Social exploration: How and why people seek new connections

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Abstract

Just as animals forage for food, humans forage for social connections. People often face a decision between exploring new relationships versus deepening existing ones. This tradeoff, known in optimal foraging theory as the *exploration-exploitation tradeoff*, is featured prominently in other disciplines such as animal foraging, learning, and organizational behavior. Many of the framework's principles can be applied to humans' choices about their social resources, which we call *social exploration/exploitation.* Using known principles in the domain of social exploration/exploitation can help social psychologists better understand how and why people choose their relationships, which ultimately affect their health and well-being. In this paper, we discuss the costs and benefits of social exploration and social exploitation. We then synthesize known person- and situation-level predictors of social decision-making, reframing them in the language of the explore-exploit tradeoff. We propose that people explore more when they find it more rewarding and less costly, and when the environment has many opportunities to do so. We conclude by discussing hypotheses generated by applying optimal foraging theory to social decision-making.

Keywords: Social connection, optimal foraging theory, explore-exploit tradeoff, social ecology, social networks

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Two people move to a new city where they do not know anyone. The first person, Person A, has a cousin who introduces him over email to a friend who lives there. Person A and the friend become close, going for bike rides every weekend. He is occasionally invited to a friend's house for small dinner parties, but he does not try hard to befriend other people there. After a few months, Person A also becomes friends with two colleagues in adjacent cubicles. He is satisfied with his small social network of increasingly close friends.

When the second person, Person B, arrives in the city, she joins a running group to meet new people. She starts a new tradition for the running group: happy hour cocktails on Fridays after their afternoon run. She is open to conversations with strangers everywhere she goes because she never knows what exciting connections she will make. A conversation with a person sitting next to her at a park reveals that they are from the same hometown; this person soon becomes a friend. By the time she has her first birthday in the new city, Person B has 30 friends to invite to her house for a party.

Why did Person A and B behave so differently in their new city? Perhaps they have different *goals*: Person A wants only a few close friends, and Person B desires an active and varied social life. Perhaps they perceive different social *affordances* because they have different abilities or resources. Person A may not feel confident starting conversations with new people or may not know how to convert acquaintances into friends. Person B may have a less demanding job and, therefore, more time and energy to socialize. Or they have the same goals, resources, and abilities but differ in *social value.* Maybe Person B is a more desirable friend to a broader variety of people because of her behavior, background, socio-economic status, appearance, or ability to broker relationships between people.

What are the consequences of Person A's and Person B's different social behaviors? Will one be happier, more psychologically enriched, healthier, or have a more successful career? Perhaps the answer depends on the situation and their personal attributes: how much stress their jobs bring, their physical health, the physical environment, or the cultural diversity of their new city.

The present work seeks to synthesize under a single umbrella the causes and consequences of different social networking strategies, aiming to better predict people's social behavior as a function of their goals, affordances, social value, and context. We apply *optimal foraging theory* (Stephens & Krebs, 1986) to human social decision-making (King & Marshall, 2022). Optimal foraging theory explains how the ideal strategy for searching for resources depends on features of the searching organism, its environment, the desired resource, and the interactions between them. According to optimal foraging theory, a fundamental tradeoff exists whenever an organism searches for resources: to *exploit* known, existing opportunities or to *explore* for information and novel opportunities (Mehlhorn et al., 2015). The tradeoff is a dilemma for all agents – humans, animals, computers – that need to optimize their reward searches using limited information. It manifests in daily decisions: the route you take to work, the food you eat for lunch, the shows you watch, and the people you interact with. By exploiting, you can enjoy sure rewards but might miss out on better, unknown options. By exploring, you can gain information and potentially locate better options but might also encounter bad options and waste time and energy searching.

We can think of other people as resources (Gonzalez et al., 2021), and the problem of deciding how to allocate one's social time as an instance of the explore-exploit tradeoff. Building and sustaining a social network requires time, effort, unknown risks, and uncertain rewards.

People must decide how to allocate their limited time and effort to maximize social rewards (e.g., friendship, social ties) and minimize social risks (e.g., rejection, scams, awkwardness, boredom). Reframing social decision-making in optimal foraging terms helps integrate many findings about why and how people network and what they get out of it.

Optimal foraging theory has yet to be applied in social psychology to the question of how people search for friendships and other general social connections. However, it has helped explain search strategies in other domains, such as how animals search for food and territory (Stephens, 2008), how algorithms search for solutions (Črepinšek et al., 2013), and how firms search for technological innovations (Gupta et al., 2006; March, 1991). In psychology, the explore-exploit tradeoff has been used to describe how humans search for monetary rewards (Sang et al., 2011), information, and memories (J. D. Cohen et al., 2007; Hills et al., 2015), mate search (Cohen & Todd, 2018; Kolze et al., 2021), how children explore their environment (Gopnik, 2020), the search biases associated with mental disorders (Addicott et al., 2017), and neuroscientific processes that govern decision-making (Laureiro-Martínez et al., 2010).

Optimal foraging theory describes whether it is better to explore or exploit in each moment based on a number of factors, including the goal of the searching agent, the fluctuations of the environment, and the time remaining in search. By applying this framework to social decisions, we can determine when people's social strategies are suboptimal. Indeed, an abundance of evidence suggests that people, on average, might not be obtaining all the benefits that come from social connections—they might not be using optimal social foraging strategies. Even though people have virtually unlimited opportunities for social interaction, many still feel lonely and disconnected (Arbes et al., 2014; Cacioppo & Patrick, 2008; Killeen, 1998). People frequently miss out on the psychological, physical, and material benefits of healthy social

connections (Wolff et al., 2009). Therefore, it is important to understand how people make decisions about their relationships, given their goals, affordances, and social value.

Mehlhorn et al. (2015) previously provided a valuable review that integrates the animal literature and human literature on the exploration-exploitation tradeoff. This provides initial evidence that there are many connections between the two literatures and highlights the insights we can gain when we apply animal foraging principles to human decision making. The authors primarily examined various types of exploration (e.g., random vs. directed) and the transitions between exploration and exploitation, with a particular emphasis on judgment and decision making. In our paper, we extend this discussion to explore how the exploration-exploitation tradeoff influences everyday social behaviors and social networks such as friendship formation and support seeking. Additionally, we draw more extensively from literature in personality psychology, socio-ecological psychology, cultural psychology, and sociology, offering a broader perspective on the topic.

In this article, we first review the explore-exploit tradeoff and synthesize ideas from neighboring literatures. Second, we introduce social exploration-exploitation and show how social resources (i.e., social connections) may be similar to and different from other foraged resources. Third, we draw from existing social psychological literature to hypothesize how individual- and situational-level factors might affect social exploration and exploitation. Fourth, we provide future directions and discuss how social psychologists can benefit from applying this framework. We propose that optimal foraging theory and the explore-exploit tradeoff can be used to understand how people find, form, and maintain social connections, and what types of search strategies are ideal under different conditions.

The explore-exploit tradeoff

Many decisions that individuals (e.g., animals, people) make involve choosing between the best-known option (exploitation) and gaining information by seeking unknown options (exploration). Exploiting an existing and familiar option allows an agent to remain where they are and to be confident in the outcome. It uses fewer resources (e.g., time and energy) and mitigates risk, but may cause the agent to miss out on better, unknown options. It might also be unsustainable in the long run if the exploited resource is finite or has diminishing returns. On the other hand, exploring is high-risk but potentially high-reward: an agent can receive important information and discover a better option, but there is a switching cost and rewards may not be guaranteed.

In previous literature on other decision-making domains, these two options have been considered a tradeoff because one cannot do both simultaneously, at least not at the same timescale in the same behavioral domain. In a single decision at a single level of analysis, exploration and exploitation are considered mutually exclusive: an agent can continue exploiting their current resource, or they can search for a new resource. Over time, these decision points accumulate, and we can quantify an agent's ratio of exploration to exploitation as a continuous metric (J. D. Cohen et al., 2007; Mehlhorn et al., 2015). As we discuss later, we think of social exploration/exploitation decisions as continuous (a decision can range from fully exploratory to fully exploitative) rather than dichotomous. For example, meeting with a close friend and their new partner can be simultaneously exploiting and exploring. And re-connecting with an old work friend might fall somewhere between exploration and exploitation. When you add up a person's decisions to explore, exploit, or be somewhere in the middle, you can place them anywhere in a two-dimensional space in which they are high or low in their tendency to socially explore *and*

their tendency to socially exploit (see Figure 1). This is because there is always the option to not socialize at all, which is neither socially exploitative nor socially exploratory.

Optimal foraging theory applies in many domains, from bacterial growth (Stocker et al., 2008) to human memory search (Baror & Bar, 2016). Exploration and exploitation usually describe behavior, not latent states such as motivations, traits, or attitudes. Generally, exploration involves alternating between novel options, whereas exploitation involves remaining at one option. One hindrance to creating a unifying body of literature is that different domains use different terminologies to refer to this search process: *optimal foraging* in animal behavior, *information search* in cognitive domains, and *bridging/bonding* in social networks. Across literatures, three differences in descriptions of exploration/exploitation have emerged: the type of exploration, the reward structure and properties, and the level of analysis. We will review these three issues next.

Directed and random exploration

Wilson et al. (2014) subdivide exploration into two types: random and directed. Random (or undirected) exploration is not goal oriented and is akin to a random walk. It can lead to the incidental discovery of new opportunities and rewards. For instance, children display more random sampling than adults do, resulting in more learning about the set of possibilities (Cauffman et al., 2010). Directed exploration is, as the name implies, goal directed. Directed exploration is driven by prior knowledge about resource distribution. Instead of incidental learning via random sampling, directed exploration involves the investigation of a particular state space that maximizes the reward rate. Infants may direct their exploration to things in the environment that are least familiar and will therefore yield the greatest learning rate (Oudeyer & Smith, 2016). Searching for specific information on Wikipedia, which is known as deprivation

curiosity, is another example of directed exploration (Lydon-Staley et al., 2021). With curiosity-driven behavior, *information* is the sought-after resource.[1]

Reward structures and properties

The structure and properties of rewards vary across search domains. One distinction is whether an agent can maintain access to multiple resources simultaneously, as with friendship, or whether choosing one resource means giving up another, as with monogamous relationships. In the former instance, the decision-making process is sequential. A laboratory paradigm that best captures a search problem where the agent can return to previous resources is the multi-armed bandit task (Slivkins, 2019). In this paradigm, an agent repeatedly chooses from a set of options with different payout amounts to obtain the most reward. Exploitation is choosing the available option with the highest value, while exploration is selecting a new option (Sutton & Barto, 2018). The agent can always return to a previously sampled option if it has the highest yield. This resembles animals foraging for food in patches (Stephens, 2008).

Sequential decision-making does not describe all foraging dilemmas. Sometimes, the agent explores until it reaches a sufficiently good option, which it then exploits. This is referred to as the optimal stopping problem or the secretary problem (Ferguson, 1989). People who serially date (explore) until settling (exploit) on a monogamous partner are navigating an optimal stopping problem. The decisions and strategies involved in building and maintaining a friendship

[1] Curiosity is proposed to take two forms: deprivation-based curiosity is the desire for specific information, such as the answer to a riddle, while interest-based curiosity is the desire to learn anything on a topic (Litman & Silvia, 2006). These can be reframed as directed and random exploration, respectively. Some researchers go further, defining exploration exclusively as the search for *information* about possible resources, while exploitation is pure reward seeking (Liquin & Lombrozo, 2020; March, 1991). Others define exploration as choosing a reward with greater uncertainty, while exploitation is choosing a reward with greater certainty (Lee et al., 2011). The latter is our preferred definition because it is nearly impossible to separate social information-gathering and social reward accumulation. Conversation is a central behavior in our social lives and involves the exchange of information, including information that people use to decide whether they like each other. But conversation and interaction is also rewarding.

network are qualitatively different from those involved in finding a monogamous romantic partner (or, similarly, a barber, dentist, or any role where you only need one person)[2]. This review focuses on sequential search and friendship rather than optimal stopping and monogamy, as prior work has already applied optimal foraging theory to mate selection (e.g., Cohen & Todd, 2018; Kolze et al., 2021).

Resources vary in another important way. They can be depleting, meaning that they shrink over time and cannot be reused (e.g., fossil fuels), or non-depleting, meaning that the resources do not shrink over time (e.g., solar power). As exploited resources deplete, agents must explore new opportunities. According to the marginal value theorem (Charnov, 1976), agents should stop exploiting when the current area's yield falls below the yield obtained by moving on to another place, factoring in the cost of switching. Across various taxa, animals spend relatively more time in high-quality patches that are farther from other patches and less time in patches that are low-quality and nearer to other patches (although some literature has suggested that animals often stay in an environment for too long, see Nonacs, 2011 for a review). However, if a resource is not depleting, agents can exploit it for longer, potentially forever. Trap-building spiders sample various feeding sites, a non-depleting resource, before permanently settling in one (Beachly et al., 1995) – note this is another example of an optimal stopping problem.

We suggest that whether other people are depleting or non-depleting resources depending on what rewards are obtained from them (e.g., instrumental support, emotional support, self-esteem support, etc., Cohen & Wills, 1985; Morelli et al., 2017). Suppose an agent primarily

[2] We note that there is sometimes overlap between romantic relationships and friendships. Romantic partners can certainly be friends, and many romantic partners begin that way. However, the ways that people intentionally search for romantic partners differs from how people search for friends (Sprecher & Regan, 2002). The expectations are also different (Fuhrman et al., 2009). Therefore, we believe that there is enough discrepancy that we do not include romantic partner search in our theoretical framework.

hears gossip or networking opportunities from a friend. In this case, the friend may be a depleting resource that the agent will leave and return to when those resources are replenished (i.e., when the friend has new gossip or connections to offer). But if the agent also gains comfort, enjoyment, or other non-depleting resources from a friend, they are best thought of as non-depleting (S. Cohen & Wills, 1985). How an individual sees the norms around which benefits are given and received has been classified as exchange or communal relationships, where in exchange relationships, people expect comparable repayment for a benefit given, while in communal relationships, people do not expect repayment and give benefits out of concern (Clark & Mils, 1993). Other people may be perceived to be depleting resources to a greater extent in exchange relationships (in which the main purpose of the relationship is to gain information or resources) than in communal relationships (in which the main purpose of the relationships is not concerned with resources per se).

Level of analysis

What constitutes exploration and exploitation depends on the temporal and spatial scale of interest. For example, one might go to their favorite café for lunch (exploit) but choose a sandwich they have not tried before (explore). One could even decide to exploit and stick to the same habit of eating out for lunch or explore and try bringing lunch. Therefore, if the level of abstraction is not carefully defined, it can be unclear whether a behavior constitutes exploration or exploitation (Hills et al., 2008).

The searching party may not always be a single agent: searching can be done at the group level where there is a division of labor, enabling parallel exploration and exploitation. In a colony of ants, some members can explore new areas to gather food, while others harvest from dependable places (Cook et al., 2013). In human organizations, businesses can simultaneously

explore by creating new products to branch out to different markets and exploit by staying within their established market domain (Gupta et al., 2006). In this review, we focus on single-agent searches.

Optimal foraging rules

Although applications of optimal foraging are diverse and sometimes disjointed, we can extract several guiding principles about optimal foraging. The theory begins with the assumption that the basic currencies agents can spend are energy and time (Stephens & Krebs, 1986). Time and energy spent on one strategy, such as exploring, come at the cost of spending time and energy on another strategy, such as exploiting. From this assumption, we can identify the ideal foraging strategy given the state of the agent and resource distribution in the environment. For instance, *marginal value theorem* mathematically describes how an agent should stop exploiting a resource when its rate of reinforcement falls below the average reinforcement level for the environment (Charnov, 1976). For an animal foraging for food, this means the animal should leave its current patch when its rate of energy consumption falls below the average rate in the environment, which is a function of the distance between patches. As we will discuss later, individual agents vary in their estimates of the availability of resources in the environment, the rate at which they deplete exploited resources, and the value they ascribe to those resources.

There are general rules for how to optimally forage depending on the attributes of the environment and the agent, and we will name a few here. First, an agent should usually initially explore a new environment and exploit resources later, after the distribution of resources in the environment has been learned (Addicott et al., 2017). Second, more frequent exploration is necessary in an unstable and changing environment, because changes in both the distribution of possible resources and the reliability of exploited resources means an agent needs to regularly re-

update their knowledge of the environment (Donahue et al., 2013). Third, if the resources are patchily and unevenly distributed in the environment, wider exploration is warranted to determine all possible options—briefly sampling from one area may not yield an accurate estimate of the resources available in the wider environment.

Social exploration-exploitation

We define social exploration-exploitation as instances of foraging where the reward sought is social connection. Humans are a social species: our survival depends greatly on social bonds, and social bonds are therefore inherently rewarding (Atzil et al., 2018). Humans have a desire to feel connected to others (Baumeister & Leary, 1995), are wired to be socially oriented (Lieberman, 2013) and suffer greatly when they feel isolated (Cacioppo & Patrick, 2008). Therefore, we argue, social connectedness is intrinsically rewarding. Of course, part of this intrinsic reward derives from the material and psychological advantages of being around others (Atzil et al., 2018; Beckes & Coan, 2011). While we know that most humans desire connection, less is known about which type of connections people seek (new or familiar others) at a given moment, given various factors present.

For the rest of our discussion, we focus on friendships, and will not discuss kin, romantic, or transactional relationships. We do not discuss kin relationships because they are usually given and not discovered (i.e., no exploration is necessary). We do not discuss romantic or transactional relationships with proscribed roles – such as with a dentist, priest, or boss – because they are monogamous and the expected reward is more certain (clean teeth, absolution, and a paycheck, respectively, and co-parenting support and sexual intimacy for romantic partners). These searches are also subject to explore-exploit tradeoff principles (see *The Secretary Problem* section below), but in sufficiently different ways that we limit our discussion to the generic

search for social connection. In contrast to romantic and transactional relationships, one can have many friends at once, and rewards obtained from friendships are hard to predict. Finally, searching for items with other people, also referred to as *social foraging* (Giraldeau & Caraco, 2018), does not fit our definition since the reward itself is not social.[3]

Why is it important to study social exploration? Although it is generally known that satisfying relationships are essential for health and well-being (Aron et al., 2013; S. Cohen & Syme, 1985; Cundiff & Matthews, 2018; Diener & Seligman, 2002; House et al., 1988), we cannot make strong predictions about how different people in different contexts should allocate their time and energy across relationships. Evidence suggests that rates of loneliness vary across cultures and communities (Luhmann et al., 2022), but less is known about the best solutions to loneliness as a function of place and person. In Western countries, having many friends makes people happier (Kim & Lee, 2011), but so does having close relationships (Pietromonaco & Collins, 2017). Being a social broker who connects different groups is helpful in some settings (Burt, 1992) and not others (Stovel et al., 2011). And *whom* one is connected to matters. A study on more than 70 million Facebook friendship networks showed that for individuals with low socioeconomic status (SES), having more high-SES friends is one of the strongest predictors of upward mobility, as such friends can provide access to resources, information, and social norms for opportunities (Chetty et al., 2022). We can synthesize disparate literatures and identify optimal social decision-making strategies by framing choices in social relationships using optimal foraging theory.

What foraging for social and non-social resources have in common

[3] One previous study used the term "social exploration" to refer to searching for (nonsocial) rewards in an environment in the presence of absence of social others (Winet et al., 2022). However, this differs from our term in that we use social exploration to refer to the search for social rewards.

Many foraging principles derived in non-social contexts should apply to foraging for social connections (Mehlhorn et al., 2015). Rhesus macaques forage for social information similarly to how they forage for food (Turrin et al., 2017). Friends are tangible rewards, meaning that agents must physically (or, in the internet age, digitally) search for them, as opposed to searching for ideas or memories. Friendship also requires time investment, like any other resource (Hall, 2019), and social interactions can have diminishing returns, just as animals exploiting a food patch can experience declines in the reward rate. As in non-social domains, agents must balance reward output and efficiency (Cook et al., 2013). It might be most *efficient* to have only one best friend—fewer cognitive resources are required to know their attitudes, predict their behavior, etc.—but that efficiency comes at the expense of novelty, diverse perspectives, and increased social capital. And environmental factors and timescales affect the optimal strategy regarding the tradeoff in both social and nonsocial resources (Monk et al., 2018), which will be discussed later.

Like other forms of exploration, social exploration can also be directed or random. People are often goal-directed in the types of friends they are looking for (Apostolou & Vetsa, 2022; Fitzsimons & Shah, 2008), and whether they are looking for friends at all. Even children have a preconception of the traits that they want in friends (Austin & Thompson, 1948). People search for similar others (McPherson et al., 2001) and befriend those with whom they share social needs (Secord & Backman, 1964), values (Launay & Dunbar, 2015; Lönnqvist & Itkonen, 2016), and personalities (Selfhout et al., 2009). Yet there are also many opportunities for random exploration. People talk to strangers in parks (Whyte, 1980) or make friends even when it is not their main goal, such as when picking up children from child-care (Small, 2009). Simply living nearby is often a sufficient condition for friendship (Festinger et al., 1950; Martin & Yeung,

2006). Thus, connections can be intentionally sought (directed exploration) or serendipitously found (random exploration). We expect that people engage in more directed social exploration when they need a particular social resource—for instance, new parents often use friendship networking apps designed to help them meet other parents with young children. It will be valuable in future work to distinguish between directed and random social exploration, as the former may more closely resemble an optimal stopping problem: once that particular social resource has been acquired, the directed search can stop.

Like other domains, social exploration-exploitation can be considered on multiple levels of analysis. Changing temporal or spatial scales can change whether we describe a person as exploring or exploiting. Spending extensive time with one friend (i.e., social exploitation) may contain elements of exploration if the friendship deepens into new and previously unexplored domains. Disclosing sensitive information to a friend represents short-term topic exploration that can have momentary risk (rejection, vulnerability), but in the longer term, such disclosure can sustain and deepen a relationship (Bruk et al., 2018), allowing for further exploitation of the rewards it has to offer. Some psychological factors hypothesized to influence social networking decisions, which we discuss later, may similarly influence explore-exploit decisions on shorter and longer timescales. Social exploration can also be considered on multiple spatial scales if we consider social networks as a topological space. A person can explore the network by befriending someone several network degrees away or exploit their network by mostly befriending friends-of-friends (Jackson & Rogers, 2007).

What makes foraging for social resources unique

Although we consider social resources (i.e., other people) to be sufficiently like other resources that optimal foraging theory can apply, they have several unique properties that make

them vastly more complex than non-social resources. First, connections to others can provide access to additional rewards such as money, food, emotional support, physical aid, safety, networking, and information. When animals forage for nonsocial tangible resources, such as food, the resource can usually only help them meet one goal (e.g., hunger). However, when people forage for social resources, the resource can serve multiple goals.

A single social tie can provide friendship and belonging (Baumeister & Leary, 1995), information and ideas (Paulus, 2000), an expanded sense of self (Aron & Aron, 1997) and connections to new friends (Siciliano et al., 2018). Acquaintances are important in providing new information and ideas and can provide a sense of belonging and happiness (Sandstrom & Dunn, 2014a). Relationships bring happiness (Diener & Seligman, 2002) and health benefits (Umberson & Karas Montez, 2010). They can provide access to other nonsocial resources, such as job opportunities (Granovetter, 1973) or feedback (Wanberg & Kammeyer-Mueller, 2000). A coworker can be a companion to talk to at lunch, alleviating boredom and loneliness. They may also have good tips about the company's norms (Ashford & Black, 1996). Lastly, the coworker can introduce other company members, providing access to more social ties. Thus, social rewards can beget more social rewards, whereas food can only solve hunger.

Often, one must create social ties before knowing what resources will be gained. Investing in social relationships with unknown returns is known as *social capital* (Lin, 2001). Individuals preemptively create ties and network with others under the expectation that there will be some future benefit. These social ties compound and combine in social networks, potentially benefiting beyond individual relationships (Burt, 2000). Being part of a social network can allow greater access to information, equipping individuals to find opportunities and choices that are otherwise unavailable (Haythornthwaite, 1996; Lin, 2001). It can also elevate an individual's

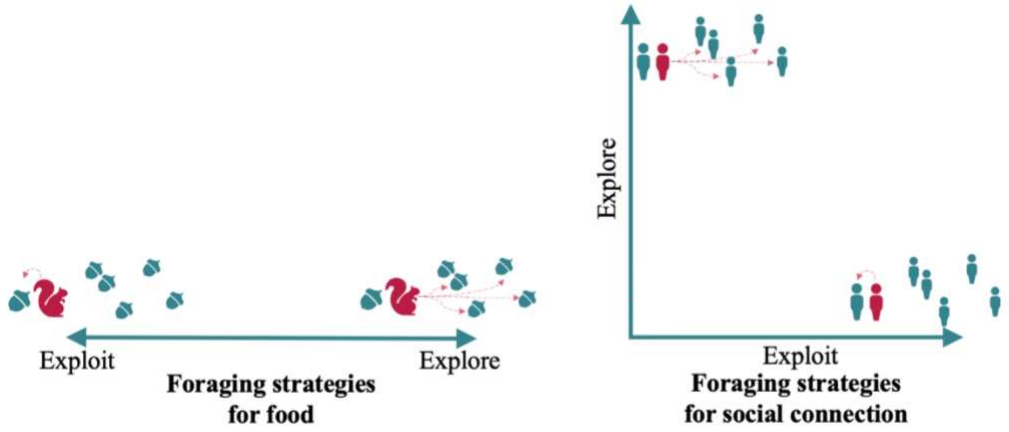
social credentials, giving them more access to resources or leading to sponsorship within a system, such as a reference for a job position (Seibert et al., 2001).

A second property of social connections is they are non-depleting resources, as spending time with someone does not "use them up." However, specific benefits derived from a friendship, such as networking opportunities, may have limitations. For instance, after meeting all your friend's acquaintances, the potential to expand your network through them may be exhausted. While the connection itself is non-depleting, certain practical advantages it offers can be finite. Additionally, people vary in how much they value solitude, and at some point in a social interaction, their need for solitude can surpass their need for connection (Burger, 1995; Leary et al., 2003). Maintaining close friendships requires regular time and resource investment (Hall, 2019). The extent to which a person perceives a particular relationship as serving their goals may also determine their desire to exploit it (Fitzsimons & Shah, 2008). Future work should explore whether individual differences in the tendency to see social partners in terms of their instrumentality, or to approach relationships with a transactional rather than communal mindset (Mattingly et al., 2011), predicts greater social exploration.

Third, although social connections are important predictors of health (Holt-Lunstad et al., 2015), adults can survive, at least for a decent amount of time, without them. People can go for weeks or years without social interaction. The same cannot be said for other resources, such as food. This means that social exploration and exploitation are not proportional inverses of each other. People can choose solitude (Burger, 1995). Someone low in *sociotropism* (seeking socialization) and high in *solitropism* (seeking solitude) is less motivated to engage in both social exploration *and* exploitation. But people also vary in how motivated they are to pursue deep friendships versus social novelty. Thus, when we describe a person's social tendency, we are

placing them in a two-dimensional space—they can engage in high (or low) levels of social exploration *and* exploitation (see Figure 1).

Figure 1.



Left: Organisms must meet their caloric needs every day. The more time they spend exploring new food sources, the less time they will spend exploiting known food sources. Thus, pure exploitation and pure exploration are two ends of the same dimension, and agents vary in how much time they spend exploring versus exploiting. Right: In a particular moment and at a one level of analysis, a socializing person is somewhere on a single dimension from exploration to exploitation (just like animals foraging for food). But when considered over a longer time span, when these moments and decisions add up, social exploration and exploitation exist in a two-dimensional space. Adults in modern society do not *need* to socialize every day, so there is not an inherent tradeoff between socially exploring and exploiting. Socially isolated and lonely individuals do neither, so they are low in both dimensions. Highly social people might be high in both social exploitation and social exploration, nurturing close friendships while also networking with acquaintances. When considered at the trait level, it is therefore useful to think of social exploration and exploitation as separate dimensions along which people vary.

Lastly, social resources differ from non-social resources in that the resources themselves are agentic and make their own social decisions. Social ties are normally a mutual transaction (Antonucci & Jackson, 1990): to make a social tie, not only does one need to choose the other, but one also must be chosen by them in return. This adds another layer of complexity to the anticipated reward. Nonsocial resources can have fixed probabilities and varied expected values (e.g., knowing that there is nectar in a patch but not knowing how good the nectar is) or varied

probabilities (a patch may or may not have nectar). For social resources, the searcher must not only find a person but also determine whether said person reciprocates the desire for connection. Thus, the searcher faces the possibility of rejection, which is a unique cost to social resources. Foraging food could fail or result in an unpleasant outcome, but food cannot actively reject someone in ways that are hurtful to self-esteem and health the way that other humans can (Leary, 2015). Thus, this fear of rejection can preemptively dictate actions and influence behavior that largely affects decisions to explore or exploit.

The secretary problem: The closest psychology has come to studying social exploration

A version of social foraging is seen in the secretary problem, a well-known experimental paradigm for studying optimal stopping decisions. In this paradigm, an interviewer desires to hire the best secretary from a finite pool of applicants. Applicants are interviewed one by one, in random order of quality. The interviewer can only hire one person. Once they hire someone, they cannot see the remaining applicants; once they reject someone, they cannot return to the rejected applicant later (Seale & Rapoport, 1997). The interviewer's goal is to hire the best person, given the parameters and their limited knowledge. This problem is also frequently known as the marriage problem because monogamous people face a similar dilemma when seeking a romantic partner.

This problem is outside the scope of the current review, as it describes a "transactional relationship" and people are only looking for one person to fill the role, unlike in friendship where multiple partners are possible. Still, this paradigm is worth mentioning for a few reasons. First, it demonstrates that some social decisions can be examined computationally and empirically, which is the ultimate goal of our framework (Carley, 2009). Second, it shows that people do not always behave optimally. While optimal foraging theory suggests the interviewer

should stop looking when the costs of further search outweigh the benefits that could be gained by stopping (Stigler, 1961), in real-life choices, people cannot know when that moment has been reached. Instead, people rely on heuristics and best guesses (Gigerenzer & Todd, 1999). This is acceptable because people tend to *satisfice* (Simon, 1956), or look for a "good enough" solution (Todd & Gigerenzer, 2003), such as a friend whose company they enjoy (Newman et al., 2018) and not necessarily a "perfect friend." Indeed, people general stop "too early" in the search in experimental studies (Rapoport & Tversky, 1970). For instance, one study showed that instead of stopping at the optimal point (in this case, after seeing 37% of the available choices), people stopped after seeing fewer than 12% of the options (Todd & Miller, 1999).

Lastly, work using the secretary problem demonstrates that when humans search for social resources, they do not always follow rules of optimality. In searching for a romantic partner, people do not explore for as long as optimal foraging theory says they should, are biased in their evaluations (e.g., fall into endowment and sunk cost fallacies), and underestimate the likelihood of divorce, all leading to "sub-optimal" foraging behavior (Frey & Eichenberger, 1996). When researchers examined which decisions and heuristics people used in a real speed dating setting, they found that people use stable thresholds related to their attractiveness coming into the speed-dating but also updated their thresholds during the activity (Beckage et al., 2009). The results showed that people are neither rigid nor looking to optimize their search but instead are adaptive and use heuristics instead. We speculate that people will similarly use such sub-optimal strategies in foraging for non-romantic social partners. For instance, people attending social gatherings tend to talk mostly to the people they already know, even if their explicit goal is to network (Ingram & Morris, 2007). Using optimal foraging theory to identify the ideal strategy

for a given person and context can reveal the ways in which people's socializing is sub-optimal, leading to increased loneliness.

The consequences of social exploration and exploitation

The benefits of social exploration (and costs of social exploitation)

Expanding one's network by meeting more acquaintances can lead to more information gain. Weak ties, as compared to strong ties, often have access to different pools of knowledge and connections. Therefore, as Granovetter (1973) demonstrated in his seminal paper on the "Strength of Weak Ties", connections with acquaintances are often more useful in accessing new job opportunities, networking, and information gain. However, people underestimate how much they will learn from strangers in conversations (Atir et al., 2022).

Social exploration in the form of talking to strangers also yields immediate psychological benefits (Epley & Schroeder, 2014). A study on college campuses showed that students reported more happiness and feelings of belonging when interacting with more classmates than usual (Sandstrom & Dunn, 2014a). Even the most minimal social interactions with strangers, such as stopping to greet, thank, and wish strangers well, increase happiness (Gunaydin et al., 2021) and belonging (Sandstrom & Dunn, 2014b). Weak ties, or acquaintances, can also provide social support in difficult life events, and are even sometimes preferred over strong ties (Moreton et al., 2023). Although people usually prefer turning to strong ties for support, they might turn to weak ties when they perceive deficiencies in their social networks or when they are self-conscious about the issue for which they need support (Wright & Miller, 2010). Some people may generally estimate the risk of being open and vulnerable with a close friend to be greater than any risks involved in interacting with strangers and weak ties, leading them to rely more on exploration than exploitation (Small, 2017).

Social exploration can lead to more friendships. Having more friends yields a range of benefits for emotional health (Nangle et al., 2003; Santini et al., 2021), physical health (House et al., 1988), stress, and well-being (van der Horst & Coffé, 2012). Having different types of friends, in addition to many friends, can also allow different needs to be met by different people (H. K. Collins et al., 2022; Kruglanski et al., 2002).

Social exploration increases the likelihood of forming preferred friendships, which can enhance similarity (homophily) or encourage diversity within social networks. People have a strong preference for similarity (McPherson et al., 2001), and therefore naturally choose friends that they are more similar to. In environments that facilitate easier entering and exiting of relationships (indicating that there is more exploration), individuals tend to choose friends with more similar characteristics, even though preference for similarity does not differ across areas (Schug et al., 2009). In large schools where there are many options for friends (e.g., more opportunities to explore), students often show greater similarity to their friends compared to those in smaller schools, despite the increased potential for diverse connections (Bahns et al., 2012). Conversely, social exploration also creates opportunities for more diverse ties. This can yield benefits such as individual creativity and helping society by mitigating ideological "echo chambers" (Cinelli et al., 2021) and reducing the perpetuation of harmful behaviors such as poor study habits (McCabe, 2016), obesity (Christakis & Fowler, 2007), depression (Fowler & Christakis, 2008), and alcoholism (Rosenquist, 2010). In summary, social exploration offers more options to choose and a higher chance of finding desirable friends.

Social exploration is one behavioral strategy that, over the long term, may lead to network brokerage, but it is not the only cause of brokerage. Community members who connect otherwise disconnected subgroups are known as *social brokers*—they broker relations across the

wider community, acting as bridges through which resources and information are transmitted (Burt, 1992). Some become brokers because of roles they fill or jobs they have, not because they actively explore. For example, secretaries in an office who coordinate with multiple departments often occupy central network positions, regardless of personal traits or goals (Sozen, 2012). Likewise, children in immigrant families serve as brokers to connect their parents to institutions, such as healthcare (V. Katz, 2014).

Sociologists have long documented the benefits of network brokerage, beginning with Burt and colleagues (1992). Burt argues that social brokers fill structural holes, obtaining valuable information and having more comparative advantage. As a result, brokers can gatekeep information, elevating their positions in a network and giving them more access to resources (Burt, 2004). This can give them more power, even if their occupational status is relatively low (Sozen, 2012). Social brokerage is associated with better mental health (Erickson, 2003), physical health (Putnam, 2000), and career outcomes (Burt, 2017) for the individual. Social brokers are also important for the greater community because they enable the exchange of ideas and resources that benefit the community. Firm network brokerage is associated with greater levels of innovation both directly (Carnovale & Yeniyurt, 2015) and indirectly through the mediating role of cultural diversity (Derex & Boyd, 2016). Thus, to the extent that social exploration positions people as brokers in their communities, they will reap the documented benefits of high network brokerage.

The costs of social exploration (and benefits of social exploitation)

In terms of seeking out new connections, social exploration can be more mentally and emotionally taxing compared to social exploitation. Interacting with unfamiliar others requires impression management (Leary & Kowalski, 1990) and effortful self-presentation (Vohs et al.,

2005). Additionally, people face the risk of rejection, which is painful (Eisenberger et al., 2003). In contrast, interacting with close others does not require impression management, because one can "let down their guard". Some people may also become more vigilant in the presence of strangers because of their potential to be dangerous. Therefore, exploring can be more socially tiring than exploiting.

Friendships require time and energy to maintain, so extensive social exploration may come at the expense of close friendships. Extroverted people have larger social networks but feel less emotionally close to those within their network (Pollet et al., 2011). Friendships also come with behavioral expectations, such as reciprocal aid. Durkheim (1951) argued that too many social ties could lead to "altruistic suicide," where a person places the needs of too many others ahead of their own needs (Eder et al., 1995). Too many social ties can cause people to feel stretched thin and burdened, resulting in role strain because the demands outweigh the individual's ability to be a good friend (Coverman, 1989). Both the burden of being stretched thin and the disappointment and anxiety of negative role performance can lead to depressive symptoms (Thoits, 1991). Over-integration arises when people are overconfident in their abilities to fulfill roles and desire to positively signal to others their skills (Burks et al., 2013; Gilovich et al., 2005), making them take on more than they can handle. People with an over-integrated network experience the same levels of depression as those with no friends (Santini et al., 2021).

Stovel et al. (2011) argue that brokerage positions are fragile and difficult to maintain in the long term. Many people believe that having numerous friends makes them more desirable partners to others. However, it can actually make other people warier about their abilities to reciprocate obligations (Adams & Plaut, 2003; Si et al., 2021). If homophily is high and people distrust other groups, brokers themselves may be distrusted, ostracized, or pressured to commit

to one group (Krackhardt, 1999). Bizzi (2013) argues that this is because people think brokers may be tempted to privately gain from their role and have access to information that others are not privy to.

Being a broker can lead to greater role conflict; that is, if the roles that one plays in different networks are conflicting, one will have a difficult time in mingled interactions. Being part of groups with different norms and conventions can be cognitively taxing, as seen in people who straddle two cultures such as first-generation immigrant children (Aronowitz, 1984) or low social-class college students (de Vreeze et al., 2018). This mental toll might be partly due to the burden of cultural code-switching (Molinsky, 2007), which can generate anxiety, threat (Molinsky, 2007), or dissonance, especially if these norms are in direct conflict with one's identity, attitudes, values, or existing norms (Maertz Jr et al., 2009). Although being part of groups with different beliefs can create internal conflict and tension for an individual, it may lead to exposure and incorporation of diverse perspectives, a positive outcome on a societal level (Minson & Dorison, 2022).

We argue social exploitation leads to deeper connections and denser networks, which yield benefits. In adolescents, friendship quality was associated with greater adjustment to school (Waldrip et al., 2008), and the quality of friendships mattered more than quantity for university adjustment among first-year students (Buote et al., 2007). The quality of adolescent peer relationships predicted physical health quality in adulthood years later (Allen et al., 2015). Close relationships at early stages are associated with greater self-expansion (Aron & Aron, 1997) and meeting personal efficacy needs (Patrick et al., 2007). Close relationships are shown to provide more social support than weak ties in times of threat (Coan et al., 2006), are better buffers against external stressors (Sarason et al., 1997), and are more likely to provide emotional support

in times of hardship and need (Tooby & Cosmides, 1996). Strong ties can provide financial aid and instrumental services like childcare and health care (Wellman & Wortley, 1990). Social groups comprising densely connected and strong ties (which, we argue, arising from mutual social exploitation) have more shared knowledge, trust, and greater stability and cooperation, because violating norms risks one's reputation within the group (Coleman, 1994).

Balancing social exploration and exploitation

As we have seen, there are social network and psychological downsides to being too socially exploratory *or* exploitative. We conceptualize social exploration and exploitation as separate dimensions at the trait (or longer-term) level—a highly social person can spend time and effort on deepening close ties *and* widening their network. Thus, people can use both strategies, and we suggest a balance of the two is ideal in many contexts.

Among adolescents, those with too many or too few friends had higher levels of depressive symptoms (Falci & McNeely, 2009) for aforementioned reasons: having too few friends is isolating, while having too many friends is burdening. In college, students who occupy broker-like positions (perhaps achieved through social exploration) tended to have better academic performance than students who belonged to a single dense clique. Qualitative evidence suggests this is because network brokerage exposes students to different forms of academic support and diverse behavioral norms on which to model their academic habits (McCabe, 2016). Still, students who belong to densely-connected cliques tended to have more satisfying social lives. The students with the overall best outcomes were the ones who balanced network brokerage and density, perhaps by balancing social exploration and exploitation.

For students studying abroad, befriending peers from the same nation may assuage the stress of living abroad more than befriending local peers (Kim, 2001). We can think of the

former strategy as being *relatively less* socially exploratory than the latter, even though the act of seeking any new friends is exploratory by our definition. Foreign students trying to integrate into local networks may face barriers and threats such as prejudice (Zou & Cheryan, 2017) and cultural differences (Montgomery & McDowell, 2009). Friendships with co-nationals who are also studying abroad tend to be closer than friendships with locals (Robinson et al., 2020). However, exploring connections with host nationals, as opposed to same-cultured peers, is associated with lower homesickness, greater social connectedness, increased life satisfaction, and the cultivation of local knowledge and cultural understanding (Hendrickson et al., 2011). A similar story emerges in immigrants' experiences. Having higher levels of bonding (exploitative) and bridging (exploratory) social capital are both important for integration (J. W. Berry, 1997; Nannestad et al., 2008). Importantly, having more of one type of connection does not impede the development of the other, providing further evidence of our conceptualization that one can do both over time.

In the workplace, larger friendship networks (presumably built through social exploration) predict feelings of social integration (Morrison, 2002). In comparison, stronger social networks (built through social exploitation) predicted more organizational commitment, social integration, and role clarity. In scientific collaboration networks, researchers can collaborate mostly with researchers who also study the same topic, or they can explore different topics and find cross-discipline collaborators. Exploration results in more novel contributions and higher quality outputs (measured by more grant hits and the amount of grant money awarded), but at the expense of a lower overall production rate (Siciliano et al., 2018).

We do not claim that the optimal networking strategy is a perfectly equal investment in social exploring and exploiting. Rather, the optimal balance point depends on many person- and

situation-level factors, which we discuss in the next section. As an example, social brokerage, which can theoretically result from exploration, benefits American (Burt, 1992) more than Chinese organizations (Xiao & Tsui, 2007). Having a narrow, deep (exploitative) network is better in residentially stable, crisis-prone environments, but having a broad and shallow (exploratory) friendship strategy is better in a residentially mobile environments or one where the crisis probably is low (Oishi & Kesebir, 2012).

Since we argue that exploration and exploitation can exist on different levels of analysis, balancing could also mean exploring on one and exploiting on another. For example, one may take a new friend to one's favorite café for lunch. Or one may try novel experiences with a close other. According to Aron & Aron (1997), close others, particularly romantic couples, can engage in novel activities and continue to expand each other's sense of self, mitigating relationship satisfaction decline. This suggests that exploration within an established (exploitative) relationship is important as well.

By reframing social decision-making and networking in explore-exploit terms, we can apply optimal foraging theory to synthesize the many person-level and situational-level factors that should affect exploration and exploitation. In the next section, we recast personality and social psychological findings in explore-exploit terms.

Person-level factors that affect social exploration and exploitation

According to optimal foraging theory, agents should explore more when the costs are fewer than the benefits (Charnov, 1976; Turrin et al., 2017). Some factors that influence the cost-benefit ratio are trait-level, as in dispositional, and some are state-level, or temporary. Some are both. Importantly, some of these costs and benefits are objective (e.g., time scarcity), while others are based on the individual's construals (e.g., sense of security). Often, it is the perception

of costs and benefits that drives behavior, however accurate or inaccurate they are. For example, people often underestimate how much they will enjoy talking to strangers (Epley & Schroeder, 2014), and therefore avoid doing it. This is an example of an inaccurate prediction about the benefits of social exploration leading people to avoid exploring. Keeping the importance of construal in mind, we draw on theoretical and empirical evidence from previous literature on animal and human behavior to discuss how these factors should affect the cost, the reward, or both elements of social exploration.

Dispositional (trait-level) factors

Cognitive capacity to explore

Greater cognitive capacity has been shown to enable more exploration. Exploration requires having adept working memory to hold information about multiple environments. The lower the working memory capacity, the fewer exemplars one can consider at a given time (Kareev, 1995). In other words, the lower the working memory, the greater the cost of exploration. Since other human beings are highly complex resources, these results would also be expected to extend to social exploration. Indeed, one study found that participants with higher working memory capacity could use better recall strategies when naming all the people they knew (Hills & Pachur, 2012). People who are better able to recognize patterns have a greater capacity for learning social and cultural norms (Savani et al., 2022), which might also support serving as a broker and interacting with diverse others. The most direct evidence so far of the link between cognitive capacity and social exploration is a study that found that lower cognitive capacity (measured as dementia risk) was associated with a smaller social network size (Kotwal et al., 2016). However, other evidence suggests greater cognitive capacity only sometimes results in more exploration. It may instead be associated with more *optimal* decision-making. In serial

exploration/decision tasks, such as the secretary problem, cognitive capacity predicts more optimal stopping points, not necessarily more exploration (Hills & Dukas, 2012).

Motivation to seek novelty

For animals, exploration avoidance has been shown to be a stable individual difference that is heritable (Minderman et al., 2009). For humans, we predict a number of individual difference measures capture aspects of the motivation to (socially) explore: sensation-seeking, novelty-seeking, curiosity, trait affiliation, extroversion, psychological richness, boredom, and maximization. Individuals high on sensation-seeking (Franken et al., 1990; Zuckerman, 1971) and novelty-seeking (Cloninger et al., 1991) are more likely to engage in new behaviors, which may include socially exploring. Sensation-seeking predicts the tendency to disclose feelings to friends and casual acquaintances alike, which likely supports new friendship formation (Franken et al., 1990). Trait-level curiosity about the social environment (measured using items such as "I find it fascinating to get to know new people") is associated with trait-level sociability and popularity (Renner, 2006). As non-social curiosity and novelty orientation predicts non-social forms of exploration (Lydon-Staley et al., 2021), we expect social curiosity to predict social exploration, which, in turn, would explain why socially curious people are more popular. To the extent that the personality trait Openness to Experience captures curiosity (Silvia & Christensen, 2020), it may also predict social exploration. On the other hand, we expect trait affiliation (Depue & Morrone-Strupinsky, 2005), the degree to which one seeks and strengthens long-term relationships (Fedurek, 2017), to predict greater social exploitation. Overall, we predict that traits related to novelty seeking would affect desire to explore more than exploit; however, future research should test direct and indirect links between these traits and social exploration/exploitation and which associations are stronger.

Extraversion is also associated with motivation to seek new ties (McCrae & Costa, 1997; Selden & Goodie, 2018). Extraverts enjoy and engage in activities that elicit more social attention than do introverts (Ashton et al., 2002). This may be because extraverts are more sensitive to both social and non-social rewards than introverts, reflected in different dopaminergic activity in the brain (Depue & Fu, 2013). We predict that because extraverts derive greater reward for their social interactions, they would tend towards social exploration. Some studies have found that extraverts have more weak ties (evidence of more exploration) than introverts (Ishiguro, 2016). In one study of a complete network, researchers found that extraverts formed more ties than introverts, occupied more central network positions, nominated more people as friends and were nominated as friends more often (Feiler & Kleinbaum, 2015). In contrast, introverts may lean towards social exploitation because they do not experience the same level of rewards from socializing as extraverts do.

Maximizing is a trait that describes people's desire to find the best possible resource (Schwartz et al., 2002) or friendships (Newman et al., 2018). Maximizers should therefore engage in more social exploration. Psychological richness, an individual's tendency to prefer a variety of interesting and perspective-changing experiences (Oishi & Westgate, 2022), is also theorized to increase exploration. Indeed, a 2-week daily diary study found that psychological richness predicted the degree to which individuals engaged in novel behaviors such as meeting someone new (Cha et al., 2023) This was the case even after statistically controlling for happiness, meaning, positive affect, and openness to experience. On the other side, those that are xenophobic have less of a desire to meet different others (Stürmer et al., 2013).

Boredom is an affective signal to switch behavioral strategies. Boredom can be described as the uncomfortable state of wanting something to be engaged in but being unable to find

something satisfactory (a failure to launch into exploration mode). While boredom can also be a situational factor, individuals can also vary in their proneness to boredom (Danckert, 2019). We expect boredom, whether state or trait, to increase social exploration.

Finally, social exploration is likely to be facilitated or inhibited by people's latent beliefs about the world (Clifton et al., 2019). We predict individuals who construe the world as *enticing*—meaning it is largely interesting, beautiful, abundant, and worth exploring—will engage in more social exploration. Initial evidence suggests that believing the world is enticing is correlated with curiosity, extroversion, openness to experience, and having more friends. Belief that the world is enticing is one of three fundamental dimensions that capture individual differences in how people construe the world (Clifton et al., 2019). These construals about the world seem to be stable traits that are resistant to both chronic and acute situational factors (Kerry et al., 2023; Ludwig et al., 2022), so individual differences in beliefs that the world is enticing are a potentially reliable way to capture individual differences in the motivation to explore.

Motivation to avoid risk

Social exploration should also be affected by one's risk-taking threshold, such that those that are more risk-averse may perceive a greater cost of exploration and choose to exploit more. Conversely, those more tolerant of taking risks may explore more (Figner & Weber, 2011). Depending on the type of risk a person finds aversive, they may avoid social exploration on different levels of analysis. Fear of strangers should, of course, reduce a person's motivation to talk to new people (e.g., exploration at the level of partner selection), while fear of intimacy might reduce a person's motivation to broach new conversational territory with an existing social partner (e.g., exploration at the level of social affordances). Animals explore less when it is more

costly to the individual (Chamaillé-Jammes et al., 2014; Dwinnell et al., 2019; Gower et al., 2008). Those that are more curious and more tolerant of taking risks can explore more. Greater risk-taking is associated with more physical exploration in adolescents (Saragosa-Harris et al., 2022). In addition to tolerance of risk, how safe or dangerous a person perceives their environment to be should also predict how much they are willing to explore. People who perceive the world to be a safer place (Clifton et al., 2019) should be more motivated to explore because they expect the benefits to outweigh the costs.

One way that risk-taking threshold manifests is in attachment style. Infants securely attached to their caregiver expect and believe that the caregiver will be attentive and therefore explore their physical environment more (Grossmann et al., 2008) and engage in more play (Slade, 1987). Conversely, their motivation to explore is dampened when infants cannot rely on their caregivers. Insecure anxious/ambivalently attached children are more anxious and distracted during exploration (Elliot & Reis, 2003). One correlational study measured chronic attachment style in adults and willingness to explore the social (e.g., "I would like to have several friends who are very different from each other."), intellectual (e.g., "I would like to go to a modern art museum."), and environmental realms (e.g., "I would like to explore someplace that I have never been before", Green & Campbell, 2000). Individuals who reported a more avoidant attachment style expressed less interest in social exploration. In adulthood, romantic partners can serve as secure base figures, replacing caregivers (Coy et al., 2012). When spouses exhibit more encouragement, people are more interested in learning, discovering, and accomplishing goals (Feeney & Thrush, 2010), and take more enjoyment in pursuing exploration (Feeney & Van Vleet, 2010).

Trait affect

Trait-level positive affect predicts physical exploration, even when controlling for extroversion (Saragosa-Harris et al., 2022), so we expect it will also predict social exploration. We expect the relationship between positive affect and social exploration is bidirectional, just as it is for semantic exploration (Brunyé et al., 2013), although current evidence is correlational. Self-reported trait positive affect is positively correlated with the daily number of hours of social contact (Watson, 1988) and more variety in social activities (Watson et al., 1992). Furthermore, individuals with high levels of positive affect are more likely to seek connections with others, which, in turn, increases their positive affect (Berry & Hansen, 1996; McIntyre et al., 1990, 1991; Vittengl & Holt, 2000). These studies suggest that trait-level positive affect is related to the amount of social activity, yet do not specify what type of social interactions people look for. It is unclear if trait-level positive affect leads to the search for novel or familiar social contacts.

Depression involves a global lack of motivation (Neese, 2000). Depression has sometimes been shown to reduce exploratory behavior due to an impairment of flexible decision-making (Cella et al., 2010). However, other studies have shown that depression increases exploration in other tasks. Depressed individuals stop later and more optimally in a sequential decision-making task compared to non-depressed controls (who stop too early) and explore more options in another task (Blanco et al., 2013; von Helversen et al., 2011).

How depression might affect social exploration is ambiguous. On the one hand, depression causes people to be more socially avoidant (Fernández-Theoduloz et al., 2019), thereby limiting all types of social connection. One study found that depression is associated with smaller inner circle network size and smaller total network size, suggesting that depression limits interactions with close others *and* with weak ties (Schaefer et al., 2011). Yet, the direction

of causality is unclear (smaller networks could lead to a greater perceived lack of social support, a symptom of depression).

Neuroticism is a personality trait associated with emotional instability and a tendency towards negative affect. Ishiguro (2016) found people higher in neuroticism have smaller inner networks, perhaps reflecting less successful social exploitation, but this effect was smaller than the effect of extroversion. Neuroticism did not predict the size of participants' outer networks—their weak ties—in that study. It is unclear whether this reflects differences in the *motivation* to explore and exploit, or rather neurotic individuals' reduced *ability* to maintain close ties (and their social desirability, which we discuss next).

Social desirability

Some people are motivated to explore yet lack adequate social skills to make connections. Unlike food resources, social resources (e.g., other people) have agency and can choose to reject the decision-maker. Those that want to expand their social network, which involves a bidirectional friendship, need to have greater social desirability (Liu & Ipe, 2010) and make positive first impressions (Denrell, 2005). This can happen by displaying more behaviors that are approved by a peer group (Allen et al., 2005), or having a more similar personality (Selfhout et al., 2010). Certain personality traits have also been linked with greater desirability, such as self-monitoring (Bhardwaj et al., 2016), social flexibility (Paulhus & Martin, 1988), extroversion, and agreeableness (Feiler & Kleinbaum, 2015; Jach et al., 2022) [4]. High self-monitors, who are motivated and highly capable of displaying situationally fitting reactions to interaction partners, are more likely to attract new friends and fill in gaps in a network, bridging groups. They are more likely to be brokers in friendship networks (Sasovova et al., 2010),

[4] Although, what is socially desirable depends on the cultural environment. Most of the findings here are from American samples.

acquaintanceship networks (Oh & Kilduff, 2008), and organizational networks (Fang et al., 2015). Studies on network centrality in organization teams found that those that were more conscientious and agreeable held more central positions in the networks (Selden & Goodie, 2018). Conscientious people are perceived as more competent and dependable (Liu & Ipe, 2010), while agreeable people are perceived as warmer and friendlier. Those high in empathy are central to trust networks (Morelli et al., 2017). People low in neuroticism have also been shown to be more central in informal friendship networks (Klein et al., 2004). Socially desirable people might have an easier time making friends, thereby decreasing the personal cost of, and likelihood of success in, exploring.

State-level factors

Familiarity with the environment

When an agent is new to an environment, they do not know where the best resources are located. Therefore, there is a greater need to learn more by exploring. Only once those opportunities have been sampled is it optimal to begin exploiting. Infants should explore physical, behavioral, and cognitive possibilities before settling into habits. Indeed, juvenile animals engage in more exploratory behavior compared to adults (Gopnik, 2020). Juvenile rodents are more likely to explore aversive but informative options than adult rodents (Moriceau & Sullivan, 2006). In wild spotted hyenas, juveniles are less neophobic, more persistent, and exhibit a greater diversity of initial exploratory behaviors than adults when playing with a puzzle box (Benson-Amram & Holekamp, 2012). In humans, children explore more than adults in a multi-armed bandit task (Sumner et al., 2019), and adolescents explore their physical environment more than adults do (Saragosa-Harris et al., 2022). In industry firms, having an exploratory interfirm network strategy is more valuable in the early information-gathering stage.

However, as the network became more established, densely connected and established ties are more valuable than further network brokering (Walker et al., 1997). The same logic should apply to person-level social decision-making.

As the end of the lifespan approaches, the benefits of exploration decrease because there are fewer opportunities to take advantage of the information gained through exploration. This pattern is seen in how people utilize their social networks as they age. According to the socio-emotional selectivity theory (Carstensen, 1992), younger people explore social relationships more and have broader social networks, hoping these connections can have some payoff in the future. Social networks typically peak in size when people are in their mid-twenties, and contacts peter off as we age (Wrzus et al., 2013). On the other hand, older people focus on shorter-term goals such as emotional regulation and psychological well-being. They become less interested in exploring new relationships and surround themselves more with close others such as family—they socially exploit. Relatedly, age affects how satisfied people are with their current networks across different cohorts of people. In a nationally representative sample from three different cohorts, older adults were more satisfied with the number of friends and the overall size of their social network than younger adults (Lansford et al., 1998). Additionally, older adults had less frequent contact than younger adults did (Lansford et al., 1998).

The same effect of time horizons on social exploration may occur when one's existence in a particular environment, but not life itself, is coming to a close. College seniors reported spending more time with close friends relative to acquaintances (i.e., exploiting) than students who were not graduating (Fredrickson, 1995). Another study manipulated time scarcity of seniors, leading them to think of graduation as very soon or very far, and found that seniors who

thought that graduation was soon participated in more familiarity-seeking behaviors (e.g., spending time with friends, went to a favorite restaurant, etc.) (Kurtz, 2008).

Sense of security

Although feeling safe can be a chronic trait, such as attachment style, it can also be a state-level factor of how an individual currently feels in an environment. Project groups with a higher sense of psychological safety feel it is more acceptable to take creative risks, explore more learning activities, and develop more diverse solutions (Kostopoulos & Bozionelos, 2011). Young children (Bowlby, 1988) and guinea pigs (Porter et al., 1973) explore more in the presence of their mother and siblings, who provide security (Ainsworth, 1979). A study looking at college freshmen found that shy people could expand their social network more when they used a friend as a social surrogate (Souma et al., 2008). When people feel more secure, such as when they are with a social surrogate, they can explore new relationships more. How do we reconcile this security-exploration link with the fact that organisms explore more in new environments, that have the potential for unknown threats? The threat of a novel environment, which should inhibit exploration, is weighed against the benefit of learning about unknown opportunities that demand exploration. Based on evidence from rat studies, rats in a new space alternate between physical exploration and pausing in a newly established safe base (Eilam & Golani, 1989); presumably, with time and familiarity, the need for exploration decreases.

Energy level

Exploration requires more energy; therefore, those in deprived energy states may have less desire to explore. According to the information primacy hypothesis (Inglis et al., 2001), animals are motivated to learn more about the environment. Still, primary needs such as hunger are prioritized over the desire to seek information. As a result, animals exploit more when basic

needs are not satisfied, but explore more when basic needs are already met. In one study, researchers manipulated the energy state of honeybees and found that fed bees, compared to starved bees, sampled the environment more, had a lower consumptive effort, and showed a higher preference for novel rewards (Katz & Naug, 2015).

A similar phenomenon happens in human social exploration. In partial support of the information primacy hypothesis, one study found that cognitive and functional health is positively associated with occupying bridging positions in a network (Cornwell, 2009). Bridging positions are often taxing, requiring fulfillment of social responsibilities and more cognitive load. When people are in inflammatory sick states, they prefer seeking close others as opposed to distant ties (Hennessy et al., 2014; Moieni & Eisenberger, 2018), reflecting the adaptiveness of exploiting when energy is depleted.

Affective state

We have already discussed trait-level differences in affect, but how an individual feels in the moment drives the search for reward and avoidance of threat (Cunningham et al., 2013), potentially manifesting in social exploration or exploitation. For example, negative affect caused by problems and stress can cause individuals to seek more social support from close others, leading to more exploitation (Collins & Feeney, 2000; Cutrona & Russell, 2017). Generally, positive affect encourages exploration in terms of pursuing potential rewards, activating an approach motivation (Carver & White, 1994). Play, for instance, involves exploring behavioral state space and intrinsic rewards (Bekoff & Byers, 1998). Interest-driven curiosity, as opposed to deprivation-driven curiosity, is another pleasurable state that causes undirected idea exploration (J. Litman, 2005). The broaden and build theory proposes that all positive affective states, not just playfulness and curiosity, encourage cognitive and behavioral exploration that builds

physical, cognitive, and social resources for the future (Fredrickson & Branigan, 2005). However, affect can also be separated into dimensions of valence and arousal. In a laboratory foraging task, increases in arousal were correlated with increased exploration, while increases in positive valence increased exploitation (van Dooren et al., 2021). Further research should unpack this complication to our claim that exploration results from positive affect, especially in the social domain.

Situational factors that affect social exploration and exploitation

Aspects of the local or global environment influence exploration in several ways. Generally, a situation will be more conducive to exploration if there are more opportunities to explore, it is easy to do so, and it is socially permissible.

Resource availability

When resources are abundant, people can be choosier and explore more extensively. For example, in large schools, even though there are more opportunities for diverse friendships, people tend to have less of them. This is because big schools present more opportunities to socially explore for highly similar friends (Bahns et al., 2012), and people have a strong preference for similarity (McPherson et al., 2001). In romantic relationships, perceiving many potential mate options makes people less likely to commit to a relationship (Brady et al., 2022) and less likely to be faithful in one (Johnson & Rusbult, 1989).

Resource stability

When resources are depleting, agents must switch to new resources sooner and explore earlier. When resources are nondepleting or replenishing at an adequate pace, agents can continue to exploit (Charnov, 1976; Mehlhorn et al., 2015). In social exploration/exploitation, the concept applies in similar ways. When people frequently move in and out of a community—

when residential mobility is high—one cannot assume friends will always be there when needed. In high residential mobility places, one should continuously socially explore to "hedge" social ties in the event that any established social partner leaves (Oishi & Kesebir, 2012). On the other hand, when people do not relocate frequently, a small, close network could be sufficient (Oishi & Tsang, 2022). In a laboratory study, participants who imagined a mobile lifestyle were more motivated to expand their social network (explore more) than those who imagined a stable lifestyle (Oishi et al., 2013). In a survey of American households, those living in a residentially mobile area were happier if they had a broad, shallow network. In contrast, those living in a stable area with economic challenges were happier if they had a deep network (Oishi & Kesebir, 2012).

A related factor that affects the stability of social resources is relational mobility, the ease with which people can enter and exit social relationships (Yuki & Schug, 2012, 2020). The costs of entering and exiting relationships are lower in a relationally mobile area. Therefore, the environment is more conducive to social exploration. Those in relationally mobile societies report feeling less committed to their friendship than those in relationally stable societies (Thomson & Ito, 2012). Americans, who live in a relationally mobile society, report having larger social networks than Ghanaians, who live in a relationally stable society (Adams & Plaut, 2003). Interestingly, people who live in a relationally mobile society also put more effort into maintaining close ties, such as giving more gifts to their spouses (Komiya et al., 2019). This is because the market is more "competitive," and their ties can leave easily. This seems to suggest that socially exploitative behavior, in addition to socially exploration, is beneficial in a relationally mobile setting.

Environmental threats

When there is a disturbance in the environment, exploration can buffer against adverse impacts because the agent has more knowledge of other resources should exploited options become unavailable. For example, in a sample of data from fish farmers containing over 2,400 trips, researchers found that during undisturbed conditions, there was surprisingly little relationship between exploration patterns and fishing performance (O'Farrell et al., 2019). However, when a major disturbance event closed many major fishing grounds, faster and broader explorers experienced less hindrance to their performance, indicating that previous exploration could deliver benefits during instability/disturbance.

For social exploration, results are mixed. Some argue that shared challenges and hardships in impoverished neighborhoods create a strong sense of community and mutual aid, leading to more exploitative ties with others in the same plight (August, 2014). Ethnographic research posits that poverty creates strong matrilineal networks based on mutual aid among the urban poor (Stack, 1983). A paper by Kim and Suh (2022) notes that lower childhood SES influences people's networking strategy. They found in a US sample that when economic instability was salient, those with lower childhood SES preferred a narrower and deeper network, while those with higher childhood SES preferred a broader and shallower network. Others have suggested that relationships among the urban poor are more unstable since they are endangered by the stresses of poverty (Rainwater, 1970). People with lower socioeconomic status are more likely to get divorced (Matysiak et al., 2014) and have less attachment to their neighborhoods (Belle, 1983). Additionally, for impoverished individuals, social ties may incur more costs than benefits. One study found that many of the life stresses reported by impoverished individuals were from social relationships when others expected something from the individual they felt they could not deliver (Kawachi, 2001). In sum, the results are mixed and more research is warranted.

Physical space

Decades of research in sociology, psychology, and architecture have emphasized the importance of physical space in forming social ties (for a review, see Small & Adler, 2019). Since seeking out social events and friends requires being physically present, those who do not have to travel as far or dedicate as much time to transit should be able to explore more. For example, being in a physically central location allows for more spontaneous interactions and opportunities to meet people. An agent-based model found that agents physically closer to an interaction center are more likely to be more central in a social network (Helsley & Zenou, 2014). In evidence from real neighborhoods, a study of residents in Bloomington, Indiana, found that those living in the center of a block had denser networks than other residents (Campbell, 1990). Additionally, those who lived near grocery stores and churches had denser neighborhood networks. Centralized locations, such as grocery stores, churches, parks, bars, and childcare centers, allow for more social interactions, including spontaneous encounters, to take place (Small & Feldman, 2012). Multiple empirical studies have shown how parks and plazas connect strangers in urban spaces (Hampton et al., 2015; Whyte, 1980). How much people use these parks and the quality of the spaces have been positively associated with the number of friends and acquaintances (Kaźmierczak, 2013).

This exploration can be directed or random. Oldenburg (1989) argues that people use centralized establishments, such as coffee shops and bars not only for consumer purposes but also intentionally to find social ties. Physical spaces can also facilitate random social exploration, where people are not necessarily looking to make friends. Small (2009) found that mothers who enrolled their children in childcare centers had made friends there and had more close friends than comparable mothers who did not enroll their children.

Physical spaces can also lead to greater exploitation. Many studies have examined the strong effects of propinquity on friendship formation (Nahemow & Lawton, 1975). When friends are easier to reach than strangers, one might exploit more. A classic study in an MIT housing complex found that residents were likelier to be better friends with neighbors who lived closer (Festinger et al., 1950). When there are not as many centralized spaces, people are more likely to become friends with those that are physically closer, such as rural neighborhoods having more next-door neighbor bonds than urban environments (Luo et al., 2022).

Cultural diversity

When a culturally diverse community forms, social norms adjust over time to enable social connection in the face of the challenges brought by cultural diversity. In culturally diverse contexts, people tend to trust strangers more (Thomson et al., 2018), are more open-minded (Yakunina et al., 2012), and express themselves more openly (Niedenthal et al., 2019). These adaptations pay off, yielding access to a diversity of social resources. According to Burt (2019), social brokers with greater exposure to diversity can adapt to new environments, increasing entrepreneurial success. One study found that across cohorts of MBA students, international students from populations with greater present-day ethnic diversity were more likely to become social brokers than those from less diverse areas (Wood et al., 2022).

However, in the short-term, increases in cultural diversity can lead to greater intergroup conflict (Shrira, 2020), making the benefits of social exploration less clear-cut. Ethnically diverse settings are characterized by strong homophily and an emphasis on outgroup differences, which can result in conflict, decreased trust (Baerveldt et al., 2004), and greater discrimination (Tajfel & Turner, 1986). When there is greater competition over resources, discrimination may be heightened. In societies with more intergroup conflict, integrating into one group results in

greater access to resources, while being a broker results in more suspicions over loyalty and mistrust. For example, in a highly competitive fishing society with ethnically diverse groups, economic productivity was positively associated with being well-integrated, and negatively associated with brokerage (Barnes et al., 2016). Thus, a culturally diverse society is one in which potential social ties are more heterogeneous and therefore exploring and building a diverse "social portfolio" (Collins et al., 2022) will be especially beneficial. However, the increases in intergroup conflict brought on in the short-term by increases in cultural diversity may outweigh the potential benefits of social exploration.

Social norms

We expect that social norms directly and indirectly govern how much social exploration occurs. Talking to someone outside one's group identity can be frowned upon or even banned in areas of high prejudice and inter-group conflict. In areas with rigid socio-economic stratifications, or divisive religions, such as India, it is against the norm to interact with people outside of one's station (e.g., caste, status) or religion (Montes et al., 2018; Vanneman et al., 2006). Even in places where group divides are not as severe, norms can discourage conversing with strangers, such as on a commuter train or in an elevator (Goffman, 1963). When there is a social norm for conversing, such as in a cab, people assume they will enjoy it more than sitting in solitude, but this pattern reverses in situations with the norm is to disengage (Epley & Schroeder, 2014).

Social norms can also dictate how desirable it is to be an explorer or broker. Individualistic cultures are associated with weaker social ties, while collectivistic cultures are associated with stronger ones (Hofstede, 1980). In a cross-cultural study of the daily interactions of students, Hong Kong Chinese students interacted with fewer people than American students

and had statistically marginally longer interactions (Wheeler et al., 1989). This suggests that American students, who come from a more individualistic culture, tended to explore more than the Hong Kong Chinese students, who come from a more collectivistic culture. A similar pattern was observed in online social networks. Researchers found that country-level individualism was associated with greater network brokerage among over 25,000 Facebook users from 49 countries (Na et al., 2015). Theorists argue that individualistic cultures prioritize personal goals over group goals, and brokerage positions often serve personal goals (Triandis, 1995). On the other hand, collectivist countries prioritize group goals over individualistic goals. Strong commitment within tightly connected groups is therefore emphasized more than intergroup ties (Coleman, 1988). In collectivist cultures, brokers are typically trusted less and have less social capital than in individualistic cultures (Stovel & Shaw, 2012). We hypothesize that it is more socially desirable within a collectivist culture to exploit rather than straddle different networks or explore.

Table 1. List of testable hypotheses of possible factors related to social exploration/exploitation

Predictions of the social explore/exploit framework
1. At the trait level, social exploration and exploitation are two dimensions rather than opposite ends of the same dimension
2. People spend more time with friends who serve as "non-depleting" resources vs "depleting" resources
3. Decision criteria for friends and monogamous romantic partners are different in ways predicted by sequential and optimal stopping search paradigms, respectively
4. Loneliness and well-being partly depend on people's networking strategies being well-matched to properties of their context
5. Networking more closely resembles directed (versus random) exploration when people need something more specific from a partner than social connection
6. The tendency to view social partners in terms of their instrumentality is associated with more exploration than exploitation
7. Compared to the optimal strategy for a given context, people are biased towards exploitation
Predicted outcomes of social exploration & exploitation
8. Social exploration leads to greater network brokerage and more friends
9. Social exploration leads to a greater chance of finding desirable friends
10. Extensive social exploration across time comes at the cost of close ties
11. Having a tendency towards more exploration than exploitation leads to more network churn (losing and gaining friends)
12. Social exploitation leads to denser, more stable networks
13. Social exploration promotes sense of belonging to the wider community
14. Social exploitation promotes feeling socially supported
Person-level factors that predict social exploration/exploitation
People perceive a lower cost/greater benefit to exploring if
15. they have high cognitive capacity
16. they are motivated to seek novelty
17. they have high risk-taking threshold
18. they have high positive affect
19. they are socially desired
20. they are new to an environment
21. they feel a sense of security
22. they have high energy levels
Situational-level factors that predict social exploration/exploitation
People explore more when…
23. there are many other people around
24. their social environment is highly mobile (people come and go)
25. there are fewer environmental threats
26. the physical spaces makes exploration easier
27. there is more cultural diversity
28. there are norms that encourage socializing with outgroup members

Summary and future directions

In this paper, we introduce the idea of applying the exploration-exploitation tradeoff framework to people's choices about their social relationships. While applications of optimal foraging theory to social behavior have been limited outside the context of the secretary problem (Beckage et al., 2009), explore-exploit behavior underlies many well-studied social psychological constructs. The exploration-exploitation tradeoff offers several benefits to social psychologists. First, it can provide a unifying framework for tangential areas of research within psychology and in neighboring fields, including computational theories on how people should choose resources (Sang et al., 2020), social networks (Morrison, 2002), social capital (Putnam, 2000), personality (Fang et al., 2015), and socioecological psychology (Oishi & Kesebir, 2012). All these areas have principles that relate to the tradeoff or detail factors that may influence decision-making.

Next, the framework can be used to uncover when and why people make suboptimal choices about their social resources, leading them to be dissatisfied or unhealthy. As discussed, people often don’t explore minimal social interactions, even if they are shown to increase happiness and belonging (Sandstrom & Dunn, 2014a). In other cases, being over-integrated in too many networks can lead to one feeling “stretched too thin” and more depressive symptoms (Santini et al., 2021). And not only does the application of optimal foraging theory to social psychology help to unite these constructs, but considering other people to be resources also presents new and exciting modeling challenges for optimal foraging theory.

We discussed the potential consequences of both exploration and exploitation, overviewing some of the benefits of each and the dangers of engaging too much in one.

Therefore, exploration and exploitation of social ties should be balanced, as both lead to certain benefits, depending on the agent's goal. The goal may be to gain friends and information, prompting exploration, or the goal may be to build close emotional ties, prompting exploitation (Pollet et al., 2011). Personal and situational factors can also influence when each is more advantageous. Generally, one should explore more when there is a smaller cost to doing so or when there is a greater reward. The valuation of both can depend on individual trait factors, such as how curious or extroverted an individual is, or state-level factors, such as how safe an individual feels in the situation. For situational level factors, the amount of exploration depends on how many opportunities there are to create new ties, how easy it is to find the ties, and how culturally permissible it is to explore ties.

Our society faces a crisis of loneliness and social isolation. We need better interventions to improve connectedness that target both the individual- and community-level. The social exploration-exploitation framework, combined with agent-based models that simulate different networking strategies, can predict the appropriate balance of exploration and exploitation to best meet people's social needs. Future interventions can take a "precision medicine" approach, integrating information about a person's social motivations and abilities, their current network, and their environment to build a custom intervention that nudges them towards more optimal social connectedness.

Applying optimal foraging theory to social connections generates many new questions and hypotheses (see Table 1). Some hypotheses are best tested with correlational longitudinal daily diary studies and self-report measures to measure social exploration/exploitation in daily life. Some hypotheses lend themselves to lab experiments that manipulate state- or situational-factors and measure people's preference or tendency to behave exploratively (e.g., talk to

someone they don't know as well) or more exploitatively (e.g., talk to a close friend). Cross-cultural work can examine cultural variations in the proposed situational factors and others, such as normative tightness-looseness (Gelfand et al., 2011), that might impact social exploration. Lastly, we can collaborate with sociologists to examine the tradeoff with a social network lens (Stadler et al., 2014), uncovering more about the broader impacts of groups exploring or exploiting more.

In sum, applying optimal foraging theory to the topic of social exploration allowed us to better integrate research on the causes, consequences, and tradeoffs involved in social decision-making. We hope that this integrative review inspires new approaches to examining how people build and maintain satisfying social ties.

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