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Determinants of Social Cognitive Aging: Predicting Resilience and Risk

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Abstract

This review focuses on conceptual and empirical research on determinants of social cognitive aging. We present an integrated model [the social cognitive resource (SCoRe) framework] to organize the literature and describe how social cognitive resilience is determined jointly by capacity and motivational resources. We discuss how neurobiological aging, driven by genetic and environmental influences, is associated with broader sensory, neural, and physiological changes that are direct determinants of capacity as well as indirect determinants of motivation via their influence on expectation of loss versus reward and cognitive effort valuation. Research is reviewed that shows how contextual factors, such as relationship status, familiarity, and practice, are fundamental to understanding the availability of both types of resource. We conclude with a discussion of the implications of social cognitive change in late adulthood for everyday social functioning and with recommendations for future research.

Contents

INTRODUCTION

Historically, most research on cognitive functioning in late life (defined as age 65+) has emphasized information processing models, using "cold" cognitive assessments such as tests of memory and reaction time to quantify capacity limitations. Yet humans are inherently social creatures, whose everyday behavior is largely motivated by social and emotional goals, and thus it is unsurprising that research on cognitive aging soon expanded to include social cognition, which has now been the focus of hundreds of research studies. The predominant method across these studies has been to present older adults with stimuli depicting unknown individuals, whom they evaluate or respond to in some manner. Many of these tasks do not even inquire about real people, requesting judgements about schematic faces or characters in fictitious scenarios. This methodological approach provides excellent laboratory control, but it raises the possibility that the field of social cognitive aging has unintentionally restricted itself to an understanding of the psychology of strangers.

Although this criticism could just as easily be levied at the broader discipline of social cognition, motivational changes in late life suggest that this approach might be particularly problematic when studying age-related changes in mental functioning. One of the key findings from the literature on aging is that people place an increasing priority on personally relevant and meaningful goals in late life, with a resultant devaluation of goals that are not personally important (Carstensen 2021). Simultaneously, the general preference to avoid cognitive effort becomes more pronounced in late adulthood, due to the increased actual and perceived costs of engagement (Hess et al. 2021). In combination, these age-related changes in preferences raise the possibility that responses to strangers in laboratory tasks might translate poorly to everyday social functioning.

This possibility, in turn, highlights an apparent paradox in the literature on social cognitive aging. On the one hand, older adults are more likely than younger adults to struggle with laboratory tests of core social cognitive skills, such as recognizing whether somebody is scared or surprised, or sincere or sarcastic (Hayes et al. 2020, Phillips et al. 2015). Consistent with these performance deficits, older adults also show neural losses in areas that support core social cognitive processes (Vinke et al. 2018). On the other hand, older adults typically report comparable and sometimes greater levels of socioemotional well-being relative to younger adults (Mather 2016). Indeed, social cognitive difficulties do not feature prominently (if at all) in older adults' subjective

cognitive complaints (Ceccato et al. 2020). Their lack of concern with social cognitive losses stands in sharp contrast to their preoccupations with other domains, as older adults frequently worry about age-related cognitive losses, such as difficulties with word-finding and memory.

This paradoxical pattern of findings suggests three broad ways of interpreting the literature on aging and social cognition. First, as suggested above, perhaps older adults suffer social cognitive losses in laboratory tasks, but these laboratory tasks do not translate well to everyday life, where older adults are left with preserved social functioning. Second, perhaps laboratory tasks reveal meaningful social cognitive losses among older adults, but these losses are offset by areas of remaining strength or by age-related changes in socioemotional functioning and friendship networks. Third, perhaps laboratory tasks reveal important social cognitive losses among older adults, and it is those very losses that prevent them from becoming aware of the problem. In contrast to many other types of cognitive failures (e.g., misplacing car keys), social cognitive failures are more likely to result in feedback that is limited, temporally delayed, and indirect, and they also often require social cognitive abilities in order to be detected (e.g., upsetting a friend due to misunderstanding their expression but then failing to detect the subsequent social cues that signal the faux pas).

Despite widespread recognition of these fundamental concerns, this review highlights the fact that very little evidence directly addresses these three questions. Although older adults may well face a variety of social cognitive challenges when interacting with strangers in novel situations, it remains entirely unclear whether such challenges plague their everyday lives. Indeed, there may be many situations in which older adults make few or no social cognitive errors, and these situations might involve their most important interactions, that is, when socializing with family and friends in familiar contexts.

We address these central questions in the current review by highlighting what the experimental evidence shows across the four central domains of social cognition, while also emphasizing what is and is not known about the consequences in the real world. We then outline a conceptual framework that captures these competing influences on social cognitive aging and clarifies important questions that remain unanswered.

THE FOUR PILLARS OF SOCIAL COGNITIVE AGING

In daily life, social cognitive failures typically present in one of four different ways: as problems recognizing social and emotional cues (social perception), as reduced ability to understand the mental states of others [theory of mind (ToM)], as muted or excessively strong emotional responses to others (affective empathy), or as abnormal or inappropriate behavior (social behavior) (Henry et al. 2016). Unsurprisingly, these processes are interlinked, as errors in any one of these domains can have important consequences for the others. For example, a failure to recognize that somebody is sad (social perception) can short-circuit the search for causes (ToM), thereby preventing an emotional response (affective empathy) and any efforts to help (social behavior). This interdependence of social cognitive processes, and the challenges it poses for interpreting age effects is apparent throughout this review. Nonetheless, because it is useful to consider the impact of each of these processes on social functioning, we first review these four domains separately, considering how they are assessed, what type of age effects emerge, and what factors influence the magnitude of age changes in each domain.

Social Perception

An essential skill in everyday communication is the ability to recognize and interpret social and emotional cues, such as facial expressions, body language, vocal tone, and eye gaze. Most studies

of adult aging have assessed this capacity via tests of emotion recognition in which participants identify or discriminate between different emotional expressions. Meta-analysis reveals that the predominant pattern across emotions and modalities is one of age-related decline, but with notable caveats that implicate differences among emotions and methods (Hayes et al. 2020). For example, older adults are occasionally better at identifying disgust expressions than young adults. However, this effect only emerged with one set of stimuli (which happens to be the most frequently used in this research area), as older adults perform reliably worse than younger adults at recognizing disgust for all other stimuli sets.

One concern with these findings is that the frequent use of static photographs has overestimated the difficulty that older adults experience in real-world scenarios (Isaacowitz & Stanley 2011), but except for happiness, meta-analysis also revealed that dynamic videos produced age-effects of similar magnitude compared to static photographs (Hayes et al. 2020). Nonetheless, the dynamic videos typically used in this literature may also overestimate older adults' real-world difficulties. Most include limited or no background context. Rather, an unfamiliar actor's face is presented against a blank background, which is not how we typically encounter and make sense of social perceptual cues in day-to-day life.

Social context is a powerful determinant of human behavior, referring to the many physical and social characteristics of our immediate environment, such as the type of setting and social partner(s) with whom we are engaged. As noted, in most studies of social cognitive aging, social context has been restricted and homogeneous, with tests administered by strangers and depicting unknown people against the backdrop of a sterile, unfamiliar environment. In the few social perception tasks that have tried to address this issue using real protagonists and/or contextualized stimuli, the typical age effects are reduced and sometimes eliminated (Kunzmann & Isaacowitz 2017). Making the targets familiar people as opposed to strangers (Stanley & Isaacowitz 2015) reduces some age-related difficulties in emotion perception, and experimentally increasing the perceived closeness between the participant and target can also eliminate age difficulties in emotion recognition (Zhang et al. 2013). Nonetheless, only congruent contextual cues benefit older adults; incongruent (Noh & Isaacowitz 2013) or unrelated (Vetter et al. 2020) contextual cues disadvantage older adults more than younger adults. This latter finding aligns with a much broader literature showing that older adults are more likely to outsource control to their environment, increasing their reliance on environmental cues over internal representations to guide behavior (Mayr et al. 2015), sometimes to their detriment (Lindenberger & Mayr 2014).

Areas of preserved or improved social perception have also been identified in laboratory tasks. For example, the mere presence of tears enhances perceptions of sadness equally in younger and older adults (Grainger et al. 2019b), and age-related positivity biases enhance the perception of positive emotional displays (Rutter et al. 2019), although these effects are typically small. In addition, a central tenet of dual process models of aging is that whereas consciously controlled cognitive processes are subject to age-related decline, automatic processes are relatively immune to age effects (Craik & Jacoby 1996, Hasher & Zacks 1988). Consistent with such models, older adults show preserved implicit processing of emotional information, for example, via rapid facial mimicry and attentional blink responses to emotional faces (Huhnel et al. 2014, Sklenar & Mienaltowski 2019). The precise neurocognitive mechanisms responsible for such effects are unclear, but a promising approach can be found in research on neural compensation (Cabeza et al. 2018). According to the compensation hypothesis, older adults recruit additional brain regions when cognitive demands exceed the capacities of declining neural structures (Park & Reuter-Lorenz 2009). For example, older adults show greater frontal activation than younger adults when faced with effortful retrieval tasks, but not when retrieval tasks are easy (Velanova et al. 2007). Data such as these suggest that automatic processes, which are overlearned and hence

low in cognitive demands, are readily managed even by compromised neural circuitry. However, a strong test of these ideas requires assessment of age-related differences in brain activity and cognitive performance on tasks of varying levels of difficulty, familiarity, and automaticity.

Taken together, these findings support all three interpretations of the social cognitive aging literature raised above. First, laboratory-based studies that use stimuli designed to resemble aspects of real-life interactions suggest that there are many real-life situations in which older adults experience little or no difficulties. Such situations include when they encounter people they care about, or when other features of the background environment provide appropriate contextual support. Second, it seems possible that in daily life, areas of remaining strength (such as automatic social perceptual processing or age-related positivity biases) may sometimes offset other areas of weakness. Third, the literature suggests that older adults may experience difficulties recognizing emotions in at least some real-life situations, such as complex or demanding environments in which there are conflicting or irrelevant background cues, or when social interactions involve strangers. Nevertheless, there is currently no research that assesses whether losses in social perception (or, for that matter, in ToM or affective empathy) prevent older adults from identifying their own social cognitive deficits.

Theory of Mind

ToM refers to the capacity to understand others' mental states and to appreciate that these may differ from our own (Premack & Woodruff 1978), with a distinction often made between affective and cognitive components. Whereas affective ToM requires an understanding of others' emotions, affective states, or feelings, cognitive ToM requires an understanding of their cognitive states, beliefs, thoughts, or intentions. Most studies of adult aging have assessed affective ToM by presenting pictorial stimuli depicting complex affective states or verbal narratives that describe a protagonist's emotional states or behaviors. Cognitive ToM has more often been assessed by asking participants to complete tasks involving cues to sarcasm, deception, white lies, or social faux pas, as well as via false-belief paradigms that require understanding that others may hold beliefs about the world that differ from one's own or from reality.

In the first (and much cited) study of ToM in late adulthood, Happé et al. (1998) found evidence for age-related improvement. However, a later meta-analysis revealed a consistent picture of decline, with older adults performing more poorly than younger adults across all ToM measures (Henry et al. 2013). Age-related difficulties generalized across different tasks, domains, and modalities and were larger than deficits on non-mentalistic control tasks, indicating that older adults have difficulties specific to understanding complex emotions and mental states that are not easily attributed to other task demands.

Age-related ToM difficulties appear to be greater when demands on executive resources are high (Cho & Cohen 2019), but particularly when conflict is spatially mediated, with age-related declines linked to losses in spatial working memory (Rahman et al. 2021). Because spatial tasks are common in laboratory tests of ToM but rare in people's everyday interpretation of intentions, this finding provides a clear example of why losses in the laboratory might not translate to problems with real-world social functioning. When relatively automatic mental state attribution processes are assessed, such as implicit false belief tracking, the evidence also points to stasis with age (Grainger et al. 2018a).

Research on ToM nevertheless suggests a more consistent pattern of loss than is evident in the social perception literature, as the few studies that have used more ecologically valid assessments of ToM typically reveal age-related decline (Ceccato et al. 2019, Grainger et al. 2021b, Johansson Nolaker et al. 2018). Indeed, age-related difficulties were larger on one ToM task when it was

contextually enriched compared to minimally contextualized (Grainger et al. 2019a). However, in an important exception to this pattern, at least some types of age-related ToM difficulties were eliminated by experimentally increasing perceived closeness to the experimenter (Zhang et al. 2018).

As with the social perception literature, these findings are again consistent with all three interpretations of the social cognitive aging literature raised above. First, the inclusion of unnecessary cognitive conflict in some laboratory tasks may have led older adults' ToM proficiency to be underestimated. Additionally, because emotional closeness can eliminate ToM difficulties, older adults may do just as well as younger adults when they interact with familiar people in everyday life. Second, preserved implicit ToM processes in late adulthood may offset whatever losses do emerge in more explicit processes. Nevertheless, it remains the case that most studies find that older adults experience difficulties regardless of the type of ToM task used, raising the possibility that under certain circumstances (e.g., when interacting with strangers or in novel circumstances) older adults may suffer from social deficits of which they are unaware. This possibility remains a question for future research.

Affective Empathy

Affective empathy is a complex construct, with some arguing that it requires the sharing of another's emotional state (i.e., affective resonance; de Waal & Preston 2017) and others focusing on the general valence or appropriateness of the emotional reaction (Wondra & Ellsworth 2015). However, most agree that it involves an emotional response toward another individual. Although such a broad definition means that there are many possible ways of indexing affective empathy, aging studies typically rely on self-report, asking hypothetical questions about how a person believes they would respond in specific scenarios. Some studies using this approach have identified age-related decline (Chen et al. 2014), but most suggest that trait affective empathy either remains stable or increases in late adulthood (Beadle et al. 2015, Sun et al. 2018, Ze et al. 2014).

A smaller literature has assessed state empathic responses to emotionally evocative stimuli, in which emotionally arousing videos or photographs are presented to participants who are then asked to rate their emotional response. These tasks have yielded the same pattern of age effects as self-reports, with most studies revealing either age-related stasis (Beadle et al. 2015) or gains in emotional responding (Katzorreck & Kunzmann 2018, Sun et al. 2018, Sze et al. 2012). As with social perception and ToM, there are hints that these age effects are influenced by context. For instance, older adults react with greater anxiety and sadness to death-related films but not to a film about divorce, possibly implicating the importance of personal relevance (Katzorreck & Kunzmann 2018).

Several studies have also differentiated between empathic accuracy (akin to a hybrid of social perception and ToM), emotional congruence (feeling with another person), and sympathy (feeling for another person). Such studies suggest that age is unrelated or positively related to emotional congruence and sympathy (Richter & Kunzmann 2011, Wieck & Kunzmann 2015) but negatively related to empathic accuracy (Ruffman et al. 2020, Wieck et al. 2021). As with other domains, these age-related difficulties can sometimes be eliminated by making the protagonists' experience more personally relevant (Richter & Kunzmann 2011, Wieck & Kunzmann 2015). However, in the only study to index affective empathy in everyday life, older adults' empathic accuracy was poorer when their partner was physically present but not when their partner was absent (Rauers et al. 2013). This finding raises the possibility that older adults might have greater difficulty making use of real-time social cues to inform their empathic response, despite the optimistic picture suggested by laboratory tasks.

Taken as a whole, research on empathy deviates from the rest of the literature by revealing a more optimistic picture of aging. Most empathy studies reveal stasis or even age-related gains on tasks in which older adults report how strongly they experience an emotional response toward someone else's situation. Nonetheless, because most of these findings are based on self-report rather than task performance, they may suffer from the problem noted at the outset: Social cognitive losses might prevent older adults from being alerted to their own impairments. Additionally, these findings may be unique to the laboratory, as the literature also suggests that older adults may struggle to use real-time social cues available in everyday life to inform their affective response, unless the context makes these social cues highly relevant. Thus, the case of affective empathy may well be a reverse of social perception and ToM, with laboratory studies failing to reveal problems that manifest in the real world.

Social Behavior

Relative to the other three social cognitive domains, the impact of age on social behavior has been the focus of less empirical study, possibly reflecting the greater difficulties associated with operationalizing and measuring socially appropriate behavior. Positive social behaviors can include a great variety of everyday actions such as displays of insight, warmth, social influence, and altruism, while negative social behaviors include poor tact, lack of manners, interpersonal boundary infringements, reduced use of communicative gestures, and unsolicited affiliative contact with strangers. Adding to this complexity, context and relationship status are critical, as a social behavior that is appropriate in one setting (such as inquiring about a close friends' mental health in a private setting) may be unacceptable in another (such as making this same query of an acquaintance in front of work colleagues). In a similar manner, a joke that causes offense to one person may be considered highly entertaining by another.

Because people are often quite poor at judging the appropriateness of their own social behavior (presumably because they typically would not engage in socially inappropriate behavior if they knew it was inappropriate), some of the strongest evidence on age effects has been provided by informant-rated measures. Studies using this approach reveal that older adults are rated by their peers as exhibiting more socially undesirable behaviors relative to younger adults, with these age effects mediated by participants' own performance on measures of executive control (Henry et al. 2009). Older adults are also more likely than younger adults to talk excessively and about topics that are irrelevant to the stream of conversation (Pushkar et al. 2000) and to inquire about private issues in public settings (von Hippel & Dunlop 2005), with these age differences also mediated by executive cognitive losses. Social perception failures associated with aging also contribute to negative social behaviors, linked to increased off-target verbosity (Ruffman et al. 2010), difficulties differentiating between socially appropriate and inappropriate behaviors (Halberstadt et al. 2011), and increased likelihood of endorsing extreme attitudes that are aversive to others (Ruffman et al. 2016).

Despite the consistency of these findings, much of this literature showing age-related increases in undesirable social behaviors is now quite old. This shift away from such studies may reflect motivational models of aging, which predict that older adults should be at a clear advantage owing to their increased wisdom, positivity, and prioritization of close emotional relationships (Carstensen 2021). Consistent with such a possibility, management of social conflict appears to improve with age (Grossmann et al. 2010), and older adults also appear to be more altruistic than younger adults (Lockwood et al. 2021, Sparrow & Spaniol 2018). However, with regard to this latter effect, when nonmonetary donations are considered, older adults are not consistently more prosocial than younger or middle-aged adults (Best & Freund 2021). Older adults are also not

equally generous to all; toward nonrelatives, older adults have been shown to be less generous than younger adults (Gong et al. 2019), consistent with an increased focus among older adults on close friends and family.

As with the other three domains of social cognition, the changes in social behavior in late life are somewhat mixed. Laboratory findings suggest gains as well as losses, but older adults are more likely to engage in positive social behaviors quite selectively, that is, when the recipient is someone they care about. Some of the data showing that older adults engage in more inappropriate social behavior have been provided by participants' actual peers, suggesting that these problems emerge in everyday life. Unfortunately, most of the data showing these latter effects are over 10 years old, and thus they would be strengthened through larger samples and preregistered replication.

UNDERSTANDING AGING FROM A SOCIAL COGNITIVE RESOURCES FRAMEWORK

The mixed effects of aging on the four pillars of social cognition can give the impression that there are no systematic effects of aging on social cognition. Although that may well prove to be true, the discussion so far has focused primarily on empirical findings in isolation, without due consideration to the multiple and competing effects of age on social cognitive functioning. To consolidate these effects into a single model, we propose the social cognitive resources (SCoRe) framework (see **Figure 1**). In this model, genetic and environmental factors jointly determine cognitive capacity via the degree of biological deterioration (senescence) that occurs with aging. The model indicates that cognitive performance is heavily influenced by motivational processes, which reflect a trade-off between expectations of gain and loss as well as perceptions of effort. Finally, the model clarifies the central role of experience, highlighting how and why familiarity can influence both capacity and motivation.

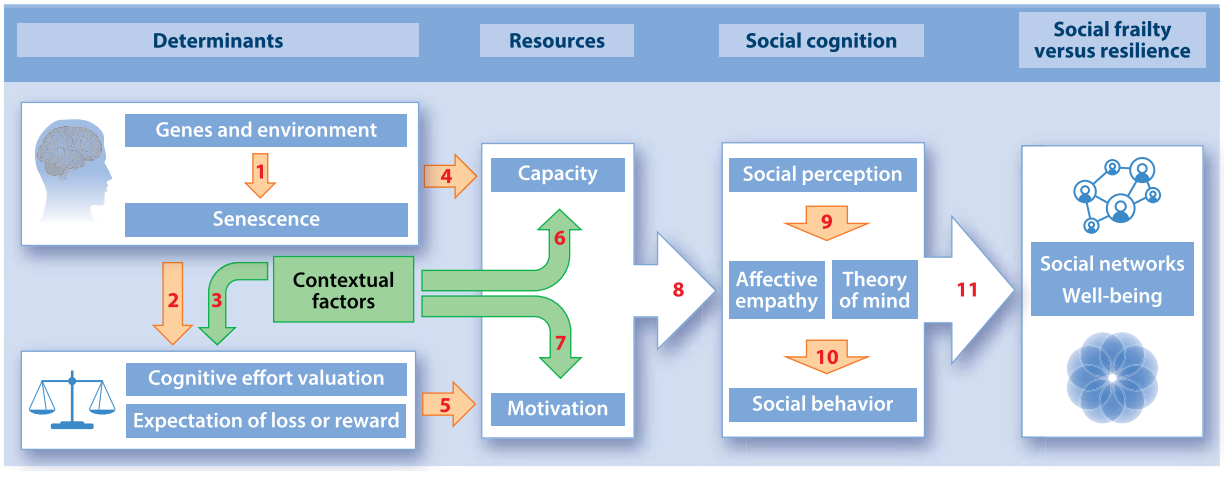

Figure 1

The social cognitive resource (SCoRe) framework. Genetic and environmental factors determine the degree of senescence that emerges in late life (*Step 1*), which combines with contextual factors to influence effort valuation and expectations of loss or reward (*Steps 2*, *3*). All these factors then jointly influence the individual's capacity and motivation to engage with others (*Steps 4*–*7*). Capacity and motivation, in turn, combine to influence social cognitive functioning (*Step 8*), which begins with social perception, leading to affective empathy and theory of mind (*Step 9*) and ultimately to social behavior (*Step 10*). These social cognitive processes play a role in older adults' ability to maintain social networks, supporting their well-being (*Step 11*).

The SCoRe framework suggests that contextual factors determine not only how we approach a task (the motivational component), but also how objectively challenging we experience a task to be (the capacity component). Because many cognitive processes become automated with practice, especially when completed in familiar environments, many social processes are likely to be automatized by late life and hence show stasis with age (Craik & Jacoby 1996). Even covert practice (simply imagining responding repeatedly to a stimulus) can be sufficient to automate cognitive processes (Liefooghe et al. 2021). Although capacity and motivational resources jointly determine social cognitive functioning, the SCoRe framework clarifies that contextual factors are fundamental to understanding the availability of both. In the sections below, we review literature that is relevant to each component of the model.

Direct Determinants of Capacity

There has been considerable interest in the possibility that cognitive, neural, perceptual, and hormonal changes that occur with age directly influence social cognitive function. Here, we discuss the role of each of these factors in isolation, although in real life these factors can, and likely do, interact.

Cognitive determinants. Normal adult aging is associated with decline in many aspects of cognitive function, such as processing speed, executive control, and memory (Salthouse 2019). Because social cognitive processes rely on broader cognitive resources, these age-related changes in cognitive functioning exert important influences on social cognitive aging. For example, off-target verbosity and insensitive or prejudicial behaviors are linked to losses in executive function (Henry et al. 2009, Pushkar et al. 2000), and social perception, ToM, and empathy also rely on basic cognitive operations such as memory and attention (Rubio-Fernandez 2017). Measurement issues also loom large in social cognitive aging. For instance, the most widely used measure of social perception is facial affect recognition, which involves either labeling (making explicit choices between different affective labels) or discriminating (deciding whether two faces display the same or differing emotions). The former task is more dependent on language and executive control, and the latter task more strongly implicates face processing abilities (Phillips et al. 2010).

It should come as no surprise that social cognitive processes often rely on the integrity of more basic cognitive operations, but as the data show with spatial confounding of ToM tasks (Rahman et al. 2021), the first question is whether the cognitive processes underlying task performance are implicated in how the social cognitive abilities are used in the real world. The next question is whether age-related changes in social cognitive functioning are simply a byproduct of more basic cognitive losses or whether social cognitive processes introduce unique demands. The answer to this question has been mixed. Some studies have shown that cognitive losses account for some of the age-related variance in social cognition (Johansson Nolaker et al. 2018), but others have shown that age-related social cognitive difficulties can occur independently of broader cognitive losses. For instance, in one study, decline in processing speed and episodic memory predicted but did not mediate age effects in cognitive ToM (Laillier et al. 2019), whereas in another, general cognitive abilities did not influence age differences in either ToM or empathy (Reiter et al. 2017).

These latter findings suggest that social cognitive aging is more than simply a consequence of broader age-related cognitive decline, but the former findings indicate that general cognitive decline can contribute to older adults' social cognitive difficulties. These findings speak directly to the importance of contextual influences in any consideration of age effects. The socioemotional and background cues afforded by true-to-life social stimuli may not only be motivating but may

also sometimes be more demanding of older adults' limited cognitive resources due to their increased complexity, and the magnitudes of these effects are likely to differ as a function of context. For example, cognitive demands seem likely to be greater in social interactions that involve strangers or unfamiliar social settings than in those involving close friends in familiar environments.

Neural determinants. Findings from neuroimaging, brain lesion, and electrophysiological studies converge to show that many distinct neural structures and networks combine to support social cognitive function (Cohen-Zimerman et al. 2021, Dziura & Thompson 2020, Wang et al. 2021). Key brain regions include the dorsomedial prefrontal cortex, the temporoparietal junction, the dorsal anterior cingulate cortex, the anterior insula, the posterior superior temporal sulcus, and the amygdala. Because social cognition relies on interactions within and between these large-scale neural networks, the functional integrity of these networks can be disrupted by relatively mild deterioration in any one structure, diffuse deterioration or white matter damage, and disorders associated with white matter pathology.

Abnormalities in specific neural regions have been linked to distinct social cognitive disturbances in brain-damaged populations. For instance, damage to frontotemporal brain regions is associated with disinhibited behaviors, such as social inappropriateness, hypersexuality, and compulsive gambling (Zahn et al. 2017). Lesions in the anterior cingulate cortex are associated with behavioral disturbances that include abulia (an inability to act decisively) or its more severe form, akinetic mutism (a wakeful state of profound apathy; Darby et al. 2018). Additionally, the right temporoparietal junction plays a key role in evaluations of psychological harm (Tsoi et al. 2018), which is a key cognitive process for moral judgment.

In this context, it is therefore noteworthy that many of the neural structures implicated in social cognitive function are prone to age-related volumetric losses (Vinke et al. 2018). Moreover, the most age-dependent areas of microstructural compromise are localized to regions that include the orbitofrontal and medial temporal cortices (Reas et al. 2020). Normal adult aging is also associated with changes in the neural circuits underlying empathy (Riva et al. 2018).

Yet, despite the intuitive appeal of the idea that age-related brain changes are directly responsible for age-related social cognitive difficulties, surprisingly few studies have identified clear and direct links between neural and social cognitive changes in older adulthood. For example, one study found that greater hippocampal volume was associated with faster recognition of facial emotions in older adults, but no associations emerged between hippocampal volume and accuracy of facial affect recognition (Szymkowicz et al. 2016). In another study, reduced N250 amplitude (measured by electroencephalogram) in older adults emerged alongside equivalent performance in facial affect recognition, suggesting the existence of compensatory mechanisms (Gonçalves et al. 2018).

The much larger literature focused on aging and general cognitive functions also fails to identify compelling evidence of normal age-related brain changes leading directly to cognitive losses. Rather, weak associations typically emerge between age-related losses in cortical volume and poorer cognitive performance (Oschwald et al. 2019), while striking cases of gross pathological changes in the brain have been found to coexist with relatively well-preserved cognitive performance (Stern et al. 2019). Although the brain is ultimately the seat of social cognitive functioning, age-related neural losses do not necessarily manifest in real-life social cognitive difficulties, and this finding points strongly to the existence of compensatory mechanisms at the neural and/or behavioral level. For instance, function may be preserved despite volumetric losses if connectivity is intact, and normal aging is associated not only with decreases but also with some increases in white matter structural connectivity (Coelho et al. 2022).

Perceptual determinants. Late life is associated with declines in all sensory modalities, including losses in auditory and visual acuity, and it has frequently been suggested that these losses may contribute to social cognitive difficulties. Yet, in the absence of substantial sensory impairment, the data suggest that normal sensory changes may matter little, if at all. For example, substantial hearing loss contributes to older listeners' difficulties in vocal emotion recognition (Christensen et al. 2019), but among older listeners with normal hearing, age-related hearing losses do not predict difficulties in auditory emotion recognition (Christensen et al. 2019, Dupuis & Pichora-Fuller 2015). Similarly, older adults are sometimes just as good as younger adults at integrating auditory and visual information to compensate for degraded signals (de Boer et al. 2021). Older listeners also retain the ability to extract and track temporal regularity, even in crowded acoustic environments (de Kerangal et al. 2021).

Studies such as these highlight the fact that sensory losses might not explain age-related changes in social perception, but they also clarify that age-related changes in perceptual processing are nonetheless common. One of the most important changes concerns attention toward the eyes. Eye contact is often a precursor to joint attention, which occurs when an individual gazes at an object, causing another individual to orient their gaze toward the same object (McKay et al. 2021). Joint attention is fundamental to shared intentionality and to social cognitive processes such as empathy, ToM, and social bonding that depend on sharing thoughts, intentions, and desires (Stephenson et al. 2021). It is therefore potentially important that normal adult aging is associated with attenuated gaze-cueing, whereby older adults are slower to respond to a gazed-at target than younger adults (McKay et al. 2022).

Eye-tracking studies have also consistently shown that older adults attend less to the eye region of emotional faces (Grainger & Henry 2020) and less to people's faces in social scenes (Grainger et al. 2019a) relative to younger adults. Moreover, although older adults gaze more at facial expressions of emotionally close than of non-close targets (Fung et al. 2019), older adults attended less than younger adults to the experimenter's face during a real-life conversation, and less to people in general when navigating the real world (De Lillo et al. 2021). It has been suggested that these age-related biases away from the emotionally richest sources of social information in our environment may explain age differences in social cognitive function, but these gaze patterns do not appear to be correlated with older adults' emotion perception or their ToM abilities (Grainger & Henry 2020, Grainger et al. 2019a).

In sum, although older adults exhibit sensory decline and alterations in how they allocate perceptual attention to their social environment, social cognitive difficulties cannot simply be attributed to normal sensory decline, and the role of altered visual attention in day-to-day social functioning remains unclear.

Hormonal determinants. There is a gradual reduction in the endogenous production of many hormones in late life, including dehydroepiandrosterone (DHEA) and its sulfate (DHEA-S), growth hormone, and insulin-like growth factor 1 (IGF-1), and these changes could contribute to poorer cognitive function in older age in many ways, such as via reduced metabolic health (Pataky et al. 2021). However, to date there has been only limited assessment of how age-related hormonal changes influence social cognitive function.

Here, the hormones oxytocin and vasopressin (both of which exert widespread neuromodulatory effects and therefore also function as neuropeptides) have been the focus of great interest. Both have been identified as potentially important in socioemotional aging (Ebner et al. 2014). It remains unclear whether central levels of these neuropeptides change across the adult lifespan, but cerebrospinal fluid and plasma oxytocin concentrations are positively correlated in children (Carson et al. 2015), suggesting that peripheral levels may reflect central ones. While there is

stasis in plasma levels of oxytocin, vasopressin levels are higher in older relative to younger adults, and levels of both have been linked to at least some measures of attachment and/or cognition (Plasencia et al. 2019). In contrast, although evidence suggests that intranasal application protocols increase central oxytocin levels (Quintana et al. 2021), intranasal oxytocin does not consistently modulate age-related behavioral effects. In one study, age-related difficulties on measures of social perception and ToM were essentially unchanged by intranasal oxytocin (Grainger et al. 2018b); in another, intranasal oxytocin differentially affected younger and older adults' neural responses to a breach of trust but did not modulate age effects in actual trusting behavior (Frazier et al. 2021).

Less research has focused on sex hormones, although higher endogenous testosterone levels have been linked to poorer social cognition and social outcomes in younger males, including self-rated physical aggression (Gottlich et al. 2021) and reduced empathic accuracy as evaluated by peer report (Ronay & Carney 2013). Exogeneous administration of testosterone has also been linked to increased selfishness (Ou et al. 2021) and greater social status seeking (Wu et al. 2020).

Levels of testosterone naturally decline with age in both males and females, suggesting the potential for improved social functioning with age, but higher levels of testosterone have been linked to better ToM in older males (despite predicting poorer ToM in younger males) (Grainger et al. 2021a). These results are consistent with a broader literature suggesting that testosterone possesses neuroprotective properties in older age and with the idea that only very high levels of testosterone (as found in younger males) might have problematic social cognitive consequences. The absence of effects among females (who have much lower levels of testosterone) in many of the studies in this literature also suggests that testosterone may have a meaningful impact on social cognitive abilities only when present at sufficiently high levels, consistent with a potential threshold effect.

Like testosterone, estrogen is thought to possess neuroprotective effects in older age (Baez-Jurado et al. 2019), but evidence with respect to how estrogen levels impact social cognition is limited. While higher levels of estrogen appear to play a role in emotional memory consolidation (Hsu et al. 2021), another study revealed no associations between levels of salivary estrogen and several empathy-related measures (Gamsakhurdashvili et al. 2021). In one of the largest studies to date, neither hormonal contraceptive use nor naturally varying ovarian hormones predicted complex emotion recognition (Shirazi et al. 2020). Although menopause is associated with an abrupt loss of estrogen and progesterone production, it remains to be established whether losses in these hormones impact social cognitive functioning in late life.

In sum, despite widespread decline in the production and action of many hormones in late adulthood, as well as evidence that hormonal change is likely to impact social cognitive function in late adulthood, limited research has explored this potentially important topic.

Direct Determinants of Motivation

Social cognitive functioning is jointly determined by capacity and motivation. Traditionally, older adults' motivation to engage in social cognition and behavior has been conceptualized in terms of expectation of gain or loss of socioemotional reward. More recently, research has highlighted the key role played by cognitive effort valuation, which refers to how cognitively effortful the social cognitive activity is anticipated to be. Because self-reported energy level is inversely associated with advancing age (Sprague et al. 2021), cognitive effort becomes both subjectively and objectively more costly as we age (Hess et al. 2021). In the SCoRe framework, deterioration caused by biological aging can indirectly impact motivation, but here we focus on how expectation of loss versus reward and cognitive effort valuation can directly influence motivation.

Expectation of loss versus reward. Motivation is critical in any consideration of social cognitive aging. Older adulthood is accompanied by physical decline and an awareness of impending mortality, and these two uncomfortable facts impact the goals held by older people. First, there is a shift in goal orientation from predominantly striving for gains to focusing on maintenance and loss avoidance (Gong & Freund 2020). There are also systematic changes in the types of goals considered most meaningful, with older adults especially motivated to prioritize experiences that enhance emotional well-being. Consistent with these mood-regulatory goals, older adults show an attentional and memory bias for positive relative to negative emotional stimuli and are also more likely to interpret emotionally ambiguous stimuli (such as surprised faces) as positive (Shuster et al. 2017).

This age-related positivity effect has been documented not only behaviorally but also at the neural level. Views differ on whether age-related losses in adrenergic and amygdala functioning cause positivity effects (Cacioppo et al. 2011) or whether age-related neurophysiological changes are themselves the consequence of decreased perceptual processing of negative stimuli (Mather 2016), but both models predict an emphasis on positivity in late adulthood. Most studies have identified precisely this type of age-related pattern, and neural response time data indicate that the shift from negativity in younger adulthood toward positivity in older adulthood is not driven by conscious or effortful processing but appears to occur quite effortlessly (Petro et al. 2021).

Many motivational models have been proposed to explain age-related shifts in goal orientation and positivity effects. One of the most influential is socioemotional selectivity theory, which assigns a central role to altered time perspective (Carstensen 2021). An increasing awareness that time is running out is thought to cause a developmental shift from being future- to present-oriented and provides an elegant explanation for positivity effects: Positive stimuli are, in the moment, more pleasant to attend to. Altered time perspective might also explain why older people are more motivated to invest in meaningful social relationships and less interested in pursuing new or peripheral social contacts (Fung et al. 2020). Recent evidence shows that this same pattern even extends to digital social networks, with increasing age associated with reduced social network size and this reduction associated with increased emotional closeness to the remaining network ties (Chiarelli & Batistoni 2021). However, aging wild chimpanzees show this same pattern of social preference (Rosati et al. 2020), which is highly unlikely to be driven by complex future-oriented cognition (Suddendorf & Corballis 2010).

An alternative view is the selective engagement hypothesis (Hess 2014), which suggests that older people (and perhaps older chimps as well) become more selective in how they invest their increasingly limited resources, with an emphasis on positive emotional returns. Older adults are thought to be motivated to allocate their limited resources to tasks that have greater personal meaning or social consequences. This hypothesis suggests that older adults' increased social selectivity is due in part to declines in personal resources to support social behavior (O'Brien & Hess 2020). Longitudinal data also show that poorer cognitive function is related to a subsequent smaller structure of social relations, raising the possibility that reduced social diversity might at least partially reflect older adults' adaptive modification of their social relations in response to their own declining cognitive resources (Luo et al. 2021).

Although their precise explanatory mechanisms and predictions differ, these models (and many others) converge on the understanding that the aspects of our social environment that motivate us when we are younger may be very different from those that motivate us in later life, with implications for real-life social cognitive function. For instance, socioemotional selectivity theory and selective engagement theory both predict that older adults will be more motivated than younger adults to engage primarily with people they know and love, which may impact how accurately they identify, understand, and share the emotional experiences of different types

of social partners. Consistent with this view, perceived relationship effort outside biological kin relationships is more strongly associated with emotional closeness in older adults than in younger adults (Lang et al. 2013). As we noted at the outset of this review, because the stimuli used in research on social cognitive aging typically depict strangers, older adults are less likely to devote their full attention to understanding them. More research that examines social cognitive processes when interacting with friends and family will provide critical evidence for whether research on reactions to strangers accurately captures social cognitive functioning in older adults.

Taken together, these findings show that with age there is an increasing prioritization of personally relevant and meaningful goals and a devaluation of goals that are not. Consequently, personal meaning (or lack thereof) is a critical consideration in research on social cognitive aging.

Cognitive effort valuation. The importance of motivation has long been understood in social cognitive aging, but most often from the perspective of motivation to acquire reward or avoid loss. The SCoRe framework also highlights that motivation can be influenced by cognitive effort valuation, or how cognitively effortful an activity is expected to be. Because people are generally averse to exerting cognitive effort (the so-called cognitive miser phenomenon; Fiske & Taylor 1991), rewards are discounted by the amount of effort required to obtain them. When the subjective costliness of cognitive effort is consequential, it may dissuade people from pursuing even valuable social goals.

These reward/effort trade-offs may be particularly critical to understanding age effects in social cognitive tasks. Because older adults are more averse to engaging in cognitive effort than younger adults (Hess et al. 2016), effort avoidance may contribute to declining cognitive performance as we age (Westbrook et al. 2013). Selective engagement theory highlights the key role of cognitive effort valuation in understanding age effects, but most studies have focused on how effort avoidance impacts nonsocial cognitive activities such as memory or executive function. One notable exception indicates that willingness to engage in social interactions may be related to perceived benefits and costs (O'Brien & Hess 2020), implying a potential role for effort valuations.

The social cognitive processes that support social behavior might be evaluated in terms of effort as well. For instance, Cameron et al. (2019) identified a robust preference to avoid empathizing with others and showed that this avoidance was related to empathy being perceived as effortful and aversive. Unfortunately, like most of the broader social cognitive literature, Cameron et al.'s (2019) research was laboratory based and focused solely on empathizing with strangers. Empathy for strangers is particularly unmotivating (Ferguson et al. 2020), and a more recent experience-sampling study found high rates of spontaneously empathizing with others in daily life, particularly people with whom there was a close personal relationship (Depow et al. 2021). It remains to be established what effect age would have on these findings, and particularly whether emotional closeness would mitigate the perceived effort costs of empathizing with others.

The limited evidence we do have suggests that these trade-offs may differ across the adult life span. In a study of the impact of physical effort costs, older adults were more willing than younger adults to exert force (30–70% of maximum grip strength) that benefited others (Lockwood et al. 2021). Future work is needed to establish whether these results replicate using a more naturalistic design and when the tasks demand cognitive rather than physical effort. People are differentially sensitive to physical and cognitive effort (Chong et al. 2017), and with advancing age, apathy typically increases in cognitive but not behavioral domains (Brodaty et al. 2010). Thus, it is unclear whether and when older adults might be more or less willing to engage in cognitive effort to benefit others.

In sum, social cognition is likely to be bound by similar principles and constraints as other effortful acts; yet at present we have only a superficial understanding of what these effort costs might

be for many real-life social cognitive activities, or how reward/effort trade-offs might change with advancing age. Laboratory-based studies suggest that social cognitive engagement may be effortful, aversive, and potentially even avoided, but the limited evidence we have from more naturalistic studies points to a more nuanced picture. It is also important to understand how these effort costs might interact with other age-related changes. For instance, fatigue from listening is a common complaint among individuals with hearing difficulties, and the age-related costs associated with effortful listening are greatest in social domains (McGarrigle et al. 2021).

The Fundamental Role of Context

As shown in **Figure 1**, context plays a central role in the SCoRe framework. Contextual factors refer to the many variables—both personal and environmental—that determine how we subjectively approach a task and how demanding we experience it to be. Although motivation and capacity jointly explain performance on social cognitive tasks, contextual influences govern the availability of both. Personal factors that influence how we perceive, process, and interpret social information include prior knowledge, experience in the domain, meaningfulness, and familiarity as well as prior or potential future relationships (including not only emotional relationships but also more transactional or professional ones as well as those that simply bind us to kin). Environmental factors include the degree of busyness, regularity, structure, and complexity of the setting in which the social cognitive activity is set. Here we focus on what is known about each of these influences and how personal and environmental factors interact.

Contextual factors and motivation. Context is a direct determinant of motivation, but few studies to date have manipulated or measured contextual influences while also indexing motivation and social cognitive test performance. Nonetheless, quite simple manipulations that make stimuli more personally meaningful often reduce age-related difficulties on tests of social perception. This basic effect has been shown in several different ways, such as by experimentally increasing the perceived closeness between the participant and the target (Zhang et al. 2013) and by making the targets of social cognitive judgments romantic partners instead of strangers (Stanley & Isaacowitz 2015). The most parsimonious interpretation of such findings is that closeness particularly benefits older adults' performance because it increases their motivation to engage with the task. Indeed, research combining electroencephalogram and functional magnetic resonance imaging data in younger cohorts also reveals how familiarity matters, identifying a strong and rapid impact of personal relevance on face processing in cortical circuitry that extends beyond the core face processing network (Bayer et al. 2021). Based on the circuitry involved, these effects might reflect associative learning of the link between the visual stimulus features of emotionally close social partners and their personal relevance and reward value.

Although closeness benefits social perception, ToM and empathic accuracy have additional demands, as they require that we take an additional step to understand things from another person's perspective. If closeness primarily functions to increase older adults' attentional focus, it might enhance social perception but be insufficient to overcome the additional challenges involved in perspective taking. As perspective taking is more demanding, higher levels of motivation may also be required for older adults to maintain optimum performance. Consistent with such a possibility, individual differences in ToM ability are correlated with older adults' relationship quality with their friends, but only among those individuals with a moderate or high level of social motivation (Lecce et al. 2017).

Features of our environment are also important to understanding motivation, but again few studies to date have directly tested how characteristics such as predictability, regularity, or complexity might be important to understanding age effects in social cognition. What we do

know from laboratory studies is that increasing the extrinsic cognitive demands associated with a speech understanding task not only increases self-reported effort but also reduces motivation to complete the task (Devesse et al. 2021). Motivation to acquire novel information and/or engage in novel experiences (state curiosity) also typically declines with age, unless personal relevance is high (Chu & Fung 2022), indicating how environmental and personal contextual influences may themselves sometimes interact.

In sum, contextual influences are critical to understanding social cognitive function, as they determine the resources people are willing to allocate to an activity. Environmental factors (such as extrinsic cognitive demands) determine whether people are in fact able to allocate these resources in the manner they intend. Yet there is surprisingly little research that directly tests these relationships in the context of normal adult aging, highlighting this area as an important focus for future investigation.

Contextual factors and capacity. Contextual influences are also critical to understanding capacity. Contextual factors might not only impact biological aging but might also mitigate many of its negative effects. When context provides greater familiarity with a social cognitive activity or a social partner, the result should be that more reflexive, automatic processes are engaged, which are largely resistant to age effects. Studies of social cognitive training provide indirect support for the possibility that increased practice or familiarity may reduce age effects. Although exceptions have been noted (Schlegel et al. 2017), most studies reveal that older adults' capacity for ToM (Cavallini et al. 2021) and emotion recognition (Stanley & Webster 2019) can be improved with training. Yet when training does lead to improvement, it is often unclear whether training allows trainees to engage more reflexive, automatic social cognitive processes or to learn and deploy more explicit compensatory strategies.

Perhaps some of the clearest evidence that practice or familiarity may lead to more reflexive, automatic processing is research showing how practice or familiarity with a cognitive task reduces people's estimate of how much cognitive effort the task will require (Hess et al. 2021). These findings raise the possibility that social cognitive tasks benefit from practice if they are regarded by older adults as effortful. Because people have more familiarity with emotionally close social partners, in principle it should be less cognitively demanding to engage with them as compared to strangers. No study to date has tested this question in older cohorts, but the few studies conducted with younger adults point to a potentially complex relationship. For instance, while it requires greater cognitive effort to judge a stranger's than a friend's happiness, the reverse is true for judgements that relate to pain (Wang et al. 2016).

Attention demands are common to virtually all social cognitive domains, except when task performance has become habitual or automatic. A lifetime of practice with social cognitive tasks should theoretically lead to some aspects of the tasks becoming automatic, thus requiring fewer attentional resources. For example, we may be able to interpret our spouse's emotions quite effortlessly but not a stranger's. Recognition of strong, unambiguous emotional displays may also occur automatically and be largely resistant to age effects, whereas more subtle or complex emotional expressions likely demand more controlled attentional processes to be detected and hence might be more susceptible to age-related decline. Despite the intuitive appeal and logic of these possibilities, there is surprisingly limited research that directly tests questions regarding familiarity and automaticity in social cognitive aging.

A CASCADE OF SOCIAL COGNITIVE DIFFICULTIES

As we noted at the outset of this review, the different domains of social cognition can be examined in isolation, but social cognitive processes work together to allow people to understand and

manage others, as is reflected in the development of many complex hierarchical conceptual models (Schurz et al. 2021). Nearly all of these models propose that social perception (or at least the initial detection of social cues) temporally precedes other more complex aspects of social cognition such as ToM, either via a serial processing stage or via separate processing streams. Thus, current models of social cognition concur that any deficits in social perception will cascade through to all other domains of social cognition.

As noted above, social perception can be relatively undemanding if the stimulus is clear and unambiguous, but in daily life we encounter an extraordinary number and variety of social perceptual cues. Along with facial expressions, there are also auditory, bodily, and eye gaze cues to contend with, and these cues can arise from single individuals or multiple people at once (Homan et al. 2016). The cues we encounter in daily life also vary in intensity as well as in their genuineness and often do not manifest in discrete prototypical displays, as more than one emotion is expressed simultaneously. Real-life cues to emotional states are also often temporally limited and dynamic, in a way that is rarely captured in laboratory studies.

Regardless of age, bottlenecks in visual attention prevent us from processing all cues available to us in our environment. Selective attention is therefore an important component of human visual cognition—and as we grow older, there are systematic changes in how selective attention operates. Not only do older adults spend less time looking at the most socially rich aspects of their environment relative to younger adults (De Lillo et al. 2021, Grainger et al. 2019a), but their attention is also more easily captured by external cues (Lindenberger & Mayr 2014). Such age-related changes are likely to have important implications for higher-level social cognitive operations. Although there are few studies that directly test the consequences of age-related changes in selective attention, when older adults fail to attend to social cues they remain unaware of the emotional states of others, and as noted previously, this lack of awareness then short-circuits any attempt to understand and empathize with others or engage in appropriate social behaviors.

Highlighting the complexity of these issues, age-related inefficiencies integrating and processing multiple social cues are important for understanding difficulties in both social perception and ToM (Grainger et al. 2019a, Phillips et al. 2011). Perspective-taking difficulties have been linked to older adults' greater difficulties inhibiting the egocentric (self) perspective to take the allocentric (other) perspective (Martin et al. 2019), while age-related difficulties in emotion recognition, ToM, and empathic understanding are typically related (Gourlay et al. 2021). Age-related difficulties in social perception at least partially, and sometimes fully, mediate the relationship between age and ToM (Halberstadt et al. 2011), while distinct components of the broader construct of empathy (emotion sharing, perspective taking, and compassion) nearly always co-occur in everyday empathic experiences (Depow et al. 2021).

Taken together, there is compelling evidence that age-related losses in social cognitive processes interact with one another, such that a failure or breakdown at one stage of processing can have important implications for consecutive or concurrent ones. Even relatively simple or trivial social cognitive losses, therefore, have the potential for important downstream consequences on how we understand and subsequently interact with others—and in turn, on how we are perceived by them. Furthermore, even when social perception, ToM, and affective empathy are intact, inappropriate social behaviors may present quite independently. Declines in broader cognitive resources, such as executive control, increase the risk of engaging in inappropriate social behaviors, which then influences the responses of others and the individual's capacity to manage social relationships. For this reason, social behavior is often regarded as part, and not simply the endpoint, of social cognitive function (Henry et al. 2016). With these complexities in mind, we turn our focus to what is ultimately the most important consideration in this literature: the (limited) evidence for and the impact of social cognitive failures in older adults' everyday lives.

CONSEQUENCES OF SOCIAL COGNITIVE LOSSES IN OLDER AGE

Although poor social cognitive skills would be of interest in any age group, their effects have the potential to be particularly devastating in late adulthood. Not only do people require greater assistance in managing the demands of everyday life due to declining physical and cognitive capacities in late life, but they are also likely to require increased emotional support to cope with the loss of friends, siblings, and spouses arising from bereavement. It is therefore of concern that older adults who struggle to perceive emotions also report poorer quality of life (Phillips et al. 2010), and poorer social cognitive function in older age has been linked to smaller and more homogeneous social networks (Krendl et al. 2021).

Perhaps surprisingly, social involvement with one's family is not a good predictor of loneliness among older adults. Rather, older individuals depend on social integration with their peers to keep loneliness at bay (Pinquart & Sorensen 2001), and contact with friends (but not family) is predictive of better cognitive functioning in later life (Sharifian et al. 2020). Relationships with kin are at lower risk of breaking simply because of their strong normative component, suggesting that relationships with friends are more dependent on strong social skills than are relationships with family members. Indeed, older adults who spontaneously apply ToM to interpret social behavior report stronger relationships with friends, but this is not the case for their relations with family members (Lecce et al. 2019).

Older adults who have difficulties detecting and responding appropriately to social cues may therefore drive away the very individuals they most rely on for companionship. Older adults who engage in inappropriate social behaviors are also more vulnerable to social isolation. Although inappropriate remarks are frequently not meant to be off-putting—particularly if they arise from poor inhibitory control—social inappropriateness is widely interpreted as unfriendly. Additionally, people find the company of others who regularly make inappropriate comments aversive and tend to avoid such individuals. This effect is likely to be stronger among older adults, owing to their greater selectivity about the people with whom they choose to spend their time (Carstensen 2021).

Although traditionally models of frailty have emphasized declines in physical reserves and resilience, more recent models have emphasized the multidimensional nature of this construct and included cognitive and social domains. Social frailty refers to an actual or perceived inability to meet basic social needs (Bunt et al. 2017) and is regarded as a key threat to healthy aging. Social frailty has been identified as an important predictor of future morbidity and mortality, even after controlling for other types of vulnerability (Makizako et al. 2015). Because social frailty represents the accrual of various forms of loss, which reduce the individual's reserves and resilience (Bunt et al. 2017), the next important step in this literature is to establish the extent to which social frailty reflects the accumulation of losses in social cognitive capacities.

It will also be important to understand how social cognitive losses might be potentially offset by other positive age-related changes. Wisdom generally increases with age and is a protective factor against loneliness in late adulthood (Lee et al. 2019). Wisdom has also been shown to be positively associated with older adults' subjective well-being, even after controlling for physical, social, and cognitive characteristics (Ardelt & Edwards 2016). Psychological resilience, or the ability to soften the impact of negative emotional events, might also improve with age. For instance, acute psychosocial stress reduces younger adults' ability to implement delayed intentions but has no impact on older adults (Schnitzspahn et al. 2022). Older adults also report improved emotional well-being relative to younger adults, although this effect disappears at higher levels of chronic stress, suggesting that there may be important boundary conditions on psychological resilience in older age (Sliwinski et al. 2021). Further research is now needed on this topic, particularly given that promising preliminary evidence shows that it might be possible to strengthen wisdom and resilience in older age via targeted interventions (Lam et al. 2020).

In summary, there is surprisingly limited evidence that directly speaks to the real-life consequences of social cognitive failures in older age. This situation contrasts starkly with the literature on clinical disorders, in which social cognitive difficulties have been consistently documented and linked to negative outcomes, including less supportive social networks, unemployment, and poorer mental health (Henry et al. 2016). Because social cognitive failures are a prominent feature of many clinical disorders, the link between social cognition and social functioning is likely to be stronger and more easily captured in clinical populations. Nevertheless, the clinical literature provides a proof of concept, which suggests that if older adults experience social cognitive difficulties in their everyday lives, there are likely to be important costs to their well-being. This review highlights that further work is needed to establish the conditions in which older adults suffer social cognitive losses and the real-life consequences when such losses arise.

CONCLUSION

The goal of this review has been to highlight what is known and unknown about changes in social cognition in late life and how these changes manifest in social outcomes for older adults. In service of this goal, we have highlighted three possible interpretations of the fact that most laboratory studies show that social cognitive deficits accrue with age, but few (if any) older adults report social cognitive difficulties. Although there is insufficient research on social cognition in the real world to have confidence in any explanations of this disconnect, the existing data support all three interpretations: (*a*) Laboratory tasks underestimate the social cognitive abilities of older adults because they are bereft of context and personal meaning, (*b*) losses in social cognition that are meaningful and important are often offset by areas of remaining strength or age-related changes in socioemotional functioning and friendship networks, and (*c*) losses in social cognition that are meaningful and important can blind older adults to the very problems that they cause.

In response to this situation, we have proposed the SCoRe framework as a guide for how future research might address these important questions. The SCoRe framework integrates the research literature to highlight not only the questions we still need to answer but also the measures we need to provide those answers. Most notably, it is likely that there are many real-life situations in which older adults make few social cognitive errors, such as when interacting with family members or close friends in familiar situations, whereas other situations present more of a challenge, such as when interacting with strangers in novel contexts. The current literature provides preliminary support for this possibility, but more ecologically valid approaches are necessary to provide a rigorous test. Just as importantly, tests of this possibility should also assess possible mediating mechanisms of such effects. How does effort valuation vary with family, friends, and strangers, and across familiar and unfamiliar situations? What role does effort play in such situations, and what role is played by increased reliance on automatic processes? How are capacity and motivation influenced under such circumstances, and what effect do they have on each other? And how do all these processes play out in relation to the four individual processes of social perception, ToM, affective empathy, and social behavior? The field of social cognitive aging has gathered an enormous amount of valuable information about these processes in controlled laboratory experiments, and the next critical step is to understand when and how these laboratory results have consequences for the social functioning of older adults in their everyday lives.

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LITERATURE CITED

Ardelt M, Edwards CA. 2016. Wisdom at the end of life: an analysis of mediating and moderating relations between wisdom and subjective well-being. *J. Gerontol. B Psychol. Sci. Soc. Sci.* 71:502–13

Baez-Jurado E, Rincon-Benavides MA, Hidalgo-Lanussa O, Guio-Vega G, Ashraf GM, et al. 2019. Molecular mechanisms involved in the protective actions of selective estrogen receptor modulators in brain cells. *Front. Neuroendocrinol.* 52:44–64

Bayer M, Berhe O, Dziobek I, Johnstone T. 2021. Rapid neural representations of personally relevant faces. *Cereb. Cortex* 31:4699–708

Beadle JN, Sheehan AH, Dahlben B, Gutchess AH. 2015. Aging, empathy, and prosociality. *J. Gerontol. B Psychol. Sci. Soc. Sci.* 70:215–24

Best R, Freund AM. 2021. Beyond money: nonmonetary prosociality across adulthood. *Psychol. Aging* 36:96–107

Brodaty H, Altendorf A, Withall A, Sachdev P. 2010. Do people become more apathetic as they grow older? A longitudinal study in healthy individuals. *Int. Psychogeriatr.* 22:426–36

Bunt S, Steverink N, Olthof J, van der Schans CP, Hobbelen JSM. 2017. Social frailty in older adults: a scoping review. *Eur. J. Ageing* 14:323–34

Cabeza R, Albert M, Belleville S, Craik FIM, Duarte A, et al. 2018. Maintenance, reserve and compensation: the cognitive neuroscience of healthy ageing. *Nat. Rev. Neurosci.* 19:701–10

Cacioppo JT, Berntson GG, Bechara A, Tranel D, Hawkley LC. 2011. Could an aging brain contribute to subjective well-being? The value added by a social neuroscience perspective. In *Social Neuroscience: Toward Understanding the Underpinnings of the Social Mind*, ed. A Todorov, ST Fiske, D Prentice, pp. 249–62. New York: Oxford Univ. Press

Cameron CD, Hutcherson CA, Ferguson AM, Scheffer JA, Hadjiandreou E, Inzlicht M. 2019. Empathy is hard work: People choose to avoid empathy because of its cognitive costs. *J. Exp. Psychol. Gen.* 148:962–76

Carson DS, Berquist SW, Trujillo TH, Garner JP, Hannah SL, et al. 2015. Cerebrospinal fluid and plasma oxytocin concentrations are positively correlated and negatively predict anxiety in children. *Mol. Psychiatry* 20:1085–90

Carstensen LL. 2021. Socioemotional selectivity theory: the role of perceived endings in human motivation. *Gerontologist* 61:1188–96

Cavallini E, Ceccato I, Bertoglio S, Francescani A, Vigato F, et al. 2021. Can theory of mind of healthy older adults living in a nursing home be improved? A randomized controlled trial. *Aging Clin. Exp. Res.* 33:3029–37

Ceccato I, Lecce S, Cavallini E. 2020. Older adults' beliefs about their ability to understand others' mental states. *J. Adult Dev.* 27:294–304

Ceccato I, Lecce S, Cavallini E, Vugt FTV, Ruffman T. 2019. Motivation and social-cognitive abilities in older adults: convergent evidence from self-report measures and cardiovascular reactivity. *PLOS ONE* 14:e0218785

Chen YC, Chen CC, Decety J, Cheng Y. 2014. Aging is associated with changes in the neural circuits underlying empathy. *Neurobiol. Aging* 35:827–36

Chiarelli TM, Batistoni SST. 2021. An analysis of socioemotional selectivity theory in the context of older adults' use of Facebook. *Educ. Gerontol.* 47:13–24

Cho I, Cohen AS. 2019. Explaining age-related decline in theory of mind: evidence for intact competence but compromised executive function. *PLOS ONE* 14:e0222890

Chong TT, Apps M, Giehl K, Sillence A, Grima LL, Husain M. 2017. Neurocomputational mechanisms underlying subjective valuation of effort costs. *PLOS Biol.* 15:e1002598

Christensen JA, Sis J, Kulkarni AM, Chatterjee M. 2019. Effects of age and hearing loss on the recognition of emotions in speech. *Ear Hear*. 40:1069–83
Chu L, Fung HH. 2022. Age differences in state curiosity: examining the role of personal relevance. *Gerontology* 68(3):321–29
Coelho A, Magalhães R, Moreira PS, Amorim L, Portugal-Nunes C, et al. 2022. A novel method for estimating connectivity-based parcellation of the human brain from diffusion MRI: application to an aging cohort. *Hum. Brain Mapp*. 43(8):2419–43
Cohen-Zimerman S, Khilwani H, Smith GNL, Krueger F, Gordon B, Grafman J. 2021. The neural basis for mental state attribution: a voxel-based lesion mapping study. *Hum. Brain Mapp.* 42(1):65–79
Craik FIM, Jacoby LL. 1996. Aging and memory: implications for skilled performance. In *Aging and Skilled Performance: Advances in Theory and Applications*, ed. WA Rogers, AD Fisk, N Walker, pp. 113–37. Mahwah, NJ: Erlbaum
Darby RR, Joutsa J, Burke MJ, Fox MD. 2018. Lesion network localization of free will. *PNAS* 115:10792–97
de Boer MJ, Jurgens T, Baskent D, Cornelissen FW. 2021. Auditory and visual integration for emotion recognition and compensation for degraded signals are preserved with age. *Trends Hear*. 25:23312165211045306
de Kerangal M, Vickers D, Chait M. 2021. The effect of healthy aging on change detection and sensitivity to predictable structure in crowded acoustic scenes. *Hear. Res.* 399:108074
De Lillo M, Foley R, Fysh MC, Stimson A, Bradford EEF, et al. 2021. Tracking developmental differences in real-world social attention across adolescence, young adulthood and older adulthood. *Nat. Hum. Behav.* 5:1381–90
de Waal FBM, Preston SD. 2017. Mammalian empathy: behavioural manifestations and neural basis. *Nat. Rev. Neurosci.* 18:498–509
Depow GJ, Francis Z, Inzlicht M. 2021. The experience of empathy in everyday life. *Psychol. Sci.* 32:1198–213
Devesse A, van Wieringen A, Wouters J. 2021. The cost of intrinsic and extrinsic cognitive demands on auditory functioning in older adults with normal hearing or using hearing aids. *Ear Hear*. 42:615–28
Dupuis K, Pichora-Fuller MK. 2015. Aging affects identification of vocal emotions in semantically neutral sentences. *J. Speech Lang. Hear. Res.* 58:1061–76
Dziura SL, Thompson JC. 2020. Temporal dynamics of the neural representation of social relationships. *J. Neurosci.* 40:9078–87
Ebner NC, Kamin H, Diaz V, Cohen RA, MacDonald K. 2014. Hormones as "difference makers" in cognitive and socioemotional aging processes. *Front. Psychol.* 5:1595
Ferguson AM, Cameron CD, Inzlicht M. 2020. Motivational effects on empathic choices. *J. Exp. Soc. Psychol.* 90:104010
Fiske ST, Taylor SE. 1991. *Social Cognition*. New York: McGraw-Hill
Frazier I, Lin T, Liu P, Skarsten S, Feifel D, Ebner NC. 2021. Age and intranasal oxytocin effects on trust-related decisions after breach of trust: behavioral and brain evidence. *Psychol. Aging* 36:10–21
Fung HH, Chu STW, Jiang D, Chen AXQ, Ng CC. 2020. Contrasting the effects of mortality salience and future time limitation on goal prioritization in older and younger adults. *J. Gerontol. B Psychol. Sci. Soc. Sci.* 75:2112–21
Fung HH, Lu M, Isaacowitz DM. 2019. Aging and attention: Meaningfulness may be more important than valence. *Psychol. Aging* 34:85–90
Gamsakhurdashvili D, Antov MI, Lubke KT, Pause BM, Stockhorst U. 2021. The role of olfaction and sex-hormone status in empathy-related measures. *Physiol. Behav.* 230:113289
Gonçalves AR, Fernandes C, Pasion R, Ferreira-Santos F, Barbosa F, Marques-Teixeira J. 2018. Emotion identification and aging: behavioral and neural age-related changes. *Clin. Neurophysiol.* 129:1020–29
Gong X, Freund AM. 2020. It is what you have, not what you lose: effects of perceived gains and losses on goal orientation across adulthood. *J. Gerontol. B Psychol. Sci. Soc. Sci.* 75:2106–11
Gong X, Zhang F, Fung HH. 2019. Are older adults more willing to donate? The roles of donation form and social relationship. *J. Gerontol. B Psychol. Sci. Soc. Sci.* 74:440–48
Gottlich M, Buades-Rotger M, Wiechert J, Beyer F, Kramer UM. 2021. Structural covariance of amygdala subregions is associated with trait aggression and endogenous testosterone in healthy individuals. *Neuropsychologia* 165:108113

Gourlay C, Collin P, D'Auteuil C, Jacques M, Caron PO, Scherzer PB. 2021. Age differences in social-cognitive abilities across the stages of adulthood and path model investigation of adult social cognition. *Neuropsychol. Dev. Cogn. B Aging Neuropsychol. Cogn.* In press. **https://doi.org/10.1080/13825585.2021.1962789**

Grainger SA, Henry JD. 2020. Gaze patterns to emotional faces throughout the adult lifespan. *Psychol. Aging* 35:981–92

Grainger SA, Henry JD, Naughtin CK, Comino MS, Dux PE. 2018a. Implicit false belief tracking is preserved in late adulthood. *Q. J. Exp. Psychol.* 71:1980–87

Grainger SA, Henry JD, Steinvik HR, Vanman EJ, Rendell PG, Labuschagne I. 2018b. Intranasal oxytocin does not reduce age-related difficulties in social cognition. *Horm. Behav.* 99:25–34

Grainger SA, Mead JK, Vanman EJ, Henry JD. 2021a. The relationship between testosterone and social cognition in younger and older adults. *Biol. Psychol.* 161:108072

Grainger SA, Rakunathan V, Adams AG, Canty AL, Henry JD. 2021b. An assessment of age differences in theory of mind using the virtual assessment of mentalizing ability. *Neuropsychol. Dev. Cogn. B Aging Neuropsychol. Cogn.* 28:97–107

Grainger SA, Steinvik HR, Henry JD, Phillips LH. 2019a. The role of social attention in older adults' ability to interpret naturalistic social scenes. *Q. J. Exp. Psychol.* 72:1328–43

Grainger SA, Vanman EJ, Matters G, Henry JD. 2019b. The influence of tears on older and younger adults' perceptions of sadness. *Psychol. Aging* 34:665–73

Grossmann I, Na J, Varnum ME, Park DC, Kitayama S, Nisbett RE. 2010. Reasoning about social conflicts improves into old age. *PNAS* 107:7246–50

Halberstadt J, Ruffman T, Murray J, Taumoepeau M, Ryan M. 2011. Emotion perception explains age-related differences in the perception of social gaffes. *Psychol. Aging* 26:133–36

Happé FG, Winner E, Brownell H. 1998. The getting of wisdom: theory of mind in old age. *Dev. Psychol.* 34:358–62

Hasher L, Zacks RT. 1988. Working memory, comprehension, and aging: a review and a new view. In *The Psychology of Learning and Motivation*, Vol. 22, ed. GH Bower, pp. 193–225. New York: Academic

Hayes GS, McLennan SN, Henry JD, Phillips LH, Terrett G, et al. 2020. Task characteristics influence facial emotion recognition age-effects: a meta-analytic review. *Psychol. Aging* 35:295–315

Henry JD, Phillips LH, Ruffman T, Bailey PE. 2013. A meta-analytic review of age differences in theory of mind. *Psychol. Aging* 28:826–39

Henry JD, von Hippel W, Baynes K. 2009. Social inappropriateness, executive control, and aging. *Psychol. Aging* 24:239–44

Henry JD, von Hippel W, Molenberghs P, Lee T, Sachdev PS. 2016. Clinical assessment of social cognitive function in neurological disorders. *Nat. Rev. Neurol.* 12:28–39

Hess TM. 2014. Selective engagement of cognitive resources: motivational influences on older adults' cognitive functioning. *Perspect. Psychol. Sci.* 9:388–407

Hess TM, Lothary AF, O'Brien EL, Growney CM, DeLaRosa J. 2021. Predictors of engagement in young and older adults: the role of specific activity experience. *Psychol. Aging* 36:131–42

Hess TM, Smith BT, Sharifian N. 2016. Aging and effort expenditure: the impact of subjective perceptions of task demands. *Psychol. Aging* 31:653–60

Homan AC, Van Kleef GA, Sanchez-Burks J. 2016. Team members' emotional displays as indicators of team functioning. *Cogn. Emot.* 30:134–49

Hsu CK, Ney LJ, Honan C, Felmingham KL. 2021. Gonadal steroid hormones and emotional memory consolidation: a systematic review and meta-analysis. *Neurosci. Biobehav. Rev.* 130:529–42

Huhnel I, Folster M, Werheid K, Hess U. 2014. Empathic reactions of younger and older adults: no age related decline in affective responding. *J. Exp. Soc. Psychol.* 50:136–43

Isaacowitz DM, Stanley JT. 2011. Bringing an ecological perspective to the study of aging and recognition of emotional facial expressions: past, current, and future methods. *J. Nonverbal Behav.* 35:261–78

Johansson Nolaker E, Murray K, Happe F, Charlton RA. 2018. Cognitive and affective associations with an ecologically valid test of theory of mind across the lifespan. *Neuropsychology* 32:754–63

Katzorreck M, Kunzmann U. 2018. Greater empathic accuracy and emotional reactivity in old age: the sample case of death and dying. *Psychol. Aging.* 33:1202–14

Krendl AC, Kennedy DP, Hugenberg K, Perry BL. 2021. Social cognitive abilities predict unique aspects of older adults' personal social networks. *J. Gerontol. B Psychol. Sci. Soc. Sci.* 77:18–28
Kunzmann U, Isaacowitz D. 2017. Emotional aging: taking the immediate context seriously. *Res. Hum. Dev.* 14:182–99
Laillier R, Viard A, Caillaud M, Duclos H, Bejanin A, et al. 2019. Neurocognitive determinants of theory of mind across the adult lifespan. *Brain Cogn.* 136:103588
Lam J, Aftab A, Lee E, Jeste D. 2020. Positive psychiatry interventions in geriatric mental health. *Curr. Treat. Options Psychiatry* 7:471–88
Lang FR, Wagner J, Wrzus C, Neyer FJ. 2013. Perceived relationship effort is also more pronounced and more strongly associated with emotional closeness in older adulthood than in younger adults, or midlife. *Psychol. Aging* 28:529–39
Lecce S, Ceccato I, Bianco F, Rosi A, Bottiroli S, Cavallini E. 2017. Theory of mind and social relationships in older adults: the role of social motivation. *Aging Ment. Health* 21:253–58
Lecce S, Ceccato I, Cavallini E. 2019. Theory of mind, mental state talk and social relationships in aging: the case of friendship. *Aging Ment. Health* 23:1105–12
Lee EE, Depp C, Palmer BW, Glorioso D, Daly R, et al. 2019. High prevalence and adverse health effects of loneliness in community-dwelling adults across the lifespan: role of wisdom as a protective factor. *Int. Psychogeriatr.* 31(10):1447–62
Liefooghe B, Jim A, De Houwer J. 2021. Automatic effects of covert practice. *Q. J. Exp. Psychol.* 74:1697–708
Lindenberger U, Mayr U. 2014. Cognitive aging: Is there a dark side to environmental support? *Trends Cogn. Sci.* 18:7–15
Lockwood PL, Abdurahman A, Gabay AS, Drew D, Tamm M, et al. 2021. Aging increases prosocial motivation for effort. *Psychol. Sci.* 32:668–81
Luo MX, Edelsbrunner PA, Siebert JS, Martin M, Aschwanden D. 2021. Longitudinal within-person associations between quality of social relations, structure of social relations, and cognitive functioning in older age. *J. Gerontol. B Psychol. Sci. Soc. Sci.* 76:1960–71
Makizako H, Shimada H, Tsutsumimoto K, Lee S, Doi T, et al. 2015. Social frailty in community-dwelling older adults as a risk factor for disability. *J. Am. Med. Dir. Assoc.* 16(11):1003.e7–11
Martin AK, Perceval G, Davies I, Su P, Huang J, Meinzer M. 2019. Visual perspective taking in young and older adults. *J. Exp. Psychol. Gen.* 148:2006–26
Mather M. 2016. The affective neuroscience of aging. *Annu. Rev. Psychol.* 67:213–38
Mayr U, Spieler DH, Hutcheon TG. 2015. When and why do old adults outsource control to the environment? *Psychol. Aging* 30:624–33
McGarrigle R, Knight S, Rakusen L, Geller J, Mattys S. 2021. Older adults show a more sustained pattern of effortful listening than young adults. *Psychol. Aging* 36:504–19
McKay KT, Grainger SA, Coundouris SP, Skorich D, Phillips LH, Henry JD. 2021. Social orienting of attention: a meta-analytic review of the gaze-cueing effect. *Psychol. Bull.* 147(12):1269–89
McKay KT, Talipski LA, Grainger SA, Alister M, Henry JD. 2022. How does aging affect social attention? A test of competing theories using multilevel meta-analysis. *J. Gerontol. B Psychol. Sci. Soc. Sci.* 77(8):1454–63
Noh SR, Isaacowitz DM. 2013. Emotional faces in context: age differences in recognition accuracy and scanning patterns. *Emotion* 13(2):238–49
O'Brien EL, Hess TM. 2020. Perceived benefits and costs contribute to young and older adults' selectivity in social relationships. *GeroPsych* 33:42–51
Oschwald J, Guye S, Liem F, Rast P, Willis S, et al. 2019. Brain structure and cognitive ability in healthy aging: a review on longitudinal correlated change. *Rev. Neurosci.* 31:1–57
Ou JX, Wu Y, Hu Y, Gao XX, Li H, Tobler PN. 2021. Testosterone reduces generosity through cortical and subcortical mechanisms. *PNAS* 118:e2021745118
Park DC, Reuter-Lorenz P. 2009. The adaptive brain: aging and neurocognitive scaffolding. *Annu. Rev. Psychol.* 60:173–96
Pataky MW, Young WF, Nair KS. 2021. Hormonal and metabolic changes of aging and the influence of lifestyle modifications. *Mayo Clin. Proc.* 96:788–814
Petro NM, Basyouni R, Neta M. 2021. Positivity effect in aging: evidence for the primacy of positive responses to emotional ambiguity. *Neurobiol. Aging* 106:232–40

Phillips LH, Allen R, Bull R, Hering A, Kliegel M, Channon S. 2015. Older adults have difficulty in decoding sarcasm. *Dev. Psychol.* 51:1840–52
Phillips LH, Bull R, Allen R, Insch P, Burr K, Ogg W. 2011. Lifespan aging and belief reasoning: influences of executive function and social cue decoding. *Cognition* 120(2):236–47
Phillips LH, Scott C, Henry JD, Mowat D, Bell JS. 2010. Emotion perception in Alzheimer's disease and mood disorder in old age. *Psychol. Aging* 25:38–47
Pinquart M, Sorensen S. 2001. Influences on loneliness in older adults: a meta-analysis. *Basic Appl. Soc. Psych.* 23:245–66
Plasencia G, Luedicke JM, Nazarloo HP, Carter CS, Ebner NC. 2019. Plasma oxytocin and vasopressin levels in young and older men and women: functional relationships with attachment and cognition. *Psychoneuroendocrinology* 110:104419
Premack D, Woodruff G. 1978. Does the chimpanzee have a theory of mind? *Behav. Brain Sci.* 1:515–26
Pushkar D, Basevitz P, Arbuckle T, Nohara-LeClair M, Lapidus S, Peled M. 2000. Social behavior and off-target verbosity in elderly people. *Psychol. Aging* 15:361–74
Quintana DS, Lischke A, Grace S, Scheele D, Ma Y, Becker B. 2021. Advances in the field of intranasal oxytocin research: lessons learned and future directions for clinical research. *Mol. Psychiatry* 26:80–91
Rahman F, Kessler K, Apperly IA, Hansen PC, Javed S, et al. 2021. Sources of cognitive conflict and their relevance to theory-of-mind proficiency in healthy aging: a preregistered study. *Psychol. Sci.* 32:1918–36
Rauers A, Blanke E, Riediger M. 2013. Everyday empathic accuracy in younger and older couples: Do you need to see your partner to know his or her feelings? *Psychol. Sci.* 24:2210–17
Reas ET, Hagler DJ Jr., Andrews MJ, Lee RR, Dale AM, McEvoy LK. 2020. Associations between age and brain microstructure in older community-dwelling men and women: the Rancho Bernardo Study. *Neurobiol. Aging* 95:94–103
Reiter AMF, Kanske P, Eppinger B, Li SC. 2017. The aging of the social mind—differential effects on components of social understanding. *Sci. Rep.* 7:11046
Richter D, Kunzmann U. 2011. Age differences in three facets of empathy: performance-based evidence. *Psychol. Aging* 26:60–70
Riva F, Tschernegg M, Chiesa PA, Wagner IC, Kronbichler M, et al. 2018. Age-related differences in the neural correlates of empathy for pleasant and unpleasant touch in a female sample. *Neurobiol. Aging* 65:7–17
Ronay R, Carney DR. 2013. Testosterone's negative relationship with empathic accuracy and perceived leadership ability. *Soc. Psychol. Pers. Sci.* 4:92–99
Rosati AG, Hagberg L, Enigk DK, Otali E, Emery Thompson M, et al. 2020. Social selectivity in aging wild chimpanzees. *Science* 370:473–76
Rubio-Fernandez P. 2017. The director task: a test of Theory-of-Mind use or selective attention? *Psychon. Bull. Rev.* 24(4):1121–28
Ruffman T, Halberstadt J, Murray J, Jack F, Vater T. 2020. Empathic accuracy: worse recognition by older adults and less transparency in older adult expressions compared with young adults. *J. Gerontol. B Psychol. Sci. Soc. Sci.* 75:1658–67
Ruffman T, Murray J, Halberstadt J, Taumoepeau M. 2010. Verbosity and emotion recognition in older adults. *Psychol. Aging* 25:492–97
Ruffman T, Wilson M, Henry JD, Dawson A, Chen Y, et al. 2016. Age differences in right-wing authoritarianism and their relation to emotion recognition. *Emotion* 16(2):226–36
Rutter LA, Dodell-Feder D, Vahia IV, Forester BP, Ressler KJ, et al. 2019. Emotion sensitivity across the lifespan: mapping clinical risk periods to sensitivity to facial emotion intensity. *J. Exp. Psychol. Gen.* 148:1993–2005
Salthouse TA. 2019. Trajectories of normal cognitive aging. *Psychol. Aging* 34:17–24
Schlegel K, Vicaria IM, Isaacowitz DM, Hall JA. 2017. Effectiveness of a short audiovisual emotion recognition training program in adults. *Motiv. Emot.* 41:646–60
Schnitzspahn KM, Plessow F, Kirschbaum C, Wong YH, Kliegel M. 2022. Acute psychosocial stress impairs intention initiation in young but not older adults. *Psychoneuroendocrinology* 135:105593
Schurz M, Radua J, Tholen MG, Maliske L, Margulies DS, et al. 2021. Toward a hierarchical model of social cognition: a neuroimaging meta-analysis and integrative review of empathy and theory of mind. *Psychol. Bull.* 147:293–327

Sharifian N, Kraal AZ, Zaheed AB, Sol K, Zahodne LB. 2020. The longitudinal association between social network composition and episodic memory in older adulthood: the importance of contact frequency with friends. *Aging Ment. Health* 24:1789–95

Shirazi TN, Rosenfield KA, Cardenas RA, Breedlove SM, Puts DA. 2020. No evidence that hormonal contraceptive use or circulating sex steroids predict complex emotion recognition. *Horm. Behav.* 119:104647

Shuster MM, Mikels JA, Camras LA. 2017. Adult age differences in the interpretation of surprised facial expressions. *Emotion* 17:191–95

Sklenar AM, Mienaltowski A. 2019. The impact of emotional faces on younger and older adults' attentional blink. *Cogn. Emot.* 33:1436–47

Sliwinski MJ, Freed S, Scott SB, Pasquini G, Smyth JM. 2021. Does chronic stress moderate age differences in emotional well-being? Testing predictions of strength and vulnerability integration. *J. Gerontol. B Psychol. Sci. Soc. Sci.* 76(6):1104–13

Sparrow EP, Spaniol J. 2018. Aging and altruism in intertemporal choice. *Psychol. Aging* 33:315–24

Sprague BN, Zhu X, Ehrenkranz RC, Tian Q, Gmelin TA, et al. 2021. Declining energy predicts incident mobility disability and mortality risk in healthy older adults. *J. Am. Geriatr. Soc.* 69:3134–41

Stanley JT, Isaacowitz DM. 2015. Caring more and knowing more reduces age-related differences in emotion perception. *Psychol. Aging* 30:383–95

Stanley JT, Webster BA. 2019. A comparison of the effectiveness of two types of deceit detection training methods in older adults. *Cogn. Res. Princ. Implic.* 4:26

Stephenson LJ, Edwards SG, Bayliss AP. 2021. From gaze perception to social cognition: the shared-attention system. *Perspect. Psychol. Sci.* 16(3):553–76

Stern Y, Barnes CA, Grady C, Jones RN, Raz N. 2019. Brain reserve, cognitive reserve, compensation, and maintenance: operationalization, validity, and mechanisms of cognitive resilience. *Neurobiol. Aging* 83:124–29

Suddendorf T, Corballis MC. 2010. Behavioural evidence for mental time travel in nonhuman animals. *Behav. Brain Res.* 215:292–98

Sun B, Luo Z, Zhang W, Li W, Li X. 2018. Age-related differences in affective and cognitive empathy: self-report and performance-based evidence. *Neuropsychol. Dev. Cogn. B Aging Neuropsychol. Cogn.* 25:655–72

Sze JA, Gyurak A, Goodkind MS, Levenson RW. 2012. Greater emotional empathy and prosocial behavior in late life. *Emotion* 12(5):1129–40

Szymkowicz SM, Persson J, Lin T, Fischer H, Ebner NC. 2016. Hippocampal brain volume is associated with faster facial emotion identification in older adults: preliminary results. *Front. Aging Neurosci.* 8:203

Tsoi L, Dungan JA, Chakroff A, Young LL. 2018. Neural substrates for moral judgments of psychological versus physical harm. *Soc. Cogn. Affect. Neurosci.* 13:460–70

Velanova K, Lustig C, Jacoby LL, Buckner RL. 2007. Evidence for frontally mediated controlled processing differences in older adults. *Cereb. Cortex* 17:1033–46

Vetter NC, Oosterman JM, Muhlbach J, Wolff S, Altgassen M. 2020. The impact of emotional congruent and emotional neutral context on recognizing complex emotions in older adults. *Neuropsychol. Dev. Cogn. B Aging Neuropsychol. Cogn.* 27:677–92

Vinke EJ, de Groot M, Venkatraghavan V, Klein S, Niessen WJ, et al. 2018. Trajectories of imaging markers in brain aging: the Rotterdam Study. *Neurobiol. Aging* 71:32–40

von Hippel W, Dunlop SM. 2005. Aging, inhibition, and social inappropriateness. *Psychol. Aging* 20:519–23

Wang Y, Metoki A, Xia Y, Zang Y, He Y, Olson IR. 2021. A large-scale structural and functional connectome of social mentalizing. *Neuroimage* 236:118115

Wang Y, Song J, Guo F, Zhang Z, Yuan S, Cacioppo S. 2016. Spatiotemporal brain dynamics of empathy for pain and happiness in friendship. *Front. Behav. Neurosci.* 10:45

Westbrook A, Kester D, Braver TS. 2013. What is the subjective cost of cognitive effort? Load, trait, and aging effects revealed by economic preference. *PLOS ONE* 8:e68210

Wieck C, Kunzmann U. 2015. Age differences in empathy: multidirectional and context-dependent. *Psychol. Aging* 30:407–19

Wieck C, Kunzmann U, Scheibe S. 2021. Empathy at work: the role of age and emotional job demands. *Psychol. Aging* 36:36–48

Wondra JD, Ellsworth PC. 2015. An appraisal theory of empathy and other vicarious emotional experiences. *Psychol. Rev.* 122:411–28

Wu Y, Zhang Y, Ou J, Hu Y, Zilioli S. 2020. Exogenous testosterone increases the audience effect in healthy males: evidence for the social status hypothesis. *Proc. Biol. Sci.* 287:20200976

Zahn R, Green S, Beaumont H, Burns A, Moll J, et al. 2017. Frontotemporal lobar degeneration and social behaviour: dissociation between the knowledge of its consequences and its conceptual meaning. *Cortex* 93:107–18

Ze O, Thoma P, Suchan B. 2014. Cognitive and affective empathy in younger and older individuals. *Aging Ment. Health* 18:929–35

Zhang X, Fung HH, Stanley JT, Isaacowitz DM, Ho MY. 2013. Perspective taking in older age revisited: a motivational perspective. *Dev. Psychol.* 49:1848–58

Zhang X, Lecce S, Ceccato I, Cavallini E, Zhang L, Chen T. 2018. Plasticity in older adults' theory of mind performance: the impact of motivation. *Aging Ment. Health* 22:1592–99