The effects of early-life adversity on cognition: A comparative approach.

Berichterstattung

Projektinformationen

COMSTAR

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Zusammenfassung vom Kontext und den Gesamtzielen des Projekts

This research programme investigated how adversity experienced early in life affects cognition in adulthood in two different long-lived species, humans and European starlings. Previous research suggested that there might be cross-species similarities in the way early-life adversity shapes

cognition, but the extent of commonalities had not been systematically investigated. We focused on three cognitive domains where we had some evidence that early-life adversity may be important: impulsivity, dietary cognition, and threat-related cognition. For each domain, we sought to characterise how the outcome relates to different facets of early-life adversity. Early-life adversity was measured using socioeconomic and familial variables in humans, but in young starlings it was experimentally manipulated via cross-fostering and hand-rearing siblings apart so that they experience different early histories. To measure the adult outcomes in each cognitive domain, developed behavioural paradigms with directly analogous versions in the two species. We also examined whether telomere length, a cellular measure of cumulative stress exposure, statistically mediates the relationships between early-life adversity and the cognitive outcomes, thus testing recent theoretical models based on psychological adaptation to ones own physical state. As well as describing associations between early-life adversity and adult outcomes, we focused on adaptive questions: do the observed effects of early-life adversity simply represent pathology, or can they be considered as adaptive responses? Thus, we tried to move beyond cataloguing the cognitive consequences of early-life adversity, and begin to explain them.

We were able to show, in the starlings, that different components of early-life adversity have different effects on different adult traits. That is, each trait is affected by different signatures in early experience; in at least some cases, rather than just saying individuals have had more or less adversity, you need to investigate exactly what experiences they have had. We also found some evidence that starlings (and maybe people) are sensitive to their own physiological conditions (as reflected in their phenotypic age or developmental telomere attrition), in setting their behaviour and cognition. We found clear evidence that early experience affects telomere dynamics, but much less evidence that adult experience continues to do so. In fact, telomere length through adulthood mainly just tracks on along the path mapped out in early life. Finally, we found abundant evidence for experience, including but not limited to early life experience, affecting fat storage and weight gain, not by making individuals consume more calories, but by making their metabolic expenditures different. This has important implications for human obesity and food insecurity.

Arbeit, die ab Beginn des Projekts bis zum Ende des durch den Bericht erfassten Berichtszeitraums geleistet wurde, und die wichtigsten bis dahin erzielten Ergebnisse

We reared a cohort of starlings where each of four siblings experienced a different regime in the formative early weeks of life. Roughly, one sibling had enough to eat but had to beg to get it; one did not have to beg so much but got scarcely enough food; one did not have to beg and receive ample food; and one had to beg and received scarcely enough. We studied these birds into adulthood, uncovering numerous behavioural differences between them. Their telomere lengths in adulthood also differed systematically. We also developed a novel technology, the social foraging system, for gathering behavioural and weight data from starlings in an automatic, high welfare, high throughout way. We used this to study their weight regulation and food motivation.

In parallel to this bird work, we developed a novel approach to estimating phenotypic age from simple

markers in humans, showing that phenotypic age was related to childhood socioeonomic adversity. We also investigated food insecurity and childhood socioeconomic position more broadly as factors explaining psychological and health outcomes in humans. We developed new approaches to measuring telomere dynamics in humans, and synthesized evidence that telomere length reflects stress and adversity in humans.

These and related findings were published in a series of open-access papers.

Fortschritte, die über den aktuellen Stand der Technik hinausgehen und voraussichtliche potenzielle Auswirkungen (einschließlich der bis dato erzielten sozioökonomischen Auswirkungen und weiter gefassten gesellschaftlichen Auswirkungen des Projekts)

The starling experiments introduced a very subtle and clean way of manipulating early adversity in birds, and hence demonstrating that early experience has lasting effects in many areas. It went beyond the state of the art in allowing different dimensions of adversity to be dissociated, thereby demonstrating that the responses to different kinds of adversity are different. That is, early-life adversity is not just a matter of 'more' or 'less' stress, but rather of the particular pattern of inputs that the organism receive

With the social foraging system, we were able to extend our knowledge of weight regulation in birds (but with relevance to human obesity) beyond the state of the art. This is mainly because the social foraging system gives us such clear and precise data that we are able to show clearly what there were already fragmentary hints of in the literature: that putting on more fat does not typically involve eating more calories, but, rather, changing energetic efficiency. This paper has been recommended on facultyopinions.com with the review 'This is a really elegant approach, and I expect that both the methods and results will provide inspiration for future work in this area.'

The human work presented presents a whole novel philosophical approach to understanding the consequences of poverty and deprivation for human behaviour. It went beyond the state of the art in the following ways: 1. It sets these impacts in the biological context of behavioural ecology, as well as their traditional social context; 2. It interprets decisions made under adversity as contextually appropriate active decisions, not deficits or pathologies; 3. It draws attention to the needs and potential health benefits of structural change, rather than superficial mitigating interventions. This work has been influential and generative in both social science and biological disciplines.

Nestling starlings in one of our experiments

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