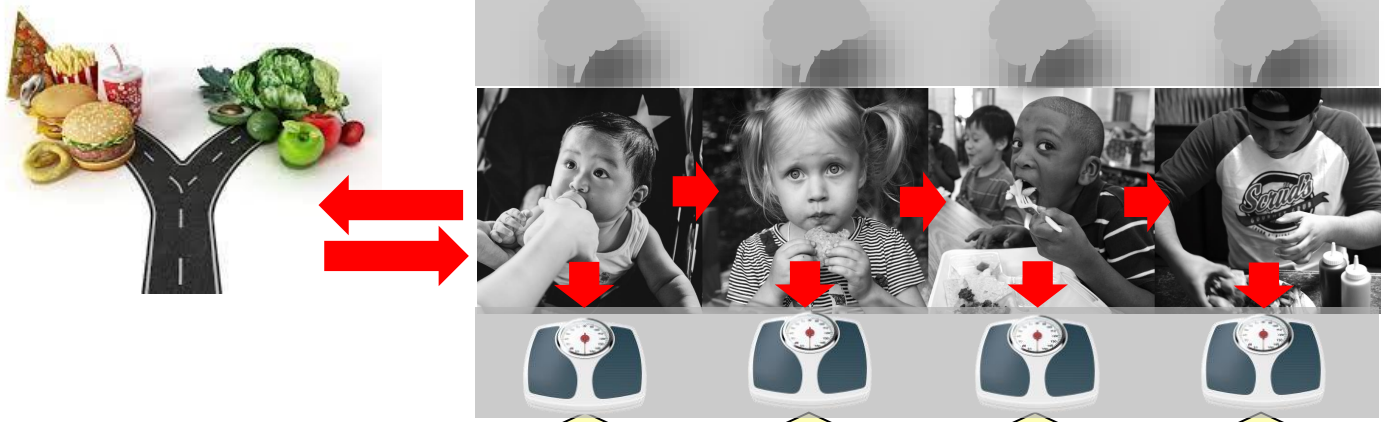
K99DK088360



Carnell et al, 2017 Neuroimage

Eating behavior from infancy through adulthood

Obesity-associated genes (e.g. *FTO*, polygenic obesity risk)



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SDoH and eating behavior

SES INDICATORS

Lower SES associated with higher FR+EF and lower SR at 16mo, higher FR+DD+EOE at 5y, greater increases in FR+EOE 16mo to 5y. *Kininmonth et al, 2020 Appetite*

Greater food delay discounting (preference for smaller sooner vs. larger later) in women with food insecurity. *Rodriguez et al, Health Psych 2021*

Greater 1-y weight gain in Head Start preschoolers from families who became food insecure.
Jansen et al, 2017 Soc Sci Med

STRESS >> [FOOD PARENTING] >> [EATING BEHAVIOR] >> OBESITY

Higher prenatal stressors specific to storm (e.g. danger due to falling ice, spending time in temporary shelters) associated with more child obesity, controlling for other potential risk factors.
Hohwu et al, 2015 Psychoneuroendo

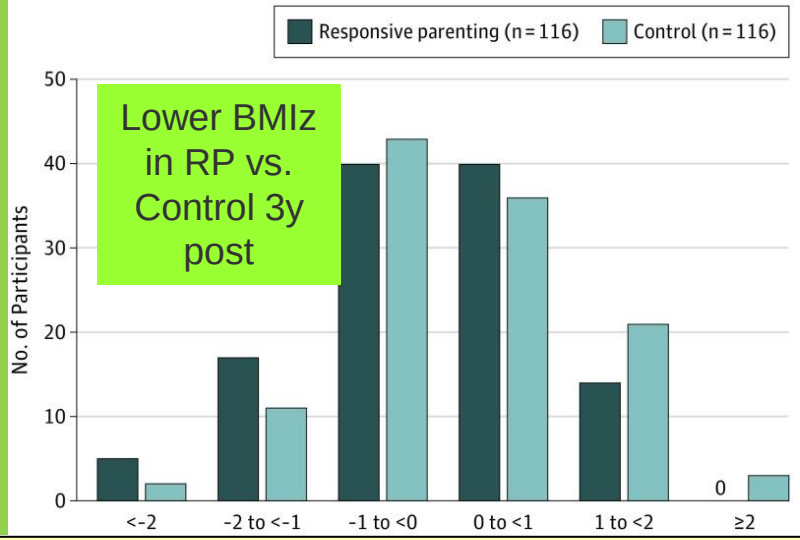
Higher COVID-stress >> more food as a reward + greater child snack intake.
Jansen et al, 2021 Appetite

Higher COVID-stress >> more food motivation. Higher COVID-stress x higher EOE >> more sweets/desserts intake.
Smith et al, 2021 Appetite; Sadler et al 2021 Nutrients

Responsive parenting intervention – effects on weight, interaction with eating behavior

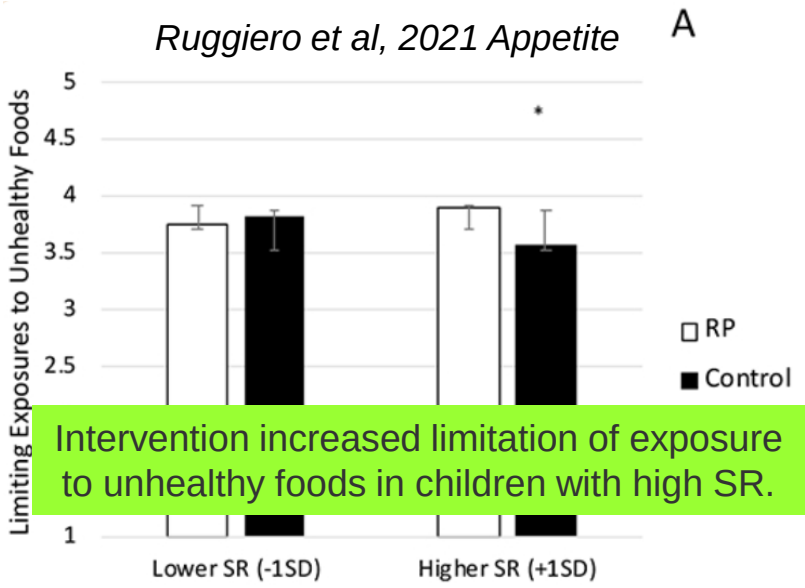
-Infant feeding
-Sleep hygiene
-Active social play
-Emotion regulation
-Growth record education

Paul et al, 2018 JAMA



Lower BMIz in RP vs. Control 3y post

Ruggiero et al, 2021 Appetite



Intervention increased limitation of exposure to unhealthy foods in children with high SR.

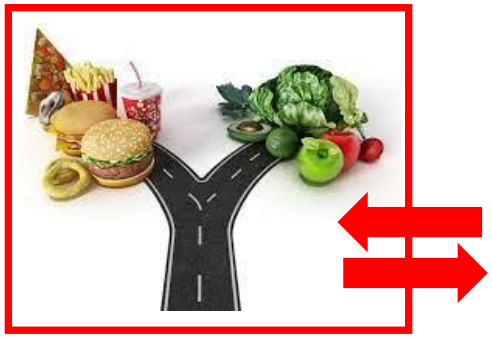
Baseline eating behaviors impact maintenance of weight loss from FBBT in children (*Boutelle et al, 2021*), and persistent binge eating impacts weight loss from in adults with T2D/ov/ob (*Chao et al, 2017*).

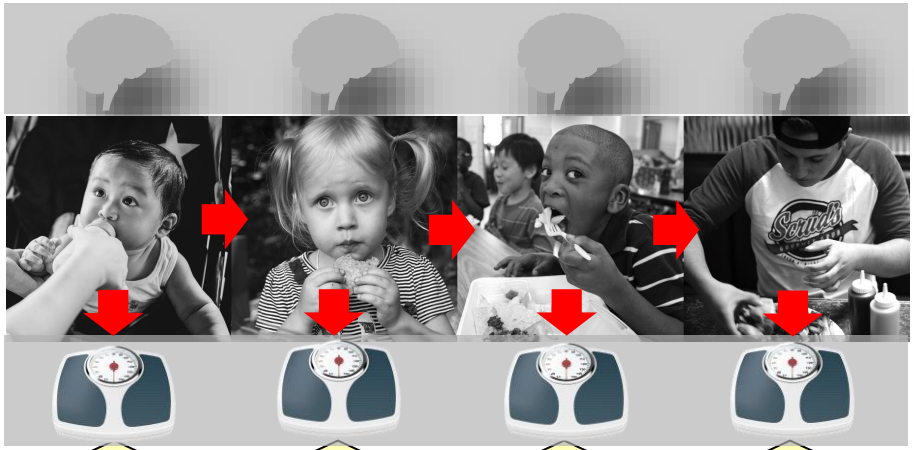
Eating behavior from infancy through adulthood

JOHNS HOPKINS MEDICINE

GENOME

Obesity-associated genes (e.g. *FTO*, polygenic obesity risk)





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Disordered eating behavior, e.g. AN, BED/LOC

ENVIRONMENT

SDoH (SES indicators, food parenting, peer influence)

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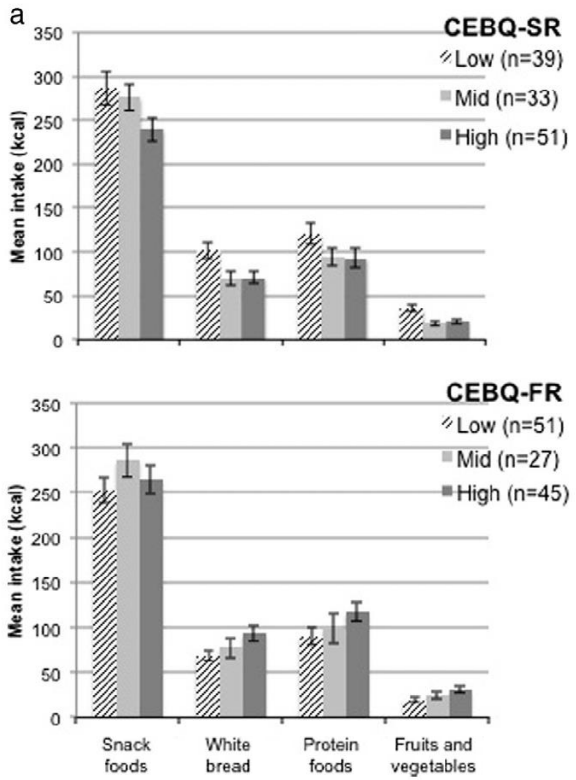
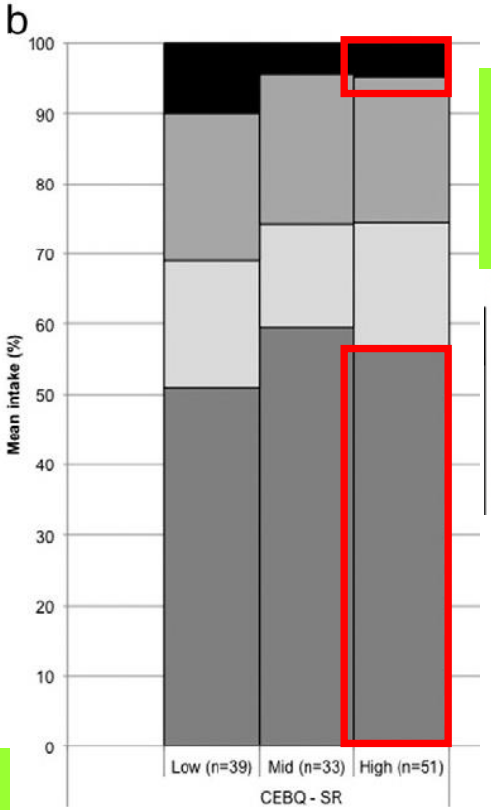
Eating behaviors >> diet composition





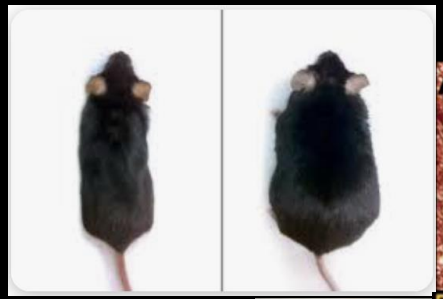
Higher SR >> lower % intake of fruits and vegetables, greater % intake of snack foods

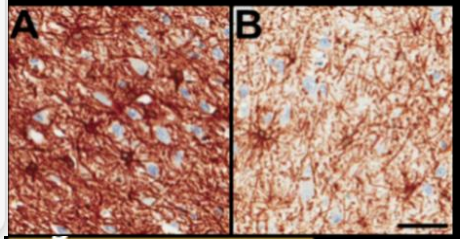
Carnell et al, 2016 Appetite

Low SR + high FR >> greater lunch intake

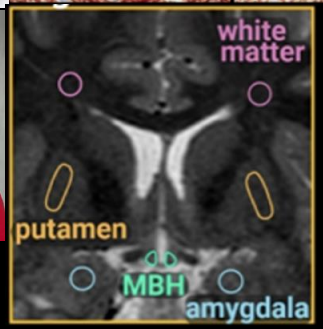
Diet + weight >> eating behaviors?

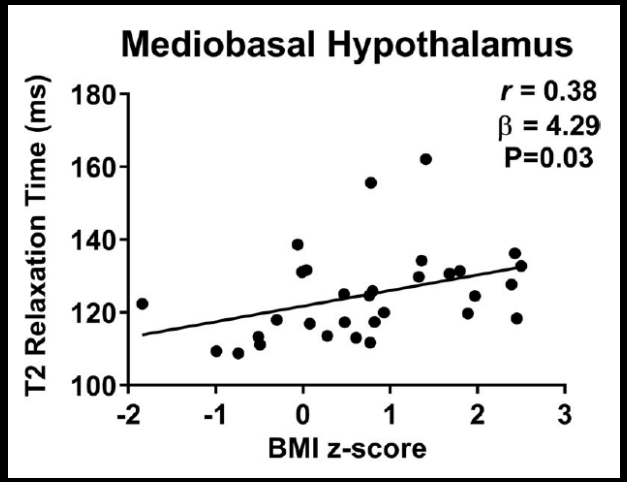
Hypothalamic gliosis and body weight





Ellen Schur





Sewaybricker et al, 2021 Ped Ob

Characteristic	Low gliosis (N=8)	High gliosis (N=8)
Energy intake, *kcals*	2056 (593)	2337 (787)
Fat intake, *% total kcals*	34 (7)	41 (5)†
Solid fat intake, *% total kcals*	13 (4)	21 (8)*

THE Beam STUDY

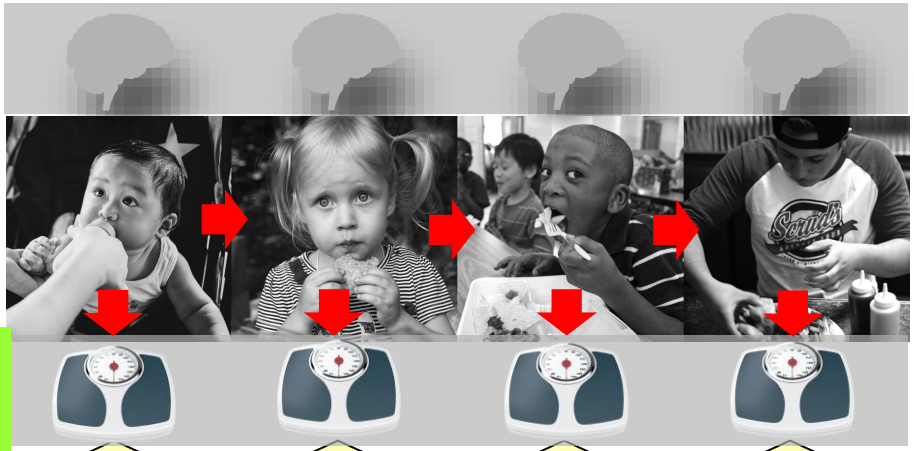
MBH gliosis predicts 1y weight gain in children with overweight *(Sewaybricker et al, 2021 Obesity)*

Takeaways

- Normative eating behaviors change with age, track through development, predict body weight, and are influenced by G+E
- Disordered eating behaviors are common and increase into adolescence, showing hormonal and psychosocial influences
- Neuroimaging studies provide evidence for biological underpinnings
- Eating behaviors influence individuals' responses to the food environment, and to prevention and treatment interventions

Remaining questions

Obesity-associated genes (e.g. *FTO,* polygenic obesity risk*)*



SDoH (e.g. SES indicators, food parenting)

What are the dynamic bidirectional relationships between eating behavior, brain and weight through development?

How does diet impact eating behavior, brain and weight?

resonance

a study of child development

ECHO

Environmental influences on Child Health Outcomes

A program supported by the NIH

How can we change eating behaviors to promote health OR modify environments to ameliorate negative effects of eating behaviors on health?

Acknowledgements

PSYCHIATRY AND BEHAVIORAL SCIENCES

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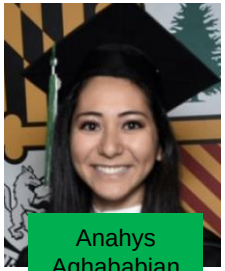
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