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The positivity effect: a negativity bias in youth fades with age

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Relative to younger adults, older adults attend to and remember positive information more than negative information. This shift from a negativity bias in younger age to a preference for positive information in later life is termed the 'positivity effect.' Based on nearly two decades of research and recent evidence from neuroscience, we argue that the effect reflects age-related changes in motivation that direct behavior and cognitive processing rather than neural or cognitive decline. Understanding the positivity effect, including conditions that reduce and enhance it, can inform effective public health and educational messages directed at older people.

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Introduction

In 2003 Charles *et al.* [1] reported findings from a study in which young, middle-aged, and older adults were asked to view images that varied by emotional valence. Some of the images were negative, some positive and others neutral. Compared to the youngest participants, middle-aged participants displayed a modest preference in memory for positive over negative images and elderly participants were far more likely to recall positive images than negative. Earlier research had demonstrated an age-related preference for emotional material over other types of information (e.g., [2]) but none had shown differential processing of positive and negative material.

The observation was striking given its juxtaposition with a large literature documenting a negativity bias in younger people. Infants reliably orient to negative stimuli more than positive, and scores of studies have shown that children detect and remember threatening stimuli better than non-threatening stimuli (e.g., [3–5]). Social psychologists have widely documented the attention-grabbing properties of negative information in young adults (mostly college students) and shown that negative events are more likely to be remembered and retold in the social transmission of stories than positive events [6]. In a now classic paper titled, 'Bad is stronger than good,' Baumeister and colleagues [7] argued that a negativity bias in humans is so reliable that it can be considered a fundamental principle of human behavior. It makes logical sense: attending to the lion in the brush more than the puppy in the grass likely holds evolutionary advantages [8].

Yet since Charles *et al.* [1] was published, scores of studies have documented an age-associated reversal in preferences for negative over positive stimuli in attention and in memory. Coined, the *positivity effect*, the pattern refers to a shift from a negativity bias early in life to a positivity bias that emerges in middle and late adulthood (see [9]). Studies have examined the positivity effect in attention, short-term memory [10], autobiographical memory [11,12], and even working memory [13] using a wide range of experimental paradigms, from eye-tracking [14,15,16•] to neuroimaging [17••,18]. The effect has been shown in many different contexts including attention to emotional faces [19], recall of facial expressions [20], memory for health information [21,22••], focusing more on positive than negative old age stereotypes [23], and the interpretation of socially ambiguous situations [24•].

Abundant empirical evidence for the positivity effect led to broad acceptance of the observation. Underlying mechanisms, on the other hand, continue to be debated. In this review, we describe initial findings and recent studies on the positivity effect and make the case that the body of literature is most coherent when viewed through the lens of motivated cognition.

Socioemotional selectivity theory

The positivity effect was first identified through tests of hypotheses grounded in socioemotional selectivity theory (SST). SST is a life-span theory of motivation that postulates systematic changes in goals as a function of perceived time horizons [25]. SST maintains that when time horizons are vast and nebulous, as they typically are in youth, goals tend to concern exploration and learning. In contrast, as time horizons grow limited, as they typically do with age, goals shift to ones realized in the

present and which tend to focus on savoring, emotional meaning, and satisfaction. Because perceived time is strongly correlated with chronological age, changes in goals appear systematically as people move through adulthood. And because goals direct cognitive resources, aging is associated with changes in preferences, decisions, and even what we see, hear, and remember.

Postulates of SST have been examined quite extensively in life-span developmental psychology and gerontology. Most of the early work addressed preferences for social partners and social network composition [26,27]. Shrinking social networks associated with aging had long been thought to reflect deaths and disabilities. Tests of SST instead revealed a proactive pruning process over the life course — discarding peripheral partners and selectively retaining a stable core of emotionally close social partners [28]. Moreover, this selective narrowing of the social world is associated with greater emotional balance [29]. In a parallel line of research, experiments have revealed that preferences for social partners shift as a function of time horizons. When time horizons are statistically controlled, age differences were eliminated [26,27].

Empirical investigation of goal-directed cognitive processing began relatively recently. Fung and Carstensen [2] found that older people better remembered advertisements when products were framed in emotionally meaningful terms than when positioned as products that facilitate exploration. Importantly, they also demonstrated that these age differences were eliminated by expanding time horizons. Extending research on SST further to cognitive processing, Charles *et al.* [1] observed age differences in memory as a function of *valence*. And recently, Barber *et al.* [30] demonstrated that the positivity effect can be effectively produced in younger people by experimentally limiting future time horizons.

Exploring alternative explanations

Although the age-related preference for positive material was identified by tests of hypotheses derived from SST, explorations of alternatives have helped to refine the concept. Two of the most viable alternatives — namely, cognitive decline and neural degradation — have been largely ruled out. Dynamic integration theory [31] posits that general age-related declines in processing capacity also affect the processing of emotion. Specifically, DIT maintains that negative information is more complex and thus more difficult to integrate into cognitive-affective systems than positive information leading to greater overall memory for, and attention to, positive stimuli. Whereas there may be empirical evidence for aspects of DIT, it does not appear to account for the positivity effect. Reasoning from DIT, the effect would be expected to be more pronounced in individuals with relatively poor cognitive functioning, for example, and less pronounced in those with higher levels of functioning. Mather and Knight [32] observed the opposite relationship, however (see also [33]): Older people with the highest levels of executive control show the strongest evidence of the positivity effect. The competing explanations were recently tested in a delayed recall task with Alzheimer's disease patients, healthy older adults and young adults. Consistent with the motivational perspective, the effect was observed in healthy older adults but not in patients with Alzheimer's disease [34•].

Similarly, the positivity effect would be expected to be degraded under conditions of cognitive load. Yet, there is considerable empirical evidence that cognitive load reduces the positivity effect [32,35,36,37,38•].

Given age-related changes in brain function and structure, neural degradation offered another viable alternative. This was a particularly intriguing alternative because compared to a normal control group and patients with lesions in other brain areas, patients with lesions in the amygdala rated negative images as less arousing than other groups rated them even though they assigned similar valence ratings to the images [39]. Based on this study, Cacioppo et al. [40] suggested that aging may be associated with decreased responsiveness of the amygdala which is important to affective processing, thereby giving rise to the positivity effect. At this point, neuroimaging and behavioral studies suggest that structural and functional integrity of the emotion regions are well maintained with age [17••,41]. Even though amygdala activation is selectively diminished in response to negative stimuli, such as in response to sad or angry facial expressions [42,43], there are no age differences in response to positive [44] or novel stimuli [45]. Using a monetary incentive delay task, older participants displayed reduced activation to potential losses compared to young adults but comparable activation to gains [46,47]; see also [48]. Importantly, Sakaki *et al.* [18] observed *greater* coupling between amygdala and medial prefrontal cortex (mPFC) in older adults relative to their younger counterparts during a task involving recall of emotional faces suggesting greater association with higher order cognitive processing and decision making.

Failures to replicate the positivity effect

Shortly after Charles *et al.* [1] was published, our research group continued to replicate the phenomenon [12,19] and evidence from other laboratories began to accrue [49–52]. Yet there were also failures to replicate using very similar methods to ours [53,54]. We began to search for systematic differences that might account for inconsistencies and recognized a subtle but theoretically important difference in approach. In our research, participants simply viewed stimuli and recall was later assessed with an incidental memory test. In experiments that failed to observe the effect, participants were asked to operate on the stimuli while viewing and in some cases were required to make