Editorial

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Babies with big appetites: do genes influence infant food reward?[1,2]

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Many parents report, anecdotally, that their child came into the world with a big appetite. They claim this drive to eat was there since birth, as if it were nature's hand at play. Indeed, questions from caregivers on this topic come up routinely in primary care pediatrics. So why do infants vary so greatly in their motivation to eat? Are they really "born that way"? In fact, there are a host of variables that could be influential: maternal prepregnancy BMI, gestational weight gain, delivery type (vaginal vs. cesarean), infant feeding type (breast vs. bottle), and parental feeding styles (e.g., more vs. less restrictive). Might these be influential?

At the same time, infant genotype also could be driving individual differences in the reinforcing value of food (RVF). There is mounting evidence for genetic influences on child eating patterns (1); yet, the genetic-environmental architecture of the RVF among infants and toddlers has not been tested to date. This is because, heretofore, protocols to directly assess this phenotype had not been established. In this context, the accompanying report by Kong et al. (2) in this issue of the Journal is a methodologic "game changer." It will enable novel studies of potential genetic influences, and gene-environmental interplay, in the emergence of RVF.

PLAUSIBILITY OF GENETIC INFLUENCES ON INFANT RVF?

Existing data on older children, adults, and families converge to suggest the possibility of genetic influences on the RVF. For example, the RVF (i.e., how hard an individual will work to earn food compared with alternative reinforcers) is greater among obese women than in nonobese women (3), predicts weight gain in nonobese adolescents (4), shows significant parent-child correlations (5), and interacts with serotonin polymorphisms in predicting adult BMI (6). Moreover, neuroimaging research suggests hyperactivation of the brain reward region associated with motivation and reward in obese compared with healthy-weight youth (7). Taken together, these and other findings are consistent with potential genetic influences on RVF and its linkage to obesity in older children and adults. With their report, Kong et al. offer a theory-driven strategy to explore these issues for early RVF.

That genes might influence infant RVF is indirectly supported by studies that used the relatively new Baby Eating Behaviour Questionnaire (8). In a population-based twin cohort, Llewellyn et al. (9) tested for genetic influences on infant "food responsiveness" (i.e., the tendency to eat in response to food cues in the environment according to parent report). Among 3-mo-old infants, genes accounted for 59% of the variance in this trait (9); moreover, higher food responsiveness predicted greater standardized weight gain through 15 mo (10). Hence, it is possible that early RVF could have a significant genetic loading, controlling for pertinent covariates.

THE IMPORTANCE OF DIRECT BEHAVIORAL MEASURES IN GENETIC STUDIES OF OBESITY

There remains a need to infuse direct behavioral assessments into behavioral genetic studies of pediatric obesity (11). Understandably, this can be very challenging. Yet, there have been noteworthy examples, such as the examination by Fisher et al. (12) of the genetic-environmental architecture of "eating in the absence of hunger" (EAH) in a large cohort of Hispanic children. They found that genes accounted for ~50% of the variance in EAH, which is the tendency to snack on palatable foods despite being full; fascinatingly, the correlation between EAH and child BMI was entirely due to environmental factors. Thus, as others have articulated, genetic studies can inform as much about the environment as they can about genetics (13).

It could be that certain genes are "driving" the correlation between higher food reinforcing value of favorite food and monthly weight gain in the studies by Kong et al. These might be established genetic suspects, such as the *fat mass and obesity associated* gene. Or, perhaps modifiable environmental variables (e.g., sedentary activities) are driving the association? It is plausible that both factors are occurring, and future research will need to answer this question.

PARENTING AND FAMILY ENVIRONMENT

The assessment tool by Kong et al. (2) opens the door to studying fascinating questions of the home environment—even if RVF is genetically influenced. First, how might parents differentially respond to infants and toddlers who are higher (vs. lower) in RVF? Does this heighten parental concern about potential obesity risk or reassure parents that infants and toddlers are eating enough? Among obesity-prone infants who are still at a healthy body weight, might higher RVF elicit restrictive feeding by caregivers that, in turn, exacerbates weight gain (14)?

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Also, do individual differences in infant RVF relate to child temperament? There is emerging evidence for a link between "difficult temperament" (assessed by parent report) and obesity risk (15). One can now start to address these questions because a behavioral measure of infant RVF exists.

CONCLUSIONS

In his 1989 Nobel lecture, Harold Varmus noted that "Science is largely the making of measurements" and reflected on "how much more important a new measurement could be than an old theory" (16). Behavioral economics theory has a strong tradition in pediatric obesity research and continues to drive new ideas. Guided by this theory, Kong et al.'s measurement innovation offers a strategy for novel studies on families, food reward, and obesity onset in early life. Replication and further validation studies are needed in more diverse populations. That caveat noted, this is an exciting behavioral paradigm that ultimately could inform new obesity prevention ideas.

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REFERENCES

1. Kral TV, Faith MS. Influences on child eating and weight development from a behavioral genetics perspective. J Pediatr Psychol 2009;34:596–605.
2. Kong KL, Feda DM, Eiden RD, Epstein LH. Origins of food reinforcement in infants. Am J Clin Nutr 2015;101:515–22.
3. Saelens BE, Epstein LH. Reinforcing value of food in obese and non-obese women. Appetite 1996;27:41–50.
4. Epstein LH, Yokum S, Feda DM, Stice E. Food reinforcement and parental obesity predict future weight gain in non-obese adolescents. Appetite 2014;82:138–42.
5. Epstein LH, Dearing KK, Temple JL, Cavanaugh MD. Food reinforcement and impulsivity in overweight children and their parents. Eat Behav 2008;9:319–27.
6. Carr KA, Lin H, Fletcher KD, Sucheston L, Singh PK, Salis R, Erbe R, Faith MS, Allison DB, Epstein LH. Two functional serotonin polymorphisms moderate the effect of food reinforcement on BMI. Behav Neurosci 2013;127:387–99.
7. Bruce AS, Holsen LM, Chambers RJ, Martin LE, Brooks WM, Zarconi JR, Butler MG, Savage CR. Obese children show hyperactivation to food pictures in brain networks linked to motivation, reward and cognitive control. Int J Obes (Lond) 2010;34:1494–500.
8. Llewellyn CH, van Jaarsveld CH, Johnson L, Carnell S, Wardle J. Development and factor structure of the Baby Eating Behaviour Questionnaire in the Gemini birth cohort. Appetite 2011;57:388–96.
9. Llewellyn CH, van Jaarsveld CH, Johnson L, Carnell S, Wardle J. Nature and nurture in infant appetite: analysis of the Gemini twin birth cohort. Am J Clin Nutr 2010;91:1172–9.
10. van Jaarsveld CH, Llewellyn CH, Johnson L, Wardle J. Prospective associations between appetitive traits and weight gain in infancy. Am J Clin Nutr 2011;94:1562–7.
11. Faith MS, Johnson SL, Allison DB. Putting the behavior into the behavior genetics of obesity. Behav Genet 1997;27:423–39.
12. Fisher JO, Cai G, Jaramillo SJ, Cole SA, Comuzzie AG, Butte NF. Heritability of hyperphagic eating behavior and appetite-related hormones among Hispanic children. Obesity (Silver Spring) 2007;15:1484–95.
13. Plomin R, DeFries JC, Loehlin JC. Genotype-environment interaction and correlation in the analysis of human behavior. Psychol Bull 1977;84:309–22.
14. Ventura AK, Birch LL. Does parenting affect children's eating and weight status? Int J Behav Nutr Phys Act 2008;5:15.
15. Anzman-Frasca S, Stifter CA, Birch LL. Temperament and childhood obesity risk: a review of the literature. J Dev Behav Pediatr 2012;33:732–45.
16. Varmus HE. Retroviruses and oncogenes I. Nobel lecture: December 8, 1989 [cited 2015 Feb 9]. Available from: http://www.nobelprize.org/nobel_prizes/medicine/laureates/1989/varmus-lecture.pdf.