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## Food colors and behavior

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### CORRESPONDENCE

CONTENT NOT FOR RELEASE

#### Food colors and behavior

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In discussing research on artificial food colours (AFCs) in their article [1], Blader and Adelman say:

Nonetheless, some research can be misleading and misinform the public on the effects of AFCs in children. A 2007 placebo-controlled study published in the *Lancet* journal reported that food coloring led to 'increased hyperactivity' in the pediatric population at large [19]. Yet, despite this study's media attention, the authors' conclusions were deceptive and incorrect. Not only was the effect size of the dietary challenge relatively modest (effect size of 0.2), but it was activity level, rather than hyperactivity, that was measured. Therefore, 'increased hyperactivity' was not an accurate description. (p. 763)

This paragraph refers to our article [2]. The accusations of deception and drawing incorrect conclusions are extremely serious, and they cannot go unchallenged.

First, there is a suggestion that we exaggerated the significance of small effects. No evidence for this is given by the authors. In fact, we placed our finding in the context of stimulant treatment for attention-deficit hyperactivity disorder (ADHD) in children "... for which one meta-analysis reported a range of effect sizes from 0.78 (0.64-0.91) by teacher report to 0.54 (0.40-0.67) by parent report. We report effect sizes that average about 0.18. Children with ADHD are generally about 2 SD higher on hyperactivity measures than those without the disorder, thus an effect size of 0.2 is about 10% of the behavioural difference between them." (p. 1566) This appraisal in our article presents the effect size as modest.

Second, there is a suggestion that we misled the reader by claiming that there was an increase in 'hyperactivity' when there was only a change in 'activity level'. In fact, in the *Lancet* article we define our terms very clearly and use a specifically operationalized notion of hyperactivity.

We define hyperactivity as follows:

The main putative effect of AFCs is to produce overactive, impulsive, and inattentive behaviour—i.e. hyperactivity—which is a pattern of behaviour that shows substantial individual differences in the general population. Children who show this behaviour pattern to a large degree are probably diagnosed with attention-deficit hyperactivity disorder (ADHD). (p. 1566)

The primary outcome we adopted operationalized a measure of hyperactivity as follows:

The GHAs was developed to measure individual differences in hyperactivity using different sources (teacher, parent ratings, direct observation, and a computerised test) and covering the components of hyperactivity (overactivity, impulsivity, and inattention). (p. 1563)

On pages 1562-1563 we identify the measures employed in this hyperactivity index as being the ADHD rating scale for teachers [3], for parents of the younger children the Weiss-Werry-Peters hyperactivity scale [4] and for the older children the ADHD rating scale for parents [5], the Classroom Observation Code [6] and for the older children the Continuous Performance Test [7]. These are all widely used measures of the three components of hyperactivity as defined in the article and not just of activity level. In our studies the effect size of 0.20 was shown on this aggregated measure of hyperactivity, not on a measure of activity level alone.

We would also like to draw attention to our subsequent article based on this study concerning genetic polymorphisms in the histamine degradation pathway that amplify the adverse effect of AFCs [8]. From our study there is, therefore, evidence not only of an adverse effect of food additives on behaviour but also of an indication of a possible mechanistic explanation.

Given their completely unfounded nature, we would ask Blader and Adelman to retract their allegations of deception and inaccuracy.

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#### Conflicts of interest

There are no conflicts of interest.

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