

# Rethinking Social Relationships in Adulthood: The Differential Investment of Resources Model

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## Abstract

Empirical evidence about the development of social relationships across adulthood into late life continues to accumulate, but theoretical development has lagged behind. The Differential Investment of Resources (DIRe) model integrates these empirical advances. The model defines the investment of time and energy into social ties varying in terms of emotional closeness and kinship as the core mechanism explaining the formation and maintenance of social networks. Individual characteristics, acting as capacities, motivations, and skills, determine the amount, direction, and efficacy of the investment. The context (e.g., the living situation) affects the social opportunity structure, the amount of time and energy available, and individual characteristics. Finally, the model describes two feedback loops: (a) social capital affecting the individual's living situation and (b) different types of ties impacting individual characteristics via social exchanges, social influences, and social evaluations. The proposed model will provide a theoretical basis for future research and hypothesis testing.

## Keywords

close relationships, individual differences, well-being, social development

Social relationships play a particularly crucial role late in life when individuals increasingly rely on their network members for support in the face of physical and cognitive decline (Antonucci et al., 2014; Pinquart & Sorensen, 2000). However, these social networks develop over the course of a lifetime. As social beings, humans are constantly engaging in interactions with others; it is the accumulation of social interactions that creates a network of ties to others that moves with us through the life course (i.e., the social convoy; Antonucci et al., 2014). Individuals invest substantial amounts of time and energy into relationships with partners, family members, friends, and acquaintances, to name a few. This investment is essential for individual functioning (Berkman et al., 2000), as social ties can provide support (Cohen, 2004), stimulation (Okun et al., 1984), and a sense of belonging (Baumeister & Leary, 1995), all of which promote subjective well-being. At the same time, social ties can hinder individual functioning by creating strain (Rook, 2015) and exerting social pressure (Cohen & Lemay, 2007), and low-quality ties can result in loneliness (Hawkey & Cacioppo, 2010).

The empirical evidence concerned with the centrality of social relationships with effective functioning in adulthood, and older adulthood in particular, continues to accumulate. This evidence has led scholars to realize the complexity, dynamism, and multifaceted nature of social relationships across the adult lifespan. Furthermore, demographic changes and historical shifts (e.g., historical delays in childbearing

and marriage) necessitate the need for a flexible theoretical framework that can explain not only the already existing heterogeneity of social networks but can also account for ongoing socio-historical changes (Fiori et al., 2020). Some existing frameworks addressing social relationships in older adults acknowledge the important role of context in shaping social ties (e.g., Antonucci et al., 2014; Blieszner et al., 2019) but are difficult to examine empirically because they do not posit specific testable mechanisms. On the contrary, those models that do offer empirically testable mechanisms for change (Carstensen, 1992; Charles, 2010) do not comprehensively account for the vast heterogeneity of older adults (Nelson & Dannefer, 1992), the diversity of social functions provided by different types of ties (Huxhold et al., 2020; Sutcliffe et al., 2012; Weiss, 1974), or the influence of the context (Fiori et al., 2020; Huxhold & Fiori, 2019), which encompasses other organisms, physical environments, and proximal (e.g., family) and distal (e.g., politics and social policy) social institutions (Lerner, 1991).

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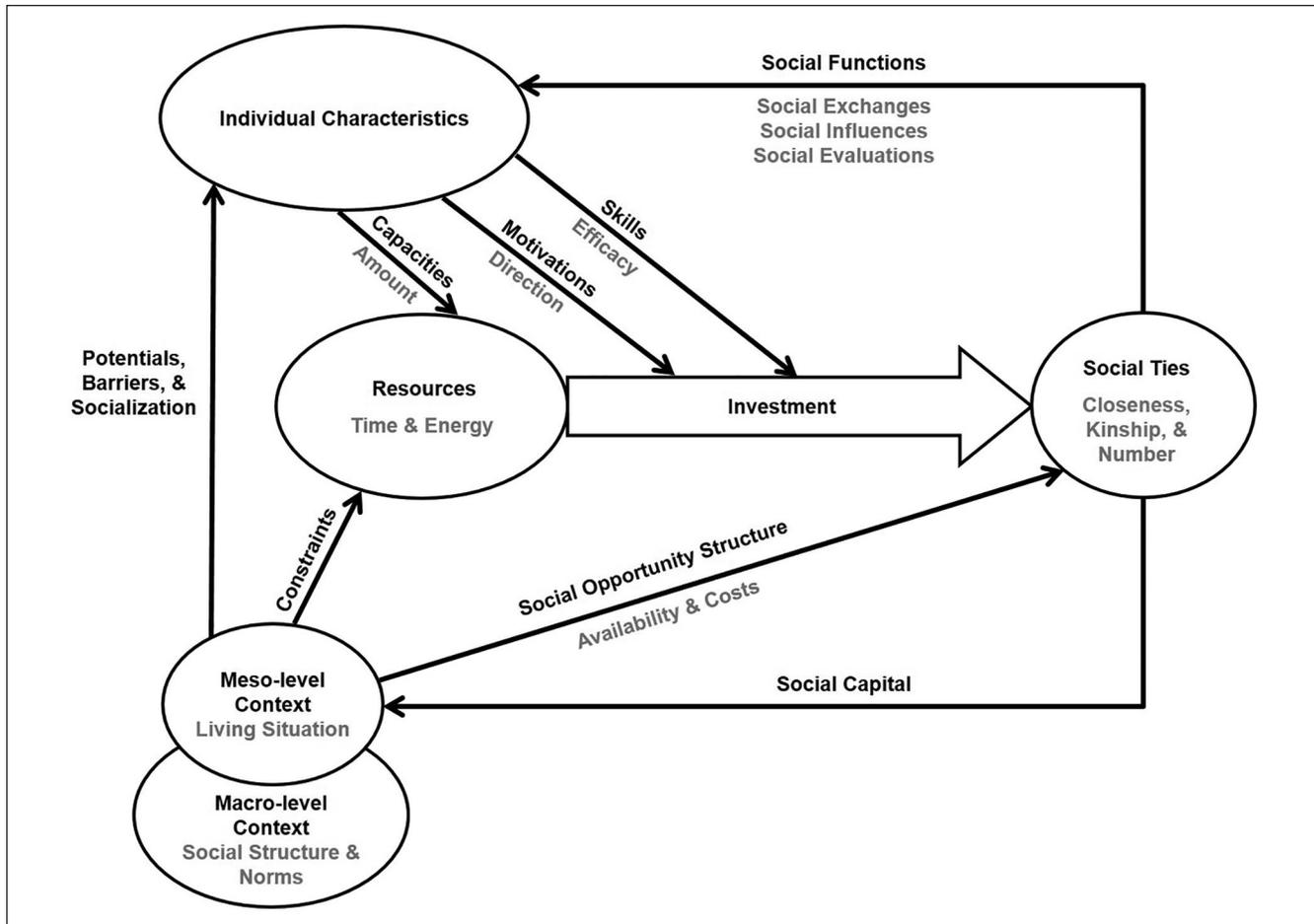
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**Figure 1.** Differential Investment in Resources Model (DIRe Model).  
Note. Arrows denote processes.

The COVID-19 crisis demonstrated all too clearly the powerful role of contextual conditions in shaping social relationships. That is, during the pandemic, required social distancing nearly completely determined the types and amounts of social interactions that were possible. In particular, social interactions were reduced to those with only our closest ties (e.g., household members) or to exchanges via the phone or internet (Birditt, Turkelson, et al., 2020; Fingerman et al., 2020). Models that place too much emphasis on individual agency and ignore the context cannot derive a full understanding of changes in social relationships. Given that theories of general development are so strongly rooted in interactive effects (e.g., Baltes et al., 1980; Lerner, 1991), it is clear that models of development in social relationships across middle age and into late adulthood should be equally focused on the interactions between the individual and their developmental context.

In this article, we present a new conceptual model—the Differential Investment of Resources (DIRe) model—that offers both a comprehensive understanding of context (Fiori et al., 2020) and specific testable mechanisms to understand

the development of social relationships across the adult lifespan. We believe that this model not only effectively incorporates the large body of existing empirical work but also provides a sound theoretical basis for future research and hypothesis testing in the field. The DIRe model is driven by a social network approach, considering different types of relationships as well as interdependencies among relationships. Thus, in this introduction to the full DIRe model, our focus is not on specific dyadic processes. However, we briefly address how dyadic processes could be incorporated into our model in the Discussion. Furthermore, although we believe that the model potentially holds across the adult lifespan, in the present article, we focus on its applicability in particular to changes in social relationships in middle age into late life.

### The DIRe Model

The DIRe model builds on and extends existing models and theories (Figure 1). The model uses a dynamic social network approach in which the aging individual—sometimes

**Table 1.** Key Terms and Definitions.

Key terms	Definitions
Social ties	All persons for which the ego has: (a) subjective awareness; (b) a mental representation of how they relate; and (c) a belief in their mutual influence on each other
Closeness	The individual's evaluation of how central a specific tie is to their day-to-day quality of emotional experience
Kinship	A mental construct encapsulating the expectation that a specific tie will provide support in times of need, stemming from genetic relatedness, societally institutionalized processes and norms, and/or mutual discourse
Resources	Available time and energy
Investment	The amount of time and energy devoted to create and/or maintain social ties
Energy	The perceived potential to perform a task
Individual characteristics	Inter- and intraindividual differences that influence the investment process
Capacities	Individual characteristics that affect the <i>amount</i> of time and energy that a person has available to invest into social ties (e.g., health, cognitive abilities, and emotional functioning)
Motivations	Individual characteristics that define the <i>direction</i> and <i>extent</i> of the investment of time and energy (i.e., determine in which social interactions an individual decides to invest; e.g., personality traits, future time perspectives, perceptions of aging)
Skills	Individual characteristics that influence the <i>efficacy</i> of investments into social interactions (e.g., theory of mind)
Context	Factors in the environment that are relevant for understanding the formation of social networks
Micro-level context	The social network (i.e., the sum of all social ties)
Meso-level context	The contextual entity that links the macro- to the micro-level; can be understood as the individual's living situation (e.g., geographical factors, socioeconomic conditions, and life course phases)
Macro-level context	The contextual entity that includes the social structure of the society (e.g., social and political institutions, laws, and distribution of wealth) as well as societal and cultural norms
Social opportunity structure	All potential ties in which an individual can invest (the <i>availability</i> of ties) as well as the "costs" of investment (in terms of time and energy) into those ties
Social capital	Those resources embedded in the social network that influence the individual's opportunity structure and/or the individual's living situation (e.g., bridging potential)
Social functions	The psychosocial pathways through which social ties exert an influence on the individual
Social exchanges	Interactions between the ego and a social tie that evokes either negative or positive emotional responses or can increase or decrease stress levels (e.g., social support and social strain)
Social influences	Influences that stimulate or restrict the individual's behavioral repertoire (e.g., social control)
Social evaluations	Judgments of the match between desired social goals and the actual social situation (e.g., loneliness)

called the ego—is at the center of its individual network of social ties that constantly changes across the individual's lifespan. In particular, the DIRE model is characterized by six distinct features. First, the model distinguishes between different types of "social ties" by defining two crucial dimensions—closeness and kinship. Second, the investment of time and energy is defined as the core mechanism that explains the formation and maintenance of social ties. Third, individual characteristics determine the amount of resources available (capacities), the direction of the investment (motivations), and the efficacy of the time and energy invested into social ties (skills). Fourth, the model incorporates context (a) in its effect on the social opportunity structure; (b) in its effect on time and energy; and (c) in its effect on the individual (via capacities, motivations, and skills). Fifth, the investment in social ties can provide the aging individual with the means to influence and potentially change their opportunity structure and their contextual conditions (i.e., social capital). Finally, the model describes how different

types of ties, in turn, affect individual characteristics via social functions (social exchanges, social influences, and social evaluations). In the following sections, we will explain all six defining features of the DIRE model in depth. The definitions of all central terms are captured in Table 1.

### *Defining Social Ties on Two Dimensions: Closeness and Kinship*

Whether a person is considered a *social tie* by the individual is subjective; the individual must be aware of the person, must have some mental representation of how they relate to that person, and must believe that both parties mutually influence one another. This definition of "social tie" is similar to other definitions that exist in the literature (e.g., Baumeister & Leary, 1995; Wrzus et al., 2012). Of course, any such social tie is unique and can be made up of a history of interactions and a multitude of processes at the individual and interpersonal trait and state levels (Back et al., 2011).

However, the DIRE model focuses only on two aspects of social ties that have been fundamental to empirical work on the development of social relationships in later life: *emotional closeness* and *kinship*.

*Emotional closeness* refers to the individual's evaluation of how central a specific tie is to their day-to-day quality of emotional experience; this evaluation can stem from affection, shared values and interests, and reciprocity of support but is not necessarily dependent on valence, proximity, or frequency of contact. Empirical research has identified emotional closeness as the key criterion by which individuals distinguish between different relationships (Fredrickson & Carstensen, 1990; Neyer et al., 2011).

Furthermore, relationships with kin differ from ties with non-kin in fundamental ways (e.g., Neyer et al., 2011; Smyth, 2016). Non-kin relationships tend to be formed on a voluntary basis and with peers who share characteristics, cohort experiences, and lifestyles (Knobloch et al., 2000; Standlee, 2019). In contrast, kin relationships have traditionally been considered only those relationships that are consanguineal (e.g., parent-child) and/or affinal (e.g., marriage). A genetically graded shared interest in the well-being of offspring (Burton-Chellew & Dunbar, 2015), along with the social norms of reciprocal intergenerational care expectations (Smyth, 2016), means that kin (whether directly genetically related or not) are expected to engage in mutually supportive behaviors.

Thus, *kinship* in the DIRE model encapsulates a mental construct, a defining characteristic of which is the expectation that a specific tie will provide support in times of need. This expectation *can* stem from genetic relatedness (Burton-Chellew & Dunbar, 2015) and/or societally institutionalized processes and norms (e.g., Smyth, 2016), but increasingly also from mutual discourse (Braithwaite et al., 2010). This more comprehensive definition of kinship better reflects the modern social reality of increased flexibility and greater diversity in relationships (Allan, 2008; Fiori et al., 2020) as well as the subjectivity of individuals' perceptions of "family" and "kinship" (Sanner et al., 2021). For example, it has been demonstrated that LGBTQ older adults (65+) create "intentional families" (Muraco, 2006) for both support and caregiving needs (Croghan et al., 2014) as a means to supplement or replace missing biological ties (e.g., children) or strained ties with families of origin (Muraco, 2006).

Although much of the existing literature (e.g., Fredrickson & Carstensen, 1990; Neyer et al., 2011) emphasizes that kinship is highly correlated with emotional closeness, family ties often contain a substantial amount of emotional ambivalence (Fingerman et al., 2004), and some family relationships can even be distant, neglectful, or abusive (Suter et al., 2014). Only in the special circumstance of "chosen kin" is closeness and kinship inevitably highly correlated as only very close ties will become chosen kin.

In the DIRE model, closeness and kinship are independent dimensions that define different forms of social ties. For

example, ties that are low on both closeness and kinship can be considered "weak ties" and might include coworkers, neighbors, and other acquaintances. If these weak ties become closer, they will be considered friends, irrespective of their origin. At some point, with a long-shared history, very close friendships could potentially evolve into "chosen kin." These chosen kin are then in the same "category" as close family and in fact are often referred to with familial titles (e.g., brother, aunt, or even son; Braithwaite et al., 2010; Sorkin et al., 2009).

### *A Mechanism for Changes in Social Networks: The Investment of Time and Energy*

We are not the first to recognize that the size and makeup of an individual's social network are limited by an individual's available resources (e.g., Sorkin et al., 2009). In fact, Dunbar and colleagues (e.g., Dunbar, 1993; Roberts et al., 2009) have shown that there is an upper limit to the number of social relationships an individual can maintain in his or her personal social network. The DIRE model focuses on two basic resources that we see as most significant for shaping social ties; namely, *time* and *energy*. Our fundamental assumption is that initiating and maintaining social ties requires the investment of these limited resources (see Figure 1).

*Investing time into social ties: The roles of closeness and kinship.* Investing time is a critical prerequisite not only for gaining new social ties (Hall, 2019; Hays, 1985) but also for maintaining or improving those relationships that already exist (Burt, 2000). In a study of college freshmen in their first term, Hays (1985) showed that the formation of friendships follows a specific pattern. Namely, the beginning of a successful new relationship was characterized by very frequent social interactions. Furthermore, at the onset of a new friendship, the sheer time spent together was the best predictor of felt friendship intensity. Similar patterns have emerged in more recent studies (Hall, 2019). Only when new friendships progress in terms of emotional closeness does the nature of the interactions become more important than the quantity (Hays, 1985). However, the investment of time remains important in close relationships. In fact, the closeness of relationships decays if dyads do not spend time together (e.g., Burt, 2000; Oswald & Clark, 2003; Oswald et al., 2004; Roberts & Dunbar, 2011a, 2011b). Therefore, maintaining close relationships can be very time-consuming. Surprisingly, this conclusion has rarely been acknowledged in the field of aging research, although it has been substantiated by a vast literature on relationship maintenance in romantic relationships (Ogolsky & Bowers, 2013) and friendships (Oswald et al., 2004).

As outlined earlier, kinship is a mental construct highlighting the expectation of mutual support. As such, kin relationships are less time-intensive to maintain than non-kin relations. Roberts and Dunbar (2011b) showed, for example,

that when young adults transitioned to college, the emotional closeness of the friendships they left behind decreased rather quickly over time, whereas closeness to family members largely remained at a comparable level over the course of a few months spent in absence. In other words, less time is required to keep kin relationships at a certain level of emotional closeness than to maintain friendship relationships (Roberts & Dunbar, 2011a, 2011b; Roberts et al., 2009). Although Roberts and colleagues only considered traditional definitions of “kin” (i.e., consanguineal and/or affinal), we believe that the investment process operates similarly for “chosen kin.”

*Investing energy into social ties: The roles of closeness and kinship.* The term energy is frequently used in everyday language (e.g., “I lack the energy to do X”). In addition, humans have no difficulties reporting their own energy level at any given point in time (e.g., “This morning I felt energized”) and easily estimate the amount of energy a task requires (e.g., “Today’s work will be exhausting”). Despite this, energy is a rather elusive concept in psychological science (Cardini & Freund, 2020). One general definition of *energy* (that we adopt in the DIRE model) is that the term describes the perceived potential to perform a task (Cardini & Freund, 2020). Effort denotes, in contrast, the experienced intensity of mental or physical activity (Inzlicht et al., 2018). In other words, effort is the subjective amount of energy people invest into a task (Cardini & Freund, 2020; Inzlicht et al., 2018).

In the DIRE model, we assume that forming and maintaining ties requires not only time but also *energy*. The main reason for this assumption is research suggesting that to maintain a specific social relationship, with all its hassles and uplifts, effort is needed (Ogolsky & Bowers, 2013; Sorkin et al., 2009). In addition to physical activities, such as performing social activities together, social interactions may require, for example, effortful mental processes like self-presentation, affect regulation, and suppression of socially inappropriate behavior, all of which have been discussed under the heading of “self-regulatory behaviors” (Diamond et al., 2011; Gosnell et al., 2011; Henry et al., 2009; Vohs et al., 2005). In fact, high capacities for self-regulation conceptualized as a trait have been found to be beneficial for social relationships in general (Tangney et al., 2004) as well as for romantic relationships in particular (Finkel & Campbell, 2001; Luchies et al., 2011).

To date, there is an ongoing debate about whether or not repeated acts of self-regulation draw from a limited resource, or if disengagement from self-regulation processes is better understood in terms of motivational dynamics (Friese et al., 2019; Inzlicht et al., 2021). At the same time, however, there is little doubt that effortful behavior is costly, and the effort invested into a specific task (i.e., the amount of energy) decreases with time (Inzlicht et al., 2018). This means that with cumulative acts of self-regulation, a successful application of

self-regulatory behavior may become less likely. As Friese et al. (2019) argue, this tendency might be particularly consequential outside the laboratory in everyday life situations. In line with this, a number of studies from the social domain have shown that with decreasing capacity to enact self-regulation, along with increasing numbers and durations of effortful social interactions, successful self-regulation becomes less likely and the likelihood of socially inappropriate behavior increases (e.g., Henry et al., 2009; Vohs et al., 2005; von Hippel & Gonsalkorale, 2005). For example, across a series of experiments, Finkel and Campbell (2001) showed that the willingness to inhibit destructive impulses and instead respond constructively to a potentially destructive behavior of a romantic partner is dependent on the individual’s self-regulating capacity. More specifically, former acts of self-regulation (i.e., suppressing affective responses to emotionally evocative film segments) decreased the likelihood of the energy-demanding constructive social behavior. Similarly, college students who reported high self-regulatory demands on a given day were more likely to experience interpersonal conflicts (Simons et al., 2016).

A cornerstone of the DIRE model is that—because of physical and self-regulatory demands—energy must be invested into basically every interpersonal exchange. However, the actual cost of that investment or the effort needed for a subjectively successful interaction depends heavily on the characteristics of the social interaction. According to Goffman (1959), the self-regulatory effort is, for example, greater when individuals are engaging in what he calls “frontstage behavior”—interactions in which individuals are engaging in impression management by constantly monitoring their own and others’ behaviors. When interacting with close others, this impression management is not as necessary, such that individuals can engage in less effortful “backstage behavior” with closer social network partners (Dominguez et al., 2020; Leary et al., 1994). Supporting this idea is research by Gosnell et al. (2011) showing that interactions with close others are more satisfying when *less* self-presentational effort is used, whereas interactions with strangers are more satisfying when *more* self-presentation is involved. Thus, the DIRE model posits that, on *average* (in everyday social interactions), close relationships require less energy to maintain than weaker ties.

In contrast, less frequent but more socially challenging situations, whether with close or weaker ties (e.g., conditions of divided attention, suppression of prejudices, critical interaction partners), require more effort (Vohs et al., 2005; von Hippel & Gonsalkorale, 2005). Furthermore, providing support to a tie during stressful times or engaging in conflict can place substantial demands on self-regulation (Baumeister et al., 2019; Gosnell & Gable, 2017). In this regard, it is important to consider that both the necessity of providing support and the possibility of engaging in conflict are more likely when interacting with a close tie (Cohen & Wills, 1985; Fingerman et al., 2004; Rook & Charles, 2017). As

such, there are times when close ties are more energy demanding than weaker ties, although the majority of social interactions do not involve these energy-intensive behaviors. Overall then, the demand for these energy-intensive behaviors decreases with increasing closeness.

Thus far, it remains an open question whether or not kin ties are less difficult on average (i.e., less energy required) to maintain than non-kin ties. On the one hand, non-kin ties, and in particular friends, share quite a lot of individual characteristics with the ego (i.e., the aging individual; Standlee, 2019). Following this line of argumentation, one might speculate that the demand for self-regulation would be comparably lower in non-kin social interactions. On the contrary, family ties tend to have a long personal history, which may lead to higher familiarity and lower demands on energy because kin sometimes become increasingly effective at managing or avoiding conflict and coordinating goals over time (Hoppmann & Gerstorf, 2009, 2014). Thus, the DIRE model does not make specific predictions at this point about the association between kinship and energy demands. However, one might hypothesize that there is more *variation* in the energy required for engaging with kin as very difficult non-kin ties would be easier to cull from one's network.

**Summary and illustration.** In sum, close relationships require more time to be formed and also require significant time investment for maintaining that particular level of closeness. At the same time, however, close relationships tend to demand on average less self-regulatory effort and thus less energy than more distant relationships (i.e., weak ties). In contrast, interactions with weak ties may entail more effortful processes and thus more energy expenditure, but not many encounters (i.e., in keeping with a low investment of time) are needed to be able to enjoy the specific benefits of these ties. At this point, it may be helpful to illustrate these concepts using a relevant example. While attending monthly meetings of a Bridge-playing club, an older adult will likely be engaging with many weak ties. Although certainly fun, these engagements will also require substantial amounts of energy because the older adult must maintain a certain level of self-presentation. Thus, even if the older adult has had a bad week, they will likely attempt to remain cheerful, or at least keep complaints to a minimal banter, as it is socially inappropriate in such situations to be overly emotionally expressive (e.g., to cry) or, conversely, too withdrawn. However, little time is required to maintain these weak ties, as a monthly two-hour get-together will suffice. In contrast, older adults can be more relaxed and open with their feelings and behaviors with a close confidant, greatly reducing the necessity of self-regulation. In a sense, the older adult is more free to "be him or herself." The older adult also likely spends much more time with the confidant compared with weaker ties; for example, the older adult might frequently meet up with their confidant for a cup of coffee and/or chat daily on the phone. Conversely,

not devoting that time could cause the relationship to begin to decay (i.e., closeness may decline).

### *The Interplay of Closeness, Kinship, and Number of Ties*

Although up until this point we have been primarily focusing on time and energy being invested in a single relationship, the amount of time and energy invested in one's social ties also dictates the total number of ties (varying in levels of kinship and closeness) that an individual has in their network at any given time. As mentioned earlier, research indicates that the size of an individual's social network is limited by the individual's amount of resources (e.g., Sorkin et al., 2009), and there is generally an upper limit to the number of social relationships an individual can maintain in his or her personal social network (e.g., Dunbar, 1993; Roberts et al., 2009). Moreover, the size of an individual's network and the average emotional closeness across all ties in that network tend to be negatively correlated (e.g., Roberts et al., 2009). This suggests that as networks become larger, the resources needed to enhance emotional closeness across multiple relationships become diluted.

Of course, to conceptualize a network in its entirety, the number of ties in the network must also be considered in concert with closeness and kinship. A finite amount of time and energy places limits on the size and makeup of a social network. For example, individuals who invest more time and energy into weak ties may have a larger number of ties overall but fewer close ties in their network. Individuals with very large families may devote more resources to fostering those ties than to maintaining connections with friends such that close relationships might be confined to family (Antonucci et al., 2010).

In fact, research indicates that although there is clearly wide variation in types of social networks, this variation in networks is "constrained," at least to some extent (Consedine et al., 2004). Research using pattern-centered approaches to examining social networks (Fiori et al., 2006; T. Y. Li & Zhang, 2015; Litwin, 2001) has revealed at least four network "types" that are relatively robust to differences in age and culture and that can be distinguished in terms of number of ties, relatedness, and, to some extent, closeness: (a) smaller networks characterized by relatively close family connections (family network); (b) larger networks characterized by less-close but more diverse social ties (diverse network); (c) larger friendship-centered networks varying in levels of closeness (friends network); and (d) networks characterized by few ties and, in some cases, very low levels of closeness (restricted network; Fiori et al., 2006, 2007, 2008). The relative universality of these four prototypical types of networks among older adults provides additional support for the idea that networks are circumscribed. The DIRE model further suggests that these network types place very different

maintenance demands in terms of time and energy on the individual. Moreover, the investment of resources in ways that contribute to different network patterns is recognized as being fundamentally shaped by interindividual differences in characteristics and diversity in contexts.

### *The Investment of Resources: Influences of Individual Characteristics*

Individuals' social networks vary widely, not just in terms of size but also in terms of average closeness and frequency of contact with or proportion of kin versus non-kin, to name a few (Antonucci et al., 2010). This heterogeneity in the makeup of social networks likely stems at least in part from variability in individuals' characteristics. We define "individual characteristics" as inter- and intraindividual differences that affect the investment process (e.g., health, cognition, personality, and so on). Although these characteristics may change on multiple timescales, in this article we focus primarily on changes that occur on an ontogenetic scale. The core tenet of the DIRe Model is that social networks are formed and maintained through a dynamic process of investing differential amounts of time and energy into social ties. In our view, to gain a comprehensive understanding of changes in social networks across adulthood into old age, it is essential to clarify the processes through which individual characteristics affect this investment of time and energy. To categorize the individual characteristics into the entities necessary to enact these specific processes, our model differentiates between *capacities*, *motivations*, and *skills* (see Figure 1). More specifically, capacities determine, to a large degree, the *amount* of resources (i.e., time and energy) available to invest, motivations determine to whom and to what extent individuals *direct* that time and energy, and social skills determine the *efficacy* of that investment into specific social ties.

Although most empirical work has described how individual characteristics affect the composition of social networks directly, the DIRe model focuses on how individual characteristics tap into these different mechanisms. We believe that our approach has two inherent benefits. First, by highlighting the investment process rather than focusing on the individual characteristics themselves, the DIRe Model promotes the formulation of hypotheses about how *any* construct of interest might shape changes in social networks via distinct pathways. Second, this approach fosters a comprehensive understanding of multidirectional, ontogenetic change (Baltes et al., 1980; Baltes & Smith, 2004) by allowing for the simultaneous modeling of age-related changes acting on different paths of the investment process (e.g., capacities may decrease with age, but skills may simultaneously increase). By applying this framework, it becomes clear that although most individual characteristics likely operate on one pathway, some individual characteristics may work on more than one pathway. Subsequently, we provide

examples of individual characteristics acting as capacities, motivations, and skills that are particularly important for the investment process in late adulthood.

*Capacities determine the amount of resources.* In our model, capacities affect the *amount* of time and energy that a person has available to invest into social ties. Although there are numerous individual characteristics that operate on this pathway, prime examples that are important to understand social network changes in late life are health, cognitive functioning, and emotional functioning. We believe that capacities are the most important drivers of changes in social networks in late adulthood as they greatly influence the amount of energy that can be used in social interactions. Although conceivably capacities could influence *both* time and energy (e.g., a chronic illness requires frequent doctor visits that limit the amount of time available for meeting with friends), the impact on available energy for social interactions is currently better supported in the literature.

Interindividual differences in health may be directly linked to the energy available for engaging in social behaviors. In fact, a recent scoping review regarding the concept of "vitality," defined as the subjective experience of physiological and psychological energy (Lavrusheva, 2020), linked unhealthy lifestyle habits, somatic health symptoms, and poor physical fitness to low levels of vitality (i.e., energy). For example, in one seminal study, Ryan and Frederick (1997) found that subjective vitality was associated with fewer physical symptoms (e.g., nausea, headaches, etc.). Following our idea that social interactions require the investment of energy, individuals in poor health are likely less inclined to engage in social interactions as being sick depletes the energy necessary for such exchanges. The link between health and energy may be particularly relevant for older adults, considering the average declines in health. In fact, Huxhold et al. (2013) found that age was positively related to the number of illnesses in a sample of adults aged 65+ and that a greater number of illnesses predicted declines in social engagement. A more recent study (Weber et al., 2020) showed that only in older adults did subjective health problems predict less diversity in social partners in daily life.

Another potential mechanism linking health and energy in late life is cognitive functioning, as it has been shown that improving an individual's physical fitness actually improves executive functioning (e.g., Colcombe et al., 2003, 2006). Because cognitive abilities decline with age, older adults must spend more energy than younger adults on the same effortful tasks (Queen & Hess, 2018). As we have discussed earlier (in the section titled, Investing energy into social ties: The roles of closeness and kinship), social interactions can be understood as everyday effortful tasks. Thus, because they spend more energy on any one social interaction, older adults may have less remaining energy available for future social interactions. In line with these ideas, experimental work has shown that the cognitive ability to inhibit impulses

(one aspect of executive functioning) is a necessary prerequisite for engaging in successful social interactions (von Hippel, 2007; von Hippel & Gonsalkorale, 2005).

This link between executive functioning and social functioning appears particularly relevant at older ages (Henry et al., 2009; von Hippel, 2007; von Hippel & Gonsalkorale, 2005) because executive functioning shows one of the steepest age-related declines in all cognitive abilities. In fact, older adults have been shown to engage in more socially inappropriate behaviors than younger adults, such as talking excessively and about irrelevant topics and asking about private issues in public settings (von Hippel, 2007). Henry et al. (2009) found that this inability to inhibit inappropriate social behaviors was almost fully explained by age-related deficits in executive functioning. In fact, this study also showed that older adults with high levels of executive functioning and general cognitive ability performed similarly to younger adults. Furthermore, even younger adults have been shown to display more socially inappropriate behaviors when sufficiently challenged (von Hippel, 2007). In relation to our model, these studies imply that levels of executive functioning affect the available energy to engage in successful social interactions. Thus, one reason why aging individuals may focus more on close ties is because interactions with such ties require on average less energy (see section on, Investing energy into social ties: The roles of closeness and kinship), a resource that may be less available for older adults due to declines in health and cognitive functioning.

However, emotional functioning is also relevant for the amount of energy available for social engagement. For example, depression has been associated with loss of energy and high levels of fatigue, which in turn is associated with a loss in social functioning (Stahl, 2002); not surprisingly then, depression has been linked to increasing loneliness over time (J. T. Cacioppo et al., 2006). Conversely, happy individuals are more likely to be rated as energetic and sociable (Lyubomirsky et al., 2005). There is some indication that emotional functioning improves with age (Blanchard-Fields, 2007; Carstensen et al., 2011; Isaacowitz & Blanchard-Fields, 2012). Therefore, it is possible that increases in energy due to increases in positive affect experienced in social interactions might actually counteract some of the energy loss mentioned earlier resulting from age-related declines in cognitive and physical functioning. In fact, given that higher levels of interactions with weaker ties are associated with increases in positive affect over time (Huxhold et al., 2020), it could be that older adults who are motivated to maintain weak ties can offset the resulting demands on energy with corresponding increases in positive affect.

*Motivations determine to whom resources are directed.* In the DIRe model, *motivations* define the direction and extent of the investment of time and energy; in other words, they determine in which social interactions an individual decides to invest (i.e., close social partners vs. strangers; family vs. friends), and how much time and energy is devoted to those

interactions. There are a host of individual characteristics that shape individual networks through this pathway, including future time perspectives (Carstensen, 1992; Carstensen et al., 1999), perceptions of aging (E. Schwartz et al., 2020), and personality facets (e.g., extraversion), to name just a few.

Motivations related to future time perspectives have been highlighted in Socioemotional Selectivity Theory (SST; e.g., Carstensen, 1992; Carstensen et al., 1999) and are frequently invoked to explain the declines seen in network size with advancing age. According to this theory, with decreasing time perspective, individuals place a stronger emphasis on meaningful emotional exchanges and therefore focus on interactions with close relationship partners more so than peripheral ties (e.g., Carstensen, 1992; Carstensen et al., 1999). Thus, this theoretical mechanism can explain the general finding that, on average, network sizes decrease with advancing age, whereas the number of close others remains relatively stable into late life (Lang, 2001).

However, recent empirical studies have shown that there are large interindividual differences in the trajectories of different facets of social networks (Shaw et al., 2007; Zhang et al., 2011). Moreover, aging individuals may have varying goals for specific relationships that drive their investments of time and energy. For example, older adults may invest more time and energy into a weak social tie that they want to become closer to or may invest less time and energy into a close relationship that they feel is unhealthy (e.g., because of a transgression; Rook et al., 2007). In line with this thinking, Cornwell (2015) found that even when older adults maintain the same number of close ties, the actual individuals making up the close network may change. Furthermore, recent research points to historical shifts in the aging trajectories of network size and makeup (Huxhold, 2019; Suanet & Huxhold, 2020; Suanet et al., 2013). These studies provide a clear indication that changes in individuals' future time perspectives are not the only drivers of interindividual differences in changes in social relationships in late life.

For example, perceptions of aging (i.e., how older individuals view their own aging) can motivate individuals to invest in particular ties. A recent longitudinal study showed that older adults with more positive perceptions of aging were more likely to form new friendships two years later (Menkin et al., 2017). Relatedly, Huxhold (2019) found that positive perceptions of aging were associated with greater numbers of friends and more social activities with friends. Finally, E. Schwartz et al. (2020) demonstrated that more positive perceptions of aging led to higher formal and informal social engagement in older adults 6 years later. Together, these results imply that perceiving late life as a phase of growth (Huxhold, 2019) may motivate individuals to not only maintain existing bonds but also to form new ties (particularly non-kin ties). However, a recent study demonstrated that self-perceptions of aging become increasingly more negative with advancing age (Diehl et al., 2021). In particular, the perception of aging as being associated with the potential for growth declined steeply after the age of 70. Thus, increasingly

negative perceptions of aging could be one driving factor of age-related declines in network size and increases in the proportion of kin in social networks.

Personality traits, in particular extraversion, have also been linked to motivations structuring the individual's social network. For example, Asendorpf and Wilpers (1998) examined the social behavior of first-year university students and found that although conscientiousness was positively associated with the number of interactions with family, extraversion was negatively associated with the number of these interactions. In contrast, extraversion was positively associated with the number of interactions with peers and potential romantic partners. Extraverts are assumed to have a high preference for social activities and social attention (Ashton et al., 2002); not surprisingly then, extraversion is linked to a greater number of ties but not to higher emotional closeness with these ties (Pollet et al., 2011). Given that extraversion decreases in late life (Graham et al., 2020), the motivation to focus on close ties and family in old age may partly be driven by these shifts. Alternatively, the focus on family in late life could also relate to the fact that the strong positive association between extraversion and spending time with friends found among younger adults appears to decline in late life (Wrzus et al., 2016). Thus, even a highly extraverted older adult may engage in fewer activities with friends than an equally extraverted younger adult.

*Social skills influence the effectiveness of investments into social interactions.* In the DIRE model, social *skills* influence the *efficacy* of investments into social interactions. Individuals with high levels of social skills know, for example, when to initiate a social interaction and how to engage effectively. Consequently, socially skilled individuals do not need to invest as much time and energy to form and maintain their social ties as do less socially skilled individuals. There are huge interindividual differences with regard to how effectively people use their time and energy in social interactions. Subsequently, we provide some examples of individual characteristics that are likely to work on this skills efficacy pathway and that may be particularly important for understanding social network changes in late life.

Theory of mind (ToM), or the awareness that mental states can predict social behavior, is one such example. ToM has been associated with greater social skills as well as the development and maintenance of positive social relationships in both children and adults (Lecce et al., 2017). Thus, ToM may be important for fostering new relationships as well as maintaining established ones. More specifically, empathy has been discussed as a trait that is particularly beneficial for the maintenance of close ties (Davis & Oathout, 1987; Morelli et al., 2017), and empathic individuals are more socially skilled, at least in part, because they are better able to understand others' feelings and emotions and to predict others' behaviors and mental states (i.e., they are better able to apply a "theory of mind"; Saban & Kirby, 2019). Thus, empathic individuals are likely more effective than

less empathic individuals in their investment of energy into social relationships, as they are more likely to avoid interpersonal tensions and to employ good communication skills, warmth, and a positive outlook in their interactions with others (Davis & Oathout, 1987). In terms of changes with age, there is evidence that younger adults outperform older adults on the cognitive tasks associated with ToM but not on the associated emotional tasks (Bottiroli et al., 2016).

In line with this idea that emotional functioning may be spared from age-related changes (Bottiroli et al., 2016), cumulative experiences in social interactions are very likely to improve the effectiveness of time and energy investments into social relationships such that with age, individuals are likely to become more socially skilled (Hess & Kotter-Gruehn, 2011; Hess et al., 2005). In fact, according to the Strength and Vulnerability Integration model (SAVI; Charles, 2010; Rook & Charles, 2017), older adults are particularly effective in handling social relationships, at least in part due to age-related tendencies to utilize strategies that facilitate positive relationships, like the avoidance of conflict (e.g., Blanchard-Fields, 2007) and the reappraisal of interpersonal tensions (Birditt, Polenick, et al., 2020). The preservation of these social strategies may actually offset some of the losses that older adults experience due to reductions in capacities (e.g., cognitive functioning) such that maintaining high levels of relationship quality is possible despite age-related declines in health and cognition.

### *The Crucial Role of Context*

In the preceding section, we focused on the role of individual characteristics in shaping how much, in whom, and how effectively time and energy are invested to form and maintain social ties. However, the *context* plays an equally important role in the investment process. The centrality of context for development is captured in Bronfenbrenner's influential bioecological model, which describes how human development unfolds over time as a result of ongoing interactive processes of exchange between a changing organism and its changing environment (Bronfenbrenner, 1977; Bronfenbrenner & Morris, 2008). As we have outlined in an earlier work (Fiori et al., 2020), if we define the "environment" as the multitude of influences that exist outside of the individual (Drewelies et al., 2019), then context consists of those factors in the environment that are relevant for understanding the formation of social networks. Consistent with adaptations of Bronfenbrenner's view (e.g., Drewelies et al., 2019), we acknowledge that contexts can be organized on multiple levels. The "micro-level" context is equivalent to the social network, which is the sum of all social ties (i.e., "social ties" in Figure 1). Next, we define the remaining two levels: the meso- and macro-levels.

In line with Bronfenbrenner's conceptualization (Bronfenbrenner & Morris, 2008), we understand the meso-level as the contextual entity that links the macro to the micro-level (i.e., social ties). In our understanding, all

meso-level contextual influences (e.g., geographical factors, socioeconomic conditions, or life course phases) that are important for the investment process can be subsumed under the individual's living situation, and all macro-level effects operate through this living situation (hence the overlapping circles for meso- and macro-level contexts in Figure 1). The macro-level context includes the social structure of the society as well as societal and cultural norms. The social structure of the society, defined by such things as social and political institutions, laws, and the distribution of capital (e.g., social inequality), heavily impacts the individual's ability to invest in social ties via the individual's living situation. Societal and cultural norms set a frame of reference under which individual development unfolds. For example, normative expectations regarding age-appropriate development determine age-specific potentials and barriers for development (e.g., Heckhausen et al., 2010).

In this article, we focus on how macro-level and meso-level factors shape ontogenetic change in social networks, which we believe occurs primarily through three pathways; specifically, through: (a) determining the person-specific *opportunity structure*; (b) affecting the time and energy available to the individual; and (c) influencing individual characteristics (see Figure 1). In our view, it is extremely important to also recognize that "context" is not a static entity and that not only does the meso-level context (i.e., the living situation) change across the life course, but the macro-level context can also be shaped by historical change. Thus, in the subsequent sections, we acknowledge the key role of ontogenetic and historical change in the description of each of the three pathways.

**Context and the social opportunity structure.** Central to the DIRe model is the tenet that the context fully determines the opportunities to interact with other people. More specifically, the opportunity structure is defined in the DIRe model as all potential ties in which an individual can invest (the *availability* of ties) as well as the "*costs*" of investment (in terms of time and energy) into those ties. Social interactions in the work context may, for example, require a relatively high *cost* in terms of energy as the specific social expectations in this context place high demands on self-regulation.

The global Covid-19 pandemic made it very clear that context is a powerful determinant of our social lives, primarily through restrictions on the social opportunity structure. Most notably in a climate of social distancing, individuals' living situations drastically change from those filled with opportunities for social interactions, particular with weak ties (e.g., the workplace, school, children's activities, etc.), to those with perhaps more opportunities to engage with close ties (e.g., immediate family) but clearly many fewer opportunities to engage with weak ties (Fingerman et al., 2020). In fact, some research shows that social interactions declined and loneliness increased among college students as a result of COVID-19 (Elmer et al., 2020), although a study of a

broader nationwide sample of American adults only showed an increase in loneliness for older adults, and only during the acute phase of the COVID-19 outbreak (Luchetti et al., 2020). A longitudinal study of community-dwelling older adults in the Netherlands also showed increases in loneliness two months after the implementation of social distancing measures (van Tilburg et al., 2020).

Although contextual influences on social opportunity structures may be more obvious during crises such as a global pandemic, contextual effects are, in fact, ubiquitous. For example, high socioeconomic status (e.g., occupational status, education, or wealth) increases the attractiveness of the ego as a social interaction partner (Lin, 1999), thus decreasing the cost of social investments. Moreover, higher income implies that there are more opportunities for social participation available as social activities often include monetary costs, such as transportation costs or entrance fees. In line with these notions, research indicates that the higher one's socioeconomic status is, the greater and more diverse their social networks tend to be (Carey & Markus, 2017).

In addition to socioeconomic factors, culture is probably one of the most studied contextual factors in development. Despite this, the various and complex ways that cultural influences shape behavior are not yet well understood (Henrich, 2015). For example, traditional assumptions about the broad applicability of the individualist-collectivist continuum have been challenged by perspectives recognizing multiple interrelated dimensions that capture different cultural value orientations (e.g., S. Schwartz, 2006) as well as empirical work pointing to the need for a more nuanced understanding of in-group processes in collectivist cultures (S. S. Liu et al., 2019).

Recognizing the complex and evolving nature of cultural psychology (e.g., Talhelm, 2020), we consider a focus on specific cultural value orientations that have direct relevance to the social opportunity structure as offering a promising starting point for considering the role of culture within the broader DIRe model. For example, *familism*, a cultural value that refers to "strong identification and solidarity of individuals with their family as well as strong normative feelings of allegiance, dedication, reciprocity, and attachment to their family members" (Knight & Sayegh, 2010, p. 7), is regarded as central to multiple ethnic groups (Knight & Sayegh, 2010; Lee & Bauer, 2013; Perez & Cruess, 2014; S. J. Schwartz et al., 2010). Individuals living within a strong cultural context of familism are typically afforded a social opportunity structure characterized by proximity to and shared activities with family (Smith-Morris et al., 2012). Thus, investing resources in kin within a highly familistic context is not very costly, which likely fosters close kinship ties.

Furthermore, as mentioned earlier, changes in individuals' living situations across the life course drive changes in social opportunity structures. For example, the workplace affords many opportunities to interact with coworkers. However, upon retirement, maintaining contact with former

colleagues becomes more costly (i.e., more time and energy needs to be invested) because rather than happening spontaneously, interactions must be scheduled and planned (Freund, 2020; Freund et al., 2009). Furthermore, the time available to these potential/actual social partners is also critical. In fact, Young and Melin (2019) proposed that time should be conceptualized as a “network good.” That is, time is valuable only when shared (i.e., due to social *coordination*). Thus, retired individuals gain very little in terms of social opportunities if the majority of their network ties remain working.

Moreover, from a lifespan developmental perspective, a central aspect of development is concerned with negotiating and establishing expertise in various successive tasks across a series of changing life contexts (Baltes et al., 1980). These tasks often follow age-graded patterns based on normative societal expectations established at the macro-level (Heckhausen et al., 2010; Neugarten, 1979) and have been shown to have an impact on individuals’ social networks (Wrzus et al., 2013). For example, middle-adulthood is a period often characterized by multiple developmental tasks concerned with maximizing career opportunities and raising young children (Lachman et al., 2015), such that most individuals in this stage are in frequent contact with work colleagues and are often presented with opportunities for social interactions in the context of their children (e.g., parents of children’s classmates). Thus, the costs of these interactions are relatively low (Freund et al., 2009). In contrast, and as outlined earlier, the costs of certain interactions (e.g., with former co-workers) may increase upon retirement, and the nature of opportunities for social interactions may change (e.g., children may now provide opportunities to interact with grandchildren).

In addition to ontogenetic changes, macro-contextual conditions are also subject to historical changes. Thus, it is important to consider the effects of historical change on the social opportunity structure (Fiori et al., 2020). For example, a historical increase in geographical mobility has likely increased the availability of potential ties (e.g., new neighbors) while simultaneously increasing the cost of investing in long-standing ties (e.g., if adult children are moving away; Huxhold & Fiori, 2018). At the same time, technological changes (such as the rapid rise in use of social media and video chatting) has made staying in touch with geographically distant family and friends less costly (Wang & Wellman, 2010) and also increased the availability of ties by making new forms of connection and relational maintenance possible (Allan, 2008; Antonucci et al., 2017). Moreover, advances in communication technology could be particularly beneficial for maintaining social ties among individuals with age-related mobility restrictions (Antonucci et al., 2017).

*Context and resources (time and energy).* The meso-level context constrains the amount of time and energy available for individuals to invest in social relationships. For example, low socioeconomic status may place severe restrictions on

the amount of energy available for social engagement. In line with this reasoning, Conger’s *family stress model* predicts that experienced economic hardships lead to interpersonal tensions and withdrawal in social relationships (Conger et al., 2010). Although the family stress model has mostly been applied to romantic and parent–child relationships, we believe that the tenets of the model may generalize to all kinds of relationships (e.g., Mahne & Huxhold, 2015). In our view, economic hardships necessitate constant emotional regulatory efforts to avoid becoming overwhelmed by existential anxiety. Thus, economic hardships constitute a continuous energy drain that may be exacerbated by associated interpersonal tensions with close family. Thus, the DIRE model predicts that empirically observed withdrawal tendencies are partly a consequence of a lack of energy to engage in social interactions, which would affect not only close-kin relationships but also (and perhaps even more so) the wider personal network (e.g., friends and weak ties).

However, the individual’s living situation will not only influence energy but also available time. For example, having to work multiple jobs to make ends meet severely constrains the time available to invest in social relationships (Campion et al., 2020). Moreover, returning to the concept of age-graded tasks (Neugarten, 1979), the significant time and energy commitments needed to achieve goals in the multiple domains of work and raising children in midlife could restrict the resources needed to invest in and foster diverse, discretionary social ties that exist outside of these contexts. In line with this, a recent analysis predicted a reduction in social activities with friends particularly between the ages of 40 and 55 years (Huxhold, 2019). In contrast, retirement may result in an increase in the amount of discretionary time and energy available to invest in social relationship goals. There may also be cultural differences in available time; for example, Americans work far longer hours than Europeans (Young & Melin, 2019), leaving less discretionary time for interactions with social network members.

Available discretionary time and energy may also be influenced by macro-level historical change. For example, due to increases in life expectancy and age at first birth (Bulley & Pepper, 2017), as well as the fact that younger adults are living at home for longer (Sironi & Billari, 2020), current living situations are more likely to lead to middle-aged adults caring for both parents and children at the same time, greatly limiting their available discretionary time to engage with other members of their social networks. Furthermore, increasing financial demands over the past decades translates to increasing numbers of dual-income households; with both men and women working, there is less time and energy available for the traditionally female role of kin-keeping, particularly in light of enduring inequalities in the division of household labor (Perry-Jenkins & Gerstel, 2020). The COVID crisis may have exaggerated these effects of multiple roles; for example, with child care and schools closed, increased financial strain, and unfavorable changes

in working conditions (i.e., telecommuting, reduced work hours, or even job loss), individuals may have been faced with much greater demands on energy.

**Context and individuals' characteristics.** Both the meso- and macro-level contexts can also work directly on the individual; that is, the living situation (i.e., the meso-level context) can provide potentials but also present barriers that might influence individuals' capacities and at the same time societal and cultural norms (i.e., the macro-level context) may influence individuals' motivations and skills through socialization.

For example, economic hardships can have long-term effects on emotional functioning (Conger et al., 2010), including mental health problems such as depression. Moreover, education not only has direct effects on the social opportunity structure (the number and nature of available ties; Lin, 1999) but can also work through an individual's capacities to engage in social interactions in late life (e.g., cognitive functioning; Thow et al., 2017), motivations to take advantage of social opportunities (e.g., extraversion; Kassenboehmer et al., 2018), and skills to maximize investment into those opportunities (e.g., by increasing ToM; X. Li et al., 2013). Education likely works through all of these pathways simultaneously, which would account for research showing that more educated individuals are better able to maintain their social ties (e.g., confidants and friends) than less educated individuals, even into late life (Cornwell, 2015; Shaw et al., 2007).

In addition to individuals' capacities being affected by potentials and barriers associated with the current living situation, individuals' motivations and skills are likely shaped ontogenetically through the process of socialization (i.e., the gradual internalization of values and social conventions; Grusec & Davidov, 2010). For example, individuals living within a strong cultural context of familism should, in theory, be highly motivated to invest in kin. In fact, Lee and Bauer (2013) found that familism was the strongest motivator for grandmothers to provide support to their grandchildren in South Korea. That being said, it needs to be acknowledged that there are large individual differences in values even within cultures and/or ethnic groups. For example, within a large sample of Hong Kong residents, Zhang et al. (2011) found that individual differences in interdependence (defined as an understanding of the self as strongly interconnected with others; Markus & Kitayama, 1991) moderated the age-related decline in peripheral social network partners.

Furthermore, historical change may shift the motivations of individuals over longer periods of time (Fiori et al., 2020). For example, in addition to increases in life expectancy, age norms have evolved over the past several decades to emphasize the increasing potential for older adults to be active and socially engaged (Johnson & Mutchler, 2014). Such changes in age norms could translate into positive changes in how individuals perceive their own aging. These historical increases in positive perceptions of aging could in turn shift

the *motivations* of older adults; for example, individuals may be more motivated to invest into non-kin ties (Huxhold, 2019). However, the empirical evidence regarding historical increases in individual's perceptions of aging are thus far inconclusive, with some studies demonstrating historical increases (Wurm & Huxhold, 2012) and other studies not finding historical differences in individual's perceptions of aging (Wahl et al., 2021).

### Social Capital

Of course, the relationship between the context and the individual's social network cannot be understood as unidirectional. Not only does the context influence the network structure via its influence on the opportunity structure, time and energy, and individual characteristics, but investing in social ties may also provide the means to change both the individual's social opportunity structure and their living situation. The sum of all of such resources embedded in the social network that the individual is able to mobilize can be defined as social capital (Lin, 1999, 2008). In the sociological literature, social capital is frequently given a rather broad definition that can also entail network resources that are used to maintain one's own well-being. In the DIRe Model, we narrow this definition by specifying that *social capital* refers exclusively to those resources embedded in the social network that influence the individual's opportunity structure and/or the individual's living situation (i.e., the meso-level context). This definition is more in line with those sociological perspectives that link micro-level social capital to macro-level phenomena and structures (Burt, 2004; Granovetter, 1973; Lin, 1999).

The capacity of social ties to alter the individual's context is probably most obvious with respect to their influence on the social opportunity structure. Investing into a new social tie not only increases the size of the individual's social network by one but also to some extent allows the individual to reach out and connect to the ties in the network of the newly formed bond, potentially expanding the network even more. Put differently, weak ties (including newly formed ties) offer opportunities to bridge across social circles (Burt, 2004; Granovetter, 1973). In addition to ties' bridging potential changing the opportunity structure, social networks may also provide means to change the individual's meso-level contextual conditions. That is, an individual may borrow or access resources such as power, reputation, or information from a tie in their network to change their living situation (e.g., Lin, 2008). An individual can, for example, reach out to distant relatives to inquire about housing opportunities in a city to which they must move or they may ask a work acquaintance for a recommendation for a job application.

An important notion of this perspective is the principle of homophily, which states that ties in the close network resemble each other in terms of sociodemographic, behavioral, and personal characteristics (McPherson et al., 2001). In terms of social capital, this means that although strong ties are more

likely to allow access to certain resources (i.e., are more willing to help out; Carpiano, 2006; Lin, 2008), weaker ties are more likely to provide access to more diverse resources, such as access to information not always obtainable in the close social network (Lin, 1999, 2008). In line with this notion, weaker ties have been argued to be more instrumental than close ties for changing individual living situations, such as the attainment of better jobs (Lin, 2008). Thus, the DIRE model predicts that if aging individuals place a greater emphasis on investing in close ties compared with weak ties, their social capital may diminish, on average.

### Social Functions

The impact of social relationships on individuals' emotional and cognitive functioning, as well as their health and well-being, is a mainstay in research on social integration (Berkman et al., 2000; Cohen, 2004). A critical tenet of this research is that social ties do not affect the individual directly, but rather work through a variety of psychosocial pathways (Berkman et al., 2000; Cohen, 2004; Thoits, 2011) that we call *social functions*. Huxhold et al. (2013) demonstrated, for example, that the effects of structural properties of the social network (i.e., number of ties and frequency of contact) on the development of health and well-being in old age were mediated by two social functions: namely, social support and engagement in social activities. In this context, it is important to note that social functions are not always beneficial (Birditt, Sherman, et al., 2020; Rook, 1984) and that the negative side of social ties may have even more long-lasting consequences for individuals than the positive aspects (Newsom et al., 2003, 2005; Rook, 2015). Furthermore, different types of social ties (defined by kinship and closeness in the DIRE model) may be more or less likely to work through specific social functions (Huxhold et al., 2020; Sutcliffe et al., 2012; Weiss, 1974). For example, close ties (e.g., close family members) are the main providers of social support, particularly in late life (Rook & Charles, 2017).

There are a number of theoretical articles that have systematized the large variety of mechanisms through which social ties can influence individual characteristics—most prominently health and well-being (e.g., Berkman et al., 2000; Cohen, 2004; Thoits, 2011). Thoits (2011), for example, detailed seven different mechanisms: social influence/social comparison, social control, role-based purpose and meaning (mattering), self-esteem, sense of control, belonging/companionship, and perceived support availability. She further described how these mechanisms are involved in stress-buffering (i.e., counteracting the stress evoked by critical life events). Finally, she identified emotionally sustaining behaviors, instrumental help, empathy, coping assistance, and role modeling as the most important influences in the stress-buffering process. Although we refer the reader to these excellent works for more detailed descriptions of mechanisms, here we

attempt to condense the many psychosocial factors potentially linking social ties to individual characteristics to a more manageable level.

Specifically, we describe three conceptual pathways (i.e., *social exchanges*, *social influences*, and *social evaluations*) through which social ties may influence individual characteristics (see Figure 1). The conceptual pathways describe a continuum ranging from rather concrete day-to-day interactions, to tangible and intangible influences on behaviors, to abstract mental representations. First, we believe that social ties can influence individual characteristics, particularly health and well-being, through concrete *social exchanges* during day-to-day interactions. Specifically, experiences of support or strain in day-to-day social interactions elicit emotional reactions and changes in stress levels that can accumulate over time and thereby change individual characteristics. Second, social networks affect individual characteristics via *social influences* that stimulate or restrict the individual's behavioral repertoire (i.e., the range of behaviors demonstrated by the individual). For example, normative expectations that exist within the individual's social ties may limit the types of health behaviors the individual is comfortable performing. Third, individuals form mental representations about whether or not their existing social ties satisfy their social needs. These global *social evaluations* of their social network can also impact individual characteristics through associated experiences, such as loneliness or a sense of belongingness.

We believe that our approach of describing these general pathways allows us to (a) condense the myriad of specific influences of social ties on the individual into meaningful categories of analysis; (b) outline the negative, positive, and ambivalent nature of these influences; and (c) describe how different types of social ties (varying in closeness and kinship) potentially operate differently in these pathways. For the purposes of parsimony and consistency with the existing literature, we discuss the three pathways separately.

**Social exchanges.** The most direct influences of social ties on individual characteristics occur during *social exchanges* in everyday social interactions (Cohen, 2004; Kremen et al., 2012; Uchino et al., 2012). In the DIRE model, we define a *social exchange* as an interaction between the ego and a social tie that evokes either negative or positive emotional responses or can increase or decrease stress levels. For example, kindness or appreciation demonstrated by a friend at the end of the day may make an individual feel more positive about themselves and may distract them from the stress they experienced at work earlier in the day. Positive social exchanges are typically conceptualized in the literature as social support, which can be further delineated as emotional, instrumental, or informational support (Uchino, 2009). Some researchers have also included companionship as a type of positive exchange (Newsom et al., 2003). In contrast, negative social exchanges

are typically referred to as social strain and can include others' unwanted advice or intrusion, others' unsympathetic or insensitive behavior (i.e., criticism), others' failure to provide needed help, and rejection or neglect by others (Newsom et al., 2003; Rook, 2015). Of course, whether a social exchange is considered positive or negative by the individual is dependent on the ego's perception of the social exchange, regardless of the intentions of the social partner (Antonucci, 1985). For example, even when support is well-intended and responsive to an existing need, it can trigger feelings of dependency and indebtedness in the target individual (Newsom et al., 2005).

Although many effects of social exchanges may be short-lived, the cumulative impact of the emotional and physiological responses elicited in social interactions can affect an individual's health or cognitive and emotional functioning in the long term (Haase et al., 2016; Kremen et al., 2012; Newsom et al., 2005). Broadly, social support has been found to predict both physical and psychological well-being as well as mortality (Berkman et al., 2000; Cohen & Wills, 1985). More recent research indicates that social strain may have even more potent negative health effects than support has positive effects (Newsom et al., 2003, 2005; Rook, 2015), although positive social interactions may actually buffer against the negative effects of negative social interactions (Fiori & Consedine, 2013).

Positive and negative social exchanges can occur with both kin and non-kin as well as with both close and less close ties (Rook, 2015). Close ties are frequently the primary source of enacted support (both emotional and instrumental), particularly during times of stress (Cohen & Wills, 1985). However, close family ties appear to be the main sources of feelings of negativity as well, and individuals are more likely to report the presence of *both* positive and negative exchanges in their closest ties (Birditt, Sherman, et al., 2020; Fingerma et al., 2004). In contrast, everyday ordinary social interactions with weak ties tend to be positive and have been shown to benefit both mental and physical health (Fingerma et al., 2019; Huxhold et al., 2020; Lakey et al., 2016).

Cross-sectional research indicates that older adults tend to report less negativity in their relationships than do younger adults (English & Carstensen, 2014). Longitudinal research shows that adults tend to report fewer distressing ties as they age (Böger & Huxhold, 2018a), and older long-term couples report fewer negative social exchanges over time as well (Verstaen et al., 2020). However, interpersonal conflicts still occur in late life and most often take place within the context of close relationships (Rook & Charles, 2017). This may be due in part to the fact that non-kin and/or less close ties are more susceptible to relationship termination due to repeated negative interactions (Sutcliffe et al., 2012), in contrast to close family and friends who are more likely to remain in spite of the presence of negativity. This particular selectivity of friends might be a reason why social activities with friends

have a larger positive impact on the well-being of older adults than activities with family (Huxhold et al., 2014).

**Social influences.** Social exchanges by definition affect individual characteristics directly via the cumulative impact of emotional and physiological responses. However, social ties can also impact individual characteristics indirectly via restricting or stimulating individual behavior. Some of these social influences are explicit and involve actions of network ties that aim to encourage or pressure the individual to perform specific activities or alternatively to dissuade the individual from performing certain activities. In the literature, these explicit influences are often labeled aspects of "social control" (Thoits, 2011). Social influences may also work implicitly via social comparisons. People tend to evaluate the appropriateness of their own behavior by comparing themselves against the internalized standards of a reference group (Fiske, 2010; Thoits, 2011). As research has shown, ties in the social network may often serve in this reference function (Marsden & Friedkin, 1993; Olivos et al., 2020). Therefore, the norms that are upheld within an individual's social network can have a profound impact on the individual's characteristics (Umberson et al., 2010).

Social control has been acknowledged as having potentially both beneficial effects (e.g., encouraging exercise or discouraging smoking) and harmful effects (e.g., encouraging risky behaviors or discouraging healthy eating; Thoits, 2011; Umberson et al., 2010). Furthermore, as explained earlier, social influences can work either explicitly (e.g., people persuading the ego to do something) or implicitly (e.g., via norms and peer pressure). Research indicates that kin are more likely than non-kin to exert explicit social influences, at least among older adults (Rook & Ituarte, 1999). In our view, this "kin effect" is likely driven in part by the comparatively large amount of time spent with (close) kin. In fact, we posit that close ties generally are more likely to provide explicit social influence (i.e., social control)—either in positive ways (e.g., reminding you to take your medicine) or in negative ways (e.g., offering you a cigarette). Weak ties, on the contrary, are more likely to influence individuals implicitly—again, in either positive ways, by acting as positive role models (e.g., by being friends who regularly exercise) or in negative ways, by setting negative norms (e.g., by being friends who smoke).

In addition, although social control has typically been understood as focused on the regulation of health behaviors, such a narrow perspective does not adequately capture the more stimulating aspects of social influences. For example, social ties may encourage individuals not only to exercise but also to go see a thought-provoking film, try a new cuisine, adopt a new hobby, or spend time with new friends. As mentioned earlier, while one's close ties are likely to be similar to oneself in many ways (e.g., socioeconomically, attitudinally, and so on), weak ties are more likely to offer more

diverse resources, opinions, perspectives, and opportunities (Lin, 1999, 2008). Thus, a stimulating influence is more likely to stem from weak ties than close ties. In fact, our own research indicates that a greater number of social ties is associated with better well-being in older adults, in part because more social ties beget greater activity involvement (Huxhold et al., 2013). Research also indicates that engagement with social groups has a particularly strong association with cognitive health, increasingly so with age (Haslam et al., 2014; Lam et al., 2020). In fact, broad social engagement can attenuate cognitive decline in late life (Lövdén et al., 2005), and weaker ties may be particularly important in this context (Pan & Chee, 2020). In sum, based on the DIRE model, we predict that the nature of social influence is likely to change with age; that is, because individuals tend to focus more on their closest ties as they age, they are more likely to experience the explicit social control provided by close ties and less likely to experience the stimulation provided by weaker ties.

**Social evaluations.** The third general pathway through which social ties can influence individual characteristics is based on the individual's global evaluation of whether or not their existing social ties meet their social goals and needs. To a certain degree, the evaluation depends on the individual's estimation of both the mere availability of ties (e.g., the existence of an intimate relationship) and opportunities to interact with others (e.g., regular social activities; Böger & Huxhold, 2018b, 2018c; Weiss, 1974). Also important to the evaluation process are mental representations of the histories of positive and negative social exchanges with different ties in the network, and more specifically, whether or not those exchanges met the individual's needs (Fiori & Consedine, 2013; B. S. Liu & Rook, 2013).

At the most basic level, then, *social evaluations* can be defined as judgments of the match between desired social goals and the actual social situation. The primary example of such a judgment is loneliness, which can be defined as a perceived mismatch between the need for attachment and the individual's quantity and quality of social relationships (Tesch-Römer & Huxhold, 2019). Loneliness poses a serious threat to individuals' health and well-being; research indicates that loneliness is a risk factor for mental health problems as well as both morbidity and mortality (Hawkey & Cacioppo, 2010). Generally speaking, a range of ties, varying in levels of closeness, is necessary to avoid feelings of loneliness. More specifically, a few close ties can stave off feelings of emotional loneliness, whereas a larger number of weaker ties may be necessary to avoid feelings of social and/or collective loneliness (S. Cacioppo et al., 2015; Hawkey et al., 2005). Furthermore, although having either kin and/or non-kin in one's network can protect against loneliness (Böger & Huxhold, 2018a), contact with friends is more important than contact with family for staving off loneliness (Pinquart & Sorensen, 2001).

Across the life course, individuals are highly motivated to create and maintain social relationships as a means of preserving a sense of belonging (Baumeister & Leary, 1995) and protecting against loneliness (J. T. Cacioppo & Cacioppo, 2018). A meta-analysis of longitudinal studies (Mund et al., 2019) indicated that changes in loneliness are not related to age. However, some causes of loneliness seem to change with age, such that, for example, having a partner is less important for preventing loneliness later in life, whereas engaging in social activities becomes more important with age (Böger & Huxhold, 2018b, 2018c). In contrast, the impact of low relationship quality on loneliness did not change across middle age and late adulthood (Böger & Huxhold, 2018a).

## Discussion

The DIRE model provides a comprehensive and testable framework to understand changes in social relationships across adulthood into late life. In essence, the model combines the testability of agentic theories of social aging (e.g., Carstensen et al., 1999; Charles, 2010) with the broader sociological perspective of contextual influences on social relationships (e.g., Antonucci et al., 2014; Granovetter, 1973; Lin, 2008). As such, the DIRE model framework follows in the footsteps of earlier lifespan perspectives on aging (Baltes et al., 1980; Lerner, 1991), emphasizing the dynamic interactions between the individual and the context over time.

### Tenets of the DIRE Model

There are three core tenets of the DIRE model. *First, creating and maintaining social ties requires the investment of time and energy, the amount of which is dependent on the closeness of the tie and whether the tie is considered kin.* Energy denotes the perceived potential to enact a behavior. The closer the social tie is to the ego, the more time and the less energy is required to maintain the tie at its current level of emotional closeness. Kinship, defined as relatedness and/or the shared expectation of mutual support in times of need, also influences the investment process, as kin ties tend to require less time to maintain than non-kin ties.

The investment of time and energy is determined in its entirety by interactions between the context and individual characteristics that tap into the investment processes via three distinct pathways. Specifically, individual characteristics can impact the *amount* of time and energy available to invest (*capacities*), influence the decisions about to whom and to what extent individuals *direct* that time and energy (*motivations*), and determine the *efficacy* of that investment into specific social ties (*social skills*). In addition, the context determines the *opportunity structure* (i.e., potentially available social ties and associated costs) for investment, posits *constraints* on the amount of time and energy available, presents both *potentials* and *barriers* for developing individuals'

capacities, and influences individuals' motivations and skills through *socialization*. Thus, the second tenet of the DIRE model is that over time, interactions between individual characteristics and the context continuously and cumulatively shape the social investment process and consequently the size and composition of individuals' social networks.

The third tenet of the DIRE model is that at the same time, social networks, via two distinct "feedback loops," can influence both (a) the individuals' characteristics and (b) their context. First, different types of ties, varying in levels of kinship and closeness, are associated with different social functions (i.e., social exchanges, social influences, and social evaluations) that, in turn, influence individuals' characteristics (such as health and well-being). A distinguishing feature of the DIRE model is that, in contrast to most of the existing theories on changes in social relationships in late life, it explicitly incorporates both positive and negative aspects of social functions. That is, social ties can provide support and also create strain, they can be stimulating or constraining, and they can lead to a sense of belonging or—in their absence—loneliness. Second, gains and losses of social ties will change the individual's social opportunity structure (e.g., when one's romantic relationship dissolves, one loses the access not only to the partner but to their partner's network to some degree as well) and can also alter the means for individuals to change their living situation (e.g., when a new tie provides information about a job opportunity).

### Generating Testable Predictions From the DIRE Model

Empirical research shows that as individuals age, their social networks tend to get smaller; at the same time, the proportion of kin and close ties increases (Wrzus et al., 2013). Existing psychological theories of the development of social relationships (e.g., SST, Carstensen et al., 1999; SAVI, Charles, 2010) focus on shifts in motivations and strategic skills with age to explain these average trends in social networks. These theories propose very testable mechanisms and have initiated numerous empirical studies that have contributed to a substantial supporting evidence base. However, they do not explicitly recognize the multitude of other interindividual differences shaping social networks (e.g., age-related changes in other motivations and skills, as well as in capacities) or age-related changes in context (e.g., retirement). In contrast, the Convoy Model (Antonucci et al., 2014), another influential theory of development of social relationships in late life, is more comprehensive in that it considers a larger number of interindividual differences as well as contextual influences. However, the Convoy Model is vague about how key underlying mechanisms account for the role of these different influences in shaping social networks in adulthood. The DIRE model combines the merits of both the agentic and the more contextualized approach to derive specific predictions regarding age-related changes in social relationships. We present several of these specific predictions subsequently.

First, we assume (in line with the Convoy Model) that the observed trends in social relationships in late life are a consequence of the interaction between age-related changes in the context and individual characteristics. As described in the section on capacities (titled, Capacities determine the amount of resources), declining health and cognitive functioning will most likely decrease the energy available for investing in social ties. At the same time, as described in the section on context (titled, The Crucial Role of Context), contextual changes in late life (such as retirement) may free up time available to spend on social activities. As a result of these age-related changes, older adults may have more time but less energy to invest in relationships. It is important in this context to consider that close ties require more time but less energy than weak ties to maintain (see section on, A Mechanism for Changes in Social Networks: The Investment of Time and Energy). Thus, the DIRE model predicts that older adults may focus on close ties to the exclusion of weak ties, as such a strategy optimizes available resources. In other words, this interaction between age-associated changes in individual capacities and contextual constraints explains why the social networks of older adults tend to become smaller and more focused on close ties over time without necessarily invoking age-related shifts in motivations. Moreover, the DIRE model would predict that older adults would *not* demonstrate a decline in network size if the opportunity structure entailed lower costs for interacting with weak ties. For example, older adults who live in age-friendly communities with readily available opportunities for social engagement should show less of a focus on close ties than their age peers living in less stimulating environments.

Second, the DIRE model suggests that age-related changes in motivations *moderate* the investment process in specific ties (see Figure 1). However, in line with the tenet of multidirectionality of life span development (Baltes & Smith, 2004), it is critical to consider multiple age-associated changes in motivations and skills simultaneously, because different developments may be working in opposition. For example, a decreasing future time perspective (Carstensen et al., 1999) and an increasing vulnerability to negative interactions (Charles, 2010) might motivate older adults to focus on and to invest in close ties even more. In contrast, positive perceptions of aging motivate older adults to broaden their social networks, and in fact, such perceptions have been linked to the development of new friendships and engagement in volunteering among older adults (Menkin et al., 2017; E. Schwartz et al., 2020). As new friendships are gained by investing in weak social ties and social engagement offers opportunities to regularly interact with weak ties, the DIRE Model predicts that older adults with a positive outlook on their own aging will not show a dramatic decrease in network ties.

Third, theoretical approaches such as the SAVI model have emphasized the increasing social expertise that comes with life experience (e.g., Birditt, Polenick, et al., 2020; Charles, 2010; Hess & Kotter-Gruehn, 2011). In this regard, it has been

shown empirically that older adults develop their social skills by frequently applying social strategies intended to maintain high levels of positivity in social relationships. Thus, as has been argued in the section on social skills, gains in social skills may offset age-related losses in capacities, such as cognitive functioning. However, as social interactions with weak ties do not only include the successful application of social skills (e.g., avoidance of conflict) but also (and to a larger degree) require effortful cognitive processes (e.g., self-presentation), the DIRe model predicts that the social expertise acquired across the lifespan is more helpful in interactions with close social ties. Some preliminary evidence in this regard is provided by a recent study (Birditt, Sherman, et al., 2020) indicating that older individuals are likely more able to handle interpersonal tensions than young adults in their closest relationships, but not in less close social ties.

Fourth, we believe that a complete understanding of changes in social relationships across adulthood into old age must include predictions about the consequence of these age-related changes for social functions. The DIRe model assumes that these social functions influence the individual's characteristics (e.g., health or emotional functioning) and thus create a feedback loop (see Figure 1). For example, a focus primarily on close ties is likely linked to high levels of social support (Cohen & Wills, 1985), but at the same time, high levels of social strain as well (Rook & Charles, 2017). Furthermore, a focus on close ties will reduce the size and diversity of the network, thereby also reducing involvement in social activities (Huxhold et al., 2013) and further reducing the social opportunity structure. In fact, our own research has shown that focusing on close ties may actually result in higher levels of depressed affect and lower levels of positive affect (Huxhold et al., 2020), which in turn may render engagement with weak ties even more demanding. In contrast, focusing primarily on weak ties may provide opportunities for social engagement and stimulation but may deprive the aging individual of the support that may become increasingly necessary to maintain health (Schöllgen et al., 2011). Poor health, in turn, decreases available energy to invest in social ties.

Thus, the DIRe model predicts that diversity in aging individuals' social networks is likely ideal, not only because ties differing in closeness can provide a broad range of social functions to help promote health and well-being in late adulthood, but also because such diversity can help older adults remain socially integrated in the face of age-related losses (e.g., Huxhold et al., 2020). Consistent with our predictions, recent research indicates that network diversity is linked not only to better mood among older adults (Fingerman et al., 2020), but also to greater cognitive and physical functioning and lower mortality (Ali et al., 2018).

Relatedly, the DIRe model would predict that even in late life, a minimal number of ties needs to be maintained to ensure successful social integration. As has been argued before (e.g., in the section on, Investing energy into social ties: The roles of closeness and kinship), social support and

interpersonal conflicts place high demands on self-regulation and therefore costs in terms of energy. If the older individual is dependent on a single tie for the satisfaction of their support needs (e.g., in a familial care situation), interpersonal tensions may arise. Moreover, unhealthy older individuals may lack the energy to efficiently deal with those tensions even in the context of a very close relationship. Finally, if there is a lack of alternative ties to turn to, older adults may not be able to successfully use avoidance strategies to uphold their relationship quality. Thus, not only does the quality of social support influence well-being in late life, but the number of people able to provide support is also a determining factor of age-related changes in well-being (Huxhold et al., 2013).

## Limitations and Potential Future Developments

Because the DIRe model is designed to simplify a very complex process as a way to derive testable hypotheses about age-related changes in social relationships, it has inherent limitations, some of which can be overcome by further developing the model. In the following section, we will describe some of these inherent limitations in line with potential future solutions.

### *Where Is the Dyad in the DIRe Model?*

By reducing the plethora of dimensions that could be used to describe social relationships with just closeness and kinship, the DIRe model takes a social network approach and focuses on optimizing overall social integration; consequently, it is less suitable for making predictions about specific relationships or understanding dyadic processes. However, the model could be developed further to incorporate a dyadic perspective by adopting concepts from existing frameworks. For example, the Social Relations Model (SRM; Back & Kenny, 2010) outlines three components of interpersonal behavior: the actor effect, the partner effect, and the relationship effect.

Actor effects, or dispositions of the ego, could be subsumed within individual differences in the DIRe model, although our model is more precise by distinguishing among capacities, motivations, and skills. Partner effects, or the dispositions of the individuals' interaction partners, were not outlined in the present article but could potentially be captured in the model. General behavioral tendencies of specific ties could be understood as operating within the individuals' specific opportunity structure. For example, the individual may perceive lower energy costs for interacting with someone who is dispositionally friendly and higher energy costs for interacting with someone they perceive as judgmental. In general, we would expect that greater similarity between partners would reduce the costs of investment as the need for self-presentation efforts decreases with familiarity (Dominguez

et al., 2020; Leary et al., 1994). For example, Cruz et al. (2014) found that divergence in acculturation for couples adjusting to a new culture was associated with lower positive marital quality. Another factor that could potentially influence familiarity is relationship duration, as presumably the longer individuals have been in contact, the more familiar with each other they become. However, whether or not the *costs* of maintaining a relationship decrease with increasing duration is an open empirical question, and likely depends on a confluence of factors (including the cumulative time invested during the course of the relationship).

Relationship effects, or unique relational actions independent of the general tendencies of actors or partners, would be more complicated to incorporate into our model. That is, it would be necessary to shift the theoretical focus from individuals' investments of time and energy to dyads' enactments of specific social behaviors (e.g., exchanging emotional support) measured repeatedly over time. As such, relationship effects unique to a particular tie may better be understood using existing frameworks (e.g., PERSOC; Back et al., 2011).

Partner effects, including the motivations and expectations of partners, would be particularly useful to incorporate into the DIRE model. When conceptualized as operating within the social opportunity structure, these partner effects could help explain changes in social relationships in late life. Consistent with the Social Input Model (Fingerman & Charles, 2010), close social partners may treat older adults more favorably in an effort to reciprocate the minimization of conflict that older adults frequently utilize as a social strategy. Close social partners may also perceive the time left for social interactions with the older adult (i.e., the ego) as limited and may therefore further minimize conflict (Luong et al., 2011) and/or aim to spend more time with the older adult. At the same time, weak social ties may also alter their behaviors around older adults due to the activation of negative age stereotypes (e.g., uncontrollable consequences of aging) and positive age norms (e.g., the need to respect one's elders).<sup>1</sup>

### Where is Time in the DIRE Model?

The DIRE model is a dynamic model governed by two feedback loops that continuously shape the investment process into social ties. In addition, individual characteristics and context change on multiple time scales independent of social interactions. This article is primarily concerned with explaining changes in social relationships on the *ontogenetic time* scale, in particular across adulthood into old age. To this end, we described primarily ontogenetic or age-related changes in individual characteristics with a focus on the ways in which different characteristics tap into the social investment process. Consequently, in the section on individual characteristics, we provided examples of how different individual characteristics acting as capacities, motivations, or skills change (on average) with advancing age. Relatedly, in the section on context, we explained how ontogenetic changes in normative patterns of

social expectations impact both the time and the energy available to invest in social ties and the social opportunity structure. In addition, we discussed the impact of life course transitions (e.g., retirement) on the social investment process. Future developments of the DIRE model need to not only describe how ontogenetic changes impact the investment process, but also how the associations between individual characteristics and the investment process change across the lifespan (Böger & Huxhold, 2018a, 2018b, 2018c; Wrzus et al., 2016).

In addition to the ontogenetic time scale, we also considered changes in macro-contextual conditions across *historical time*. Specifically, in the section 'Context and individuals' characteristics', we described how historical changes in work requirements and technological advances in communication in recent decades have not only transformed social opportunity structures (i.e., availability and costs), but have also changed the time available for investment into social ties. These technological advances may be particularly beneficial for older adults with functional limitations who may otherwise struggle to stay connected to their social networks (Antonucci et al., 2017). Furthermore, historical gains in life expectancy and increasingly more positive perceptions of aging may have changed the motivations of aging individuals to the extent that friends and weak ties may play a more important role in the future social integration of older adults (Fiori et al., 2020). These examples demonstrate that although the focus of the DIRE model is on the explanation of ontogenetic changes, all types of historical changes can also be easily integrated into the framework via formulating hypotheses about changes in macro-contextual conditions.

In addition to the time scales mentioned earlier, we believe that the DIRE model could be extended to work on shorter time scales, such as hours or days, so that the investment process could be conceptualized as operating on a more micro-level of analysis (e.g., single social interactions). In a sense, the framework of the DIRE model could provide an observational lens allowing scholars to zoom in and out of patterns of change on different time scales. If a scholar is studying social relationships at the daily level, they could assess those entities and processes immediately relevant for a given social interaction rather than those that govern ontogenetic change processes. For example, they could measure individual characteristics at the state rather than the trait level (e.g., current mood rather than overall emotional functioning) and could conceptualize meso-level contextual factors as the immediate context in which the interaction takes place (e.g., being at work versus at home).

Thus far, we have not considered the much longer evolutionary time scale. However, evolutionary processes clearly play a role in the development of motivations to invest in social ties (e.g., Baumeister & Leary, 1995). Currently, there is a common consensus in the literature that some social motivations, such as the need for attachment or the need for social status, are basic needs that are ingrained in human nature due to evolutionary processes of selective survivability (Baumeister & Leary, 1995; Dweck, 2017). One defining

feature of basic (social) needs is that they need to be at least partially satisfied to avoid serious consequences for the individual's health and well-being. In line with this feature, there is some evidence suggesting that an individual's investment into basic social needs does not change with advancing age (Buijs et al., 2021). Thus, the incorporation of an evolutionary perspective in future developments of the DIRE model could provide a better theoretical understanding of the potential range of ontogenetic change in social motivations.

## Conclusion

In line with the goals of the study of lifespan development (Baltes et al., 1980; Lerner, 1991), the primary purpose of the DIRE model is to describe, understand, and optimize the development of social relationships across adulthood into old age. First, the multidimensional nature of our model makes it a useful heuristic to *describe* changes in social relationships. In fact, the model is flexible enough to account for changes in the historical context, thereby adapting to new social realities as they appear (Fiori et al., 2020). Second, we specify concrete mechanisms to *understand* the development of social relationships and show how these mechanisms interact with individual characteristics and contextual conditions. For example, retired individuals' perceptions of their own aging process affect their investment into social ties, such that individuals with more positive perceptions may invest more time and energy into developing work ties into friendships. Third, the DIRE model is designed in a way to discover how to *optimize* the development of social relationships by identifying the relevant factors to develop targeted interventions. For example, an intervention designed to increase positive views of aging may increase individuals' investment into social ties, in particular among sedentary older adults, in turn minimizing loneliness and maximizing health. In sum, the DIRE model captures the complexity of age-related changes in social relationships with both specific, testable mechanisms and a broad perspective that can generate countless testable hypotheses and new avenues for interventions.

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