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# Embodying Social Interactions: Integrating Physiology into the Study of Connections and Relationships at Work

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## ABSTRACT

We review how positive social interactions at work affect the physiological functioning of employees' cardiovascular, immune and neuroendocrine systems. We illustrate how consideration of the physiological effects of positive connections and relationships invites new research questions for leader-member exchange, mentoring, and interpersonal helping perspectives. We then raise research questions generated by gaps in the existing literature. Finally, we address the practical implications of pursuing a research agenda that integrates physiological mechanisms and measures.

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Most adults spend a significant proportion of their waking hours interacting with other people at work. In fact, social interactions often account for the largest proportion of individuals' work time (Waldron, 2000). Understanding these social interactions, whether they are enduring relationships or brief connections, is central to understanding organizations as a significant amount of work occurs through them—either by managerial design or by employee choice. Organizational scholars have used a rich array of cognitive, behavioral and affective approaches to understand how social interactions affect a host of individual, group and organizational outcomes and processes (e.g., research on social networks, interpersonal conflict, incivility, trust, helping, caregiving, social support, coordination, collaboration, and learning). But few of the researchers working in these domains have considered the physiological processes associated with social interactions. A focus on physiological mechanisms and measures can provide organizational scholars with insight into the conditions under which social interactions can build physiological resourcefulness and physical health, which in turn can help us uncover how these bodily processes and outcomes affect relational theories and research.

The catalyst for this approach to understanding workplace social interactions is the robust finding, largely unexplored in the organizational literature, that the quality of interpersonal relationships has significant effects on individuals' health, independent of how they affect health-related behaviors such as exercise or smoking, stressful events or depression (Seeman & McEwen, 1996; Uchino, Holt-Lunstad, & Flinders, 1996). Health researchers have turned to physiological measures to help unpack the mechanisms and causality of this finding. However, work relationships make up a relatively small portion of the interpersonal relationships that have been studied, and their contribution to physiology and health is not well understood (Karlin, Brondolo, & Schwartz, 2003; Uchino et al., 1996). One contribution of this paper, therefore, is to

evaluate what existing research can tell us about positive social interactions at work and their association with physiological measures.

We focus on positive social interactions because recent research has shown that positive and negative relationships function through independent bivariate, not bipolar, processes. In this conceptualization, positive social interactions are *appetitive*, or characterized by the pursuit of rewarding and desired outcomes, while negative ones are *aversive*, or characterized by unwelcome and punishing outcomes (Reis & Gable, 2001). This means, for example, that the psychological experiences of positive social interactions, such as mutuality and growth (Miller & Stiver, 1997) are not the opposite of those experiences in negative ones, such as jealousy and isolation (Cacioppo et al., 2002; Fleischmann, Spitzberg, Andersen, & Roesch, 2005). Instead, these psychological experiences of relationships are characterized by different eliciting conditions, mechanisms and outcomes. While we have illustrated these perspectives with psychological examples, evidence supporting this view also exists in the physiological domain (Gable, Reis, & Elliot, 2003). To begin to unpack the physiological processes associated with the robust finding that positive social interactions build health and to understand how these effect appetitive relational processes, we have limited this paper to the study of connections which individuals view as positive.

Our focus on how the body's physiology is affected by positive social interactions opens new possibilities for theorizing. Most of the organizational research that has used physiological measures to understand social interactions has worked within stress paradigms, in which positive relationships function as a source of support during psychological stress or challenging work conditions (e.g., Karasek & Theorell, 1990). While clearly a valuable paradigm, its focus on buffering work stress tends to focus on the alleviation of stress, meanwhile overshadowing the possibility that a broader set of relational phenomena are likely associated with consequential

physiological measures. One purpose of this paper is to illustrate how a number of theories in which positive social interactions are a core component can be understood as being full of physiologically consequential moments. Specifically, in the second part of the paper, we illustrate how an understanding of physiological substrates can enrich three dyadic perspectives on work-based interactions: leader-member exchange, mentoring, and interpersonal helping. All three research clusters have positive social interactions as a key construct. By linking them to physiology, we articulate a foundation on which future research can build on to better articulate how social interactions at work build human health. We then raise important research questions generated by the existing scholarship on work relationships and connections. Answering these questions promises to deepen scholarship on social interactions at work and provide new ways of considering organizations as relational contexts. Finally, we consider the practical implications of pursuing a research agenda built on physiological mechanisms and measures.

When combined, understanding the physiology associated with positive connections contributes to several important discussions in the organizational literature. First, a physiological perspective on relationships provides a new way for organizational scholars to answer the calls for expanding relational perspectives on employees' work experiences (Baron & Pfeffer, 1994; Bradbury & Lichtenstein, 2000; Emirbayer, 1997; Gersick, Bartunek, & Dutton, 2000). By understanding how social interactions affect employees' physiological functioning, we bring to the foreground one research domain in which the interdependence, rather than independence, of people in organizations significantly adds to our understanding of organizational life. Specifically, a relational perspective is fundamental to this paper because it is humans' physiological responsiveness to other people that generates the strong relationship-health link.

Second, physiological measures have recently enriched the theories and broadened the methodological toolkits of researchers across a broad range of disciplines, including psychology

(Cacioppo et al., 2000; Fredrickson & Levenson, 1998; Hazler, Carney, & Granger, in press), sociology (Freese, Li, & Wade, 2003; Freund, 1990) and economics (McClure, Laibson, Loewenstein, & Cohen, 2004; Zak, 2004). With few exceptions, they have not been utilized by organizational scholars. The organizational research that has discussed physiological mechanisms has focused on leadership behavior (e.g., Goleman, Boyzatis, & McKee, 2002), destructive emotions (Frost, 2003; Goleman, 2003), personality (e.g., Ganster, Schaubroeck, Sime, & Mayes, 1991), or on how job features, like control and demand characteristics, shape physiological responses to stress (e.g., Frankenhaeser et al., 1989; Karasek & Theorell, 1990; Steptoe & Appel, 1989). A much broader range of applications is now possible, especially with advances in measurement technology. Because of both the recent development of more sophisticated perspectives on relationship quality and the strong finding that relationship quality affects peoples' physiological functioning, we propose that a high-potential place for organizational scholars to integrate physiological mechanisms and measures is with relational theory and research.

Third, scholars across many disciplines have criticized the mind-body dichotomy, resulting in a more extensive focus on the body. The body has been studied as a physiological system (Uchino, Cacioppo, & Kiecolt-Glaser, 1996), as an object shaped by social structures (e.g., Foucault, 1978), and as an artifact necessary for understanding culture (Douglas, 1986). In the study of organizations, it is rare to theorize about or measure the body (some exceptions include Davis, Diekmann, & Tinsley, 1994; Hassard, Holliday, & Willmott, 2000; Meyerson, 1998; Quinn & Dutton, 2005; Sandelands, 2003). This paper provides one way in which organizational scholars can begin to articulate how and why the body matters in organizational scholarship.

Fourth, the focus on the health-enhancing effects of positive connections is consistent with developments in psychology (Ryff & Singer, 2000; Seligman, 2002), organizational behavior (e.g., Luthans, 2002; Wright, 2003), and organizational studies more generally (Cameron, Dutton & Quinn, 2003; Spreitzer, Sutcliffe, Dutton, Sonenshein, & Grant, 2006) that encourage a focus on the conditions that foster human thriving, growth and health. It also builds directly on psychologists' interest in the generative effects of positive relationships (e.g., Reis & Gable, 2003; Ryff & Singer, 2001).

In the next section, we begin by laying a conceptual foundation for the paper, and then summarize the documented effects of positive social interactions at work on the body in terms of their effects on three physiological systems: cardiovascular, immune and neuroendocrine. This will be the basis for the theoretical and research implications of this perspective for organizational scholars, which we develop in the rest of the paper.

## **LINKING POSITIVE SOCIAL INTERACTIONS TO THE BODY**

### **A Conceptual Foundation**

Our focus is on positive social interactions at work and their effect on the body's physiological functioning. Throughout the paper, we use the terms "connection" and "relationship" to refer to specific types of social interactions. A connection is the micro-unit of a relationship. It implies that two people have interacted and have mutual awareness of the interaction. Connections vary in length, lasting one moment or many, and they may be recurring. When connections between two people are recurring, they are often called relationships (e.g., Gutek, 1995). We use the word "connection" in addition to "relationship" to clarify our inclusion of interaction experiences, those that require neither long duration nor a psychological commitment between participants (Berscheid & Lopes, 1997; Dutton & Heaphy, 2003; Miller &



Stiver, 1997)<sup>1</sup>. The value of discussing connections as well as relationships is that it suggests that brief encounters with another person can be consequential moments of interpersonal contact. This, in turn, allows us to attend to the body's "exquisite responsiveness" to positive connections (Seeman, 2001: 204). Because some of the physiological studies we review assess connections, like evaluating the quality of a particular interaction with a work colleague, while others measure long-lasting relationships, like employees' general ratings of the quality of their relationships with their supervisor, this is an appropriate setting to consider both connections and relationships.

Consistent with our interest in a bivariate theory of social interactions, we assume that people view their encounters at work as positive, negative, neutral or ambivalent (Uchino et al., 2001). Because researchers working on the links between social interactions and health use many different theories and measures, the studies we review in this paper use a variety of constructs and operationalizations. We included every study that measured the physiological effects of the *quality* of social relationships and connections. Common measures are individuals' perceptions of emotional support, social closeness, high quality relationships, or positivity of the interaction. All of the studies cited use a definition that falls under the broad definition of positive connections as subjectively perceived as rewarding or desirable in some way, and all of them focus on one person's perception of the interaction.

### **A View from the Literature**

Most research on the physiological correlates and effects of connections has been conducted outside of work contexts. The vast majority focuses on marital relationships, caregivers of chronically ill patients, and people recovering from a major health event (such as a

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<sup>1</sup> We also use the word "connection" differently than Jean Baker Miller and colleagues, who define connections as positive and growth-fostering (Miller, 1988; Miller & Stiver, 1997). This allows for the possibility that connections can be growth-fostering (life-giving) or growth-depleting (life-depleting).

heart attack), or take place in lab settings. Work-based connections tend to be more instrumentally focused, less discretionary and more short-lived than many of the relationships studied by health researchers (Duck, 2006). Accordingly, we selected studies that measured actual work connections and in three cases, lab settings that approximate them, to capture findings relevant to work contexts. To the best of our knowledge, this is the first paper to focus solely on the physiology of social interactions at work.

We organized this section around three major physiological systems: the cardiovascular, immune and neuroendocrine systems. Each of the three sections begins with a brief overview of the system and then describes what existing research can tell us about the physiological correlates and effects of positive social interactions at work. The nine studies reviewed in the cardiovascular section measure work relationships and connections in naturalistic settings, while the two immune studies are set in naturalistic contexts but measure work relationships only. In the neuroendocrine section, we report on three laboratory studies that model work situations, and a fourth in a naturalistic context. All of the naturalistic studies use self-report measures, consistent with our emphasis on individuals' perceptions of connection quality. In contrast, the three laboratory studies induce the neuroendocrine measure of interest. With the exception of the three lab studies, we can draw only correlational inferences from these studies. Therefore, the existing studies of work social interactions allow us to identify whether there are significant associations, but cannot claim causation.

### **Protective Cardiovascular Effects During and after Work**

The cardiovascular system's major pump (the heart) and distribution system (e.g., veins, arteries, and lymphatics) are responsible for distributing nutrients (i.e., oxygen) and removing waste (i.e., carbon dioxide) from every cell in the body. The studies reviewed in this section rely on three cardiovascular measures. Blood pressure (BP) and its components, systolic and diastolic

blood pressure (SBP and DBP, respectively), are of interest because they have been linked to cardiovascular disease (CVD), hypertension and other cardiovascular illnesses. SBP is considered a more reliable predictor of cardiovascular disease than DBP (Asmar, Darne, el Assaad, & Topouchian, 2001), because it is regulated by the sympathetic nervous system (SNS), which governs the body's "fight or flight" response to stress. Heart rate (HR) is also commonly measured, with elevated HR linked to cardiovascular health risks such as plaques in the carotid artery (Asmar et al., 2001). However, heart rate is a more difficult variable to interpret because it is governed by both SNS and parasympathetic nervous systems (PNS). Therefore, HR's underlying causes and consequences are more difficult to determine.

Tables 1-3 review all the studies we could find that took frequent cardiovascular measures and assessments of positive work relationships or connections. Ambulatory blood pressure (ABP), or readings obtained at regular intervals during everyday life, are particularly strong predictors of future cardiovascular problems (Uchino, 2004), in part because they are more reliable than one-time measures. By looking at cardiovascular patterns over time, researchers can make stronger claims about the links between social relationships and the cardiovascular system. The studies in each table are categorized by the duration of the measurement period (day only, or day and night) and whether relationships or connections were assessed. We excluded studies that had work-related samples but did not specifically measure work relationships (e.g., Steptoe, 2000), as well as six studies that use cardiovascular measures in ways that do not allow for strong inferences (Fletcher & Jones, 1993; Houben, Diederiks, Kant, & Notermans, 1990; Kaufmann & Beehr, 1986; Lercher, Hortnagel, & Kofler, 1993; Thomas & Ganster, 1995; Winnubst, Marcelissen, & Kleber, 1982).<sup>2</sup>

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<sup>2</sup> These six studies assessed cardiovascular measures only once and/or outside of the course of the normal work day. Current psychophysiological methods advise against these practices for two reasons. First, it is now known that one-

Five studies reported the effects of positive work relationships on cardiovascular measures taken during the day as well as the evening (Table 1). Assessing cardiovascular patterns beyond the work day is of interest because it allows researchers to see if work relationships have effects on employees' non-work time and sleep. Researchers have two strategies for studying this. Some researchers take frequent measures beyond the work day (e.g., 24 hours), while others focus specifically on "nocturnal dipping" (Ituarte, Kamarck, Thompson, & Bacanu, 1994), or BP decreases between wakefulness and sleep. Nondipping is associated with cardiovascular damage because the cardiovascular system is working at more taxing, daytime levels for longer periods of time. It has been associated with a number of cardiovascular and circulatory problems, such as organ damage (Palatini et al., 1992; Staessen et al., 2001). Both are valuable because they illustrate the degree to which the cardiovascular system is able to recover from the day's exertions. All of these studies measure work relationships in general, and do not assess specific ones, such as supervisor or coworker relationships.

Four studies utilized the first strategy, frequent measures during the day and into evening hours. The three studies that reported HR found that perceptions of positive work relationships were significantly correlated with lower HR during the day, evening, and, when it was measured, sleep (Evans & Steptoe, 2001; Rau, Georgiades, Fredrikson, Lemne, & deFaire, 2001; Undén, Orth-Gomér, & Elofsson, 1991). None of the studies found any strong relationship between perceptions of positive work relationships and SBP and DBP. The fifth study in this group

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time cardiovascular measures are unreliable (Semmer, Grebner, & Elfering, 2004). Second, when they are taken outside the context of one's normal environment, they are especially vulnerable to "whitecoat hypertension," or higher readings that result from the stress of having one's blood pressure read in, for example, a medical context (Stern, Ray, & Quigley, 2001). More recent studies guard against these two methodological weaknesses by taking an initial baseline measure as well as frequent measures over the course of the time period of interest (Semmer, Grebner, & Elfering, 2004). Therefore, we will not use these studies to draw inferences about the effects of positive connections on cardiovascular functioning. It is important to note that Uchino et al. (1996:491) based their statement that work relationships may not be related to blood pressure on four of the six studies we excluded for methodological reasons. More recent studies, which we review here, have stronger research designs and provide more valid and reliable evidence that work social interactions are consequential for cardiovascular functioning.

measured nocturnal dipping and found that greater work social support was correlated with greater nocturnal dipping.

Together, these five studies provide some support for the hypothesis that when employees perceive their work relationships positively, the cardiovascular system is less taxed not only at work, but into one's non-work and resting times. These studies' samples drew people from multiple occupations, suggesting that this pattern is likely to be found for employees in many settings. However, these studies cannot help us understand which work relationships might be particularly important and why because their measures asked people to report on work relationships in general. In addition, although three of the studies found that heart rate was significantly related to positive relationships, none of the ambulatory studies found significant results for BP. Physiologically, BP has a narrower homeostatic range than HR, meaning that body more tightly regulates BP than HR. To see significant results in BP may require more specific social interaction measures. In addition, we could be more confident of health impact of these effects with studies that demonstrated results for BP variables. The next sets of studies can help address these issues.

Two studies report on the effect of positive work relationships on cardiovascular measures during the day only (Table 2). They differ from the previous set in two ways. First, their samples consist of one type of employee in one organization, instead of the multiple occupations and organizations represented in the Table 1 studies. Second, they analyze specific positive relationships (e.g., coworker, immediate supervisor), instead of general assessments.

Wager et al. (2003) compared the cardiovascular effects of direct supervisors who were viewed positively or negatively by a sample of health care assistants. The authors found that average levels of SBP and DBP were lower when they worked for a supervisor whom they viewed positively compared to one they viewed negatively. In addition to demonstrating blood

pressure effects, this study reinforces the importance of examining the quality of relationships, and not assuming that two peoples' structural positions within an organization are sufficient for understanding either the beneficial or harmful cardiovascular effects.

Karlin et al.'s (2003) study reveals the relative effect of coworkers, immediate supervisors and unit supervisors from a study of Traffic Enforcement Agents in New York City. They found that for women, immediate supervisor support was associated with lower average SBP and DBP, but not HR. For men, coworker support was negatively associated with lower average SBP level, but not DBP or HR. Under high stress conditions, both immediate supervisor support and coworker support were associated with lower SBP. Unit supervisors never had cardiovascular effects on agents. This study indicates that not all positive relationships have cardiovascular benefits, but does not test the mechanisms that explain why some relationships have protective effects, while others do not.

The two studies reviewed in Table 3 differ from the previous ones in that participants rated the quality of social interactions, which can provide us with some insight into the physiological effects of connections as opposed to relationships. There are several key differences between the two studies, including the sampling strategy and data analysis. Holt-Lunstad and colleagues (2003) used event-contingent sampling of social interactions over three days, where the event was any interaction over 5 minutes. Participants averaged 6.3 interactions per day, which is similar to studies using similar time-based definitions of an interaction (Tschan, Semmer, & Inversin, 2004). Eighteen percent of total interactions involved work relationships. Overall, work relationships were rated more negatively than non-work relationships, and work relationships did not affect cardiovascular rates compared to non-work relationships. Because this study analyzed work relationships in comparison to non-work relationships, it may hide the cardiovascular effects of work connections. In addition, because of

the 5-minute definition of interaction, this study may miss many shorter interactions that occur throughout the work day. The next study illustrates these possibilities. Brondolo et al.'s (2003) study assessed a random sampling of social interactions over one workday among employees and students at a medical center. Participants averaged 16 interactions per day (at the time of cuff inflation). These researchers found that positive connections were associated with lower SBP and DBP compared to negative ones, consistent with our claim that positive connections build health.

The cardiovascular studies provide evidence from a variety of contexts that positive social interactions at work have both immediate and enduring effects on the cardiovascular system. As the relationship measures moved from general questions about work relationships and relational context (e.g., Undén et al.'s 1991 measure) to more precise ones about specific work relationships and connections, the cardiovascular outcomes associated with them became more substantive. The Karlin et al. (2003) study also raises the important question of why some positive work relationships have cardiovascular effects, while others do not. Research on the effects of positive connections (as opposed to relationships) was less clear, reflecting the earlier stage of this research. While one study provides evidence that positive connections affect blood pressure (Brondolo et al., 2003), the other study did not, although this was only in comparison to non-work relationships (Holt-Lunstad, Uchino, Smith, Olson-Cerny, & Nealey-Moore, 2003). Additional studies that discern the sources and effects of work connections will be necessary to understand their full physiological and health effects.

### **Strengthening the Capacity of the Immune System**

The immune system defends the body against such challenges as disease and tissue damage (Cacioppo, Bernston, Sheridan, & McClintock, 2000). The study of the psychological modulation of the immune system is a field called psychoneuroimmunology (PNI). PNI researchers typically study health-related outcomes, such as the rate of wound healing, or the

mechanisms underlying those outcomes, such as testing how specific immune cells, proteins or functions, respond to challenges like exposure to a virus (Kiecolt-Glaser & Glaser, 1997; Kiecolt-Glaser, McGuire, Robles & Glaser, 2002). One of the most robust findings of PNI is that the quality of interpersonal relationships can strengthen the immune system, with positive relationships enhancing its capacities (Kiecolt-Glaser et al., 2002; Uchino et al., 1996).

There are two studies<sup>3</sup> that focus on the link between quality of work relationships and the immune system (Table 4), both of which examined their effect in the context of a stressor. Theorell et al. (1990) found that workers' immune systems were buffered from the immunological effects of job strain when they viewed their social support as adequate, but not if they viewed their social support as inadequate. Levy et al. (1990) found that breast cancer patients recovering from surgery had healthier immune responses when they gave higher ratings of emotional support to their doctor and their spouse, while the ratings of the nurses did not have significant effects. Interestingly, seeking social support as a coping strategy and the perception of a physician as a positive source of post-surgery social support was the one significant correlation between independent variables. While this is not a study of employees, doctors and nurses do have a form of working relationship with patients.

Both studies support the broader finding that positive connections strengthen the immune system during periods of acute and chronic stress, such as job strain. There are a number of unanswered questions that future research can answer. First, the two studies discussed here illustrate only the buffering effects of positive social interactions, in other words, how they protect against the deleterious effects of stress on immune functioning. Future research is needed to determine whether work relationships also have direct effects (outside of the context of a

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<sup>3</sup> We excluded Jemmott and Magliore, 1998, because of questions about the methodology previously identified by Stone, Cox, Vladimarsdottir, & Neale (1987) and Herbert and Cohen (1993).



challenge) on immune functioning. Second, because both studies measured relationships, not connections, the existing studies can only inform us about the physiological effects of positive relationships. However, the immune system has been shown to respond to short-term stress (Segerstrom & Miller, 2004), so future research may be able to inform us about the effect of positive work connections on the immune system. Finally, like the cardiovascular studies, the study of breast cancer patients provided additional evidence that not all work relationships are associated with physiological outcomes. The significant correlation between seeking support and perceptions of the doctor may hold some clues as to why some but not all relationships are physiologically important.

### **Healthier Patterns of Neuroendocrine Response**

The neuroendocrine system refers to the interactions between the nervous system and the hormones of the endocrine system. Researchers in this area seek to understand the functions, distribution and effects of these biologically active agents (Snowdon & Ziegler, 2000). This system is of physiological interest because it helps activate a number of other physiological processes, including the immune and cardiovascular systems. It is of particular interest to social scientists because hormones are highly responsive to the quality of social relationships (Seeman & McEwen, 1996) and have effects on behavior (Lovallo & Thomas, 2000). The existing neuroendocrine research related to work relationships focuses on oxytocin (OT) and cortisol. Other hormones have been studied in relation to a broader set of human relationships, such as marital relationships (Kiecolt-Glaser, Bane, Glaser, & Malarkey, 2003; Kiecolt-Glaser & Newton, 2001), which are outside the scope of this discussion.

All hormones have multiple physiological functions. It is the patterns and proportionality of their response that can have health-enhancing or damaging effects (Epel, McEwen, & Ickovics, 1998). For example, cortisol is released when people experience certain types of

psychological stress, breaking down stored sugars (glucogenesis) and suppressing some anabolic processes (e.g., growth and digestion). A healthy response to stress includes both a spike in cortisol and a return to baseline levels, a process governed by other hormones. Both cortisol under- and overactivity are associated with health outcomes (Adam & Gunnar, 2001; Dickerson & Kemeny, 2004).

Researchers concerned with positive social interactions are particularly interested in this physiological system because of recent research which shows that the neuropeptide oxytocin (OT) may be an important physiological substrate of affiliation behaviors (Carter, 1998), by increasing social behaviors and attenuating hormone responses (e.g., cortisol) to stress (DeVries, Glasper, & Detillion, 2003). OT has been featured in many prominent social and medical scientists' theories of social relationships, including theories of love (Carter, 1998; Porges, 1998), maternal and mate attachment (Bartels & Zeki, 2004; Insel, 2000), adult attachment and affiliation (Henry & Wang, 1998), positive social interactions (Uvnäs-Moberg, 1998), and Taylor's (2002) tend-and-befriend stress response theory. Though it was previously thought of as a "women's hormone" because of its role in female reproductive processes such as birth and lactation, it exists in both men and women, and recent research has shown that it is associated with a broad array of social activities, including social elements of learning and memory (Engelmann, Wotjak, Neumann, Ludwig, & Landgraf, 1996; Ferguson, Young, & Insel, 2002).

In spite of OT's promise, there are some reasons to be cautious. The study of oxytocin in humans is still in its earliest stages. No reliable salivary measure has been developed thus far (Horvat-Gordon, Granger, Schwartz, Nelson, & Kivlighan, 2005), making expensive and intrusive blood sampling a necessity for measuring OT<sup>4</sup>. As a result, most of the studies to date

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<sup>4</sup> Oxytocin can be introduced intranasally, a technology that was developed to stimulate labor and induce lactation in women. Manufactured by Novartis, it is not available in the United States. However, it is only recently that researchers have come to some agreement that intranasal OT stimulates the hormones' release in the brain (crosses

have relied on animal samples. Given these challenges, the only studies of OT applicable to work connections take place in lab settings. In addition, theoretical interest in neuroendocrine responses arose from studies of the human stress response, which tends to view social relationships as an evolutionary means for ensuring species survival and reproduction. These theories focus on romantic, reproductive or parental relationships. Therefore, importing these theories and their evolutionary logic into the study of human relationships, and especially those in organizations, should be done with caution (Newton, 2003).

In spite of these cautions, the results of early OT studies in humans are promising. We review three lab studies, two that model exchange relationships using a paradigm from experimental economics, while the third models a job interview. We will first discuss the two studies which use variations on the same economic experiment. The experiment is designed to test trust and reciprocity in exchange relationships (see Table 4 and Berg, Dickhaut, & McCabe (1995) for more detail). One person plays the role of “investor” and the other the “trustee.” Both participants are given an initial sum of money. Any money the investor allocates to the trustee will triple; the trustee then has the choice of returning any amount of money (including zero) to the investor. Each player then keeps all money remaining. Each investor-trustee dyad makes only one exchange, so relationship history does not influence decision-making.

Zak, Kurzban, & Matzner (in press) used this paradigm to examine the effects of positive social cues of trust on trustees’ oxytocin levels. In one condition, the investor conveyed trust to their partner by choosing the amount of money given to the receiver; presumably the recipients perceived the exchanged amount as a signal of their partners’ good intentions. In the second

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the blood-brain barrier) (for discussion, see Born et al, 2002; Carter & Altemus, 1997; Stockhorst & Pietrowsky, 2004).

condition, the amount exchanged was publicly and randomly assigned; the recipient therefore knew that the exchange involved no beneficent intentions on the part of the first-mover.

This simple manipulation had significant effects on trustees' oxytocin levels. When they received the positive social cue, their oxytocin levels were twice as high as those receiving an impersonal cue. In addition, even though participants in both experimental conditions received, on average, the same amount of money, the positive social cue/high oxytocin group returned 53% of the money they had received from their partner, while the impersonal cue group returned zero. This provides evidence that even momentary positive connections have consequential behavioral, as well as neuroendocrine, effects.

In the second use of this experiment, Kosfeld, Heinrichs, Zak, Fischbacher, & Fehr (2005) ran two different versions of this experiment. In the "trust" version, participants play the full version of the game. In the "risk" version, participants only played the role of "investor," because they were allocating money not to a "trustee" but to a "project." The project offered the same pay-off distribution as in the "trust" version of the experiment, providing equal opportunity for profit. In both the "trust" and "risk" versions of the experiment, half of the participants were given OT intranasally, while the other half were given a placebo; therefore, they were experimentally manipulating OT levels. The results showed that OT significantly affected the amount investors transferred to trustees in the trust experiment only, but not the risk experiment. They also found that OT did not affect the amount the trustee returned to the investor.

What can we make of these two initial experiments? Kosfeld and colleagues (2005) suggests that OT underlies trusting behavior, in that it increased the likelihood of an initial investment with a stranger. The evidence regarding reciprocity, or the trustees' behavior, is contradictory. The Zak et al. (in press) study provides initial evidence that OT acts as a physiological mechanism for reciprocity behavior; the Kosfeld et al. (2005) findings did not

support this finding. The most likely explanation for this is that Kosfeld and colleagues did not take into account the Zak et al's finding that trustees' OT increases simply as a result of receiving an initial amount from the investor. If that is the case, then it is not surprising that the experimentally induced OT would have an effect, because *all* trustees' OT levels may already have been saturated. However, replication and more detailed testing of mechanisms will have to resolve these discrepancies.

In a third experiment (Heinrichs et al., 2003) that uses a different paradigm, men were asked to give a mock job interview to a panel of unfamiliar interviewers. There were four conditions, in which participants either had emotional and instrumental support from their best friend or were alone, and were either given OT intranasally or a placebo. The dependent variable was cortisol levels, which is a marker of stress and SNS activation. The researchers found that both OT and social support independently decreased cortisol levels, increased calmness and decreased anxiety, but when combined, the effects on cortisol were amplified. As the OT theories would predict, this finding illustrates that social support and OT interact to engender the psychological and physiological of social support, providing support for the argument that OT is a mechanism through which positive social interactions builds health.

One study addresses the link between positive relationship quality and cortisol's strong diurnal patterns. The degree to which one's cortisol levels follow the normal pattern (high before waking, low from evening to 2-3 a.m. (Lovallo & Thomas, 2000)) is associated with health outcomes (Adam, 2005; Antoni, 1987). Adam & Gunnar (2001) assessed individuals' general relationship functioning (operationalized as an individual difference variable) with four different measures, including qualitative and quantitative data. However, the measures did not focus explicitly on work relationships. Therefore, this only has suggestive implications for the neuroendocrine effects of work relationships. The researchers looked at the effect of relationship

functioning and home and work demands on the cortisol levels of 70 mothers of toddlers. They found that positive relationship functioning, as well as number of children and hours of work, explained a significant amount of variance in the diurnal cortisol rhythms, with higher scores on positive relationship functioning associated with healthier cortisol rhythms.

Together, these four studies support the hypothesis that positive social interactions have beneficial effects on neuroendocrine functioning through either the release of OT or contributing to healthier diurnal cortisol response, which in turn, are associated with better physical health. While this research confirms the general theories about the benefits of positive social interactions on neuroendocrine functioning, future research will have to answer questions about the relative contribution of work relationships and determine the mechanisms that underlie these effects.

### **Positive Work Relationships' Contribution to Physiological Resourcefulness and Health**

The review of these findings illustrates humans' "exquisite responsiveness" (Seeman, 2001) to positive work relationships and connections. We propose that together, these mechanisms build peoples' physiological resourcefulness and health by fortifying the cardiovascular, immune and neuroendocrine systems. By physiological resourcefulness, we mean the body's physical capacity to deal with internal and external challenges and to be in a replenishing state in the absence of challenge.<sup>5</sup> Over time, they contribute to greater levels of physical health, both through separate physiological pathways as well as in combination, since many diseases affect multiple systems.

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<sup>5</sup> Physiological resourcefulness differs from resilience in that the definition of physiological resourcefulness includes how the body is functioning outside of challenging circumstances, while resilience focuses on response to and recovery from a challenging state (Masten & Reed, 2002; Sutcliffe & Vogus, 2003). Physiological resourcefulness is similar to allostatic load (McEwen, 1998), in its attention to the physiological ease or difficulty that dealing with and recovering from a stressful physical states (e.g., hunger or wakefulness) and social and environmental changes (e.g., isolation, crowding, temperature). However, because the construct is rooted in stress research, it is focused on stressful circumstances, while we posit physiological resourcefulness is broader than the focus on stress and recovery from it.

The cardiovascular studies provide evidence that positive work relationships are associated with decreases in cardiovascular reactivity at work and beyond. Over time, elevated HR and BP can have serious effects on cardiovascular health (Uchino, 2004). Positive work relationships appear to strengthen the immune system by bolstering components of immune response. Because the immune system is always alert for challenges such as viruses, the strength of the immune system can have effects on short (Kiecolt-Glaser, Garner, Speicher, Penn & Glaser, 1984) and long-term health (Esterling, Kiecolt-Glaser, Bodnar, & Glaser, 1994; Kiecolt-Glaser, McGuire, Robles, & Glaser, 2002). The neuroendocrine studies suggest that positive work relationships contribute to healthier hormone patterns. Positive social connections appear to prompt the release of oxytocin, which has been shown to have short-term effects on attenuating hormonal reactions to stress, and long-term effects on anabolic processes such as growth (Uvnäs-Moberg, 1998). The cortisol finding (Adam & Gunnar, 2001) suggests that positive relationships contribute to more proportional responses to stress and build long-term reserves of health.

### **THE VALUE OF AN EMBODIED VIEW OF POSITIVE SOCIAL INTERACTIONS**

In the next section, we will draw out some of the ways that physiological correlates and effects of positive work connections can be used to generate new theoretical insights. First, we will examine how three dyadic perspectives on connections at work can be expanded. Second, we will highlight some of the ways that organizational scholars can help to answer important questions raised by the current state of the literature. Finally, we will consider the practical implications of implementing these physiological mechanisms and measures into organizational research.

### **Uncovering New Mechanisms, Antecedents and Outcomes of Dyadic Theories**

Consideration of physiological changes that occur in positive social interactions generates new understandings for a broad range of relational research in organizational studies. To simplify

the extension exercise and to allow for comparability of insights across the three research domains, we focus on three research domains that share a focus on the dyad as the unit of analysis. By introducing a physiological theoretical account into these three research domains we enrich current theory in three ways: 1) by identifying new sets of independent variables; 2) by elaborating the major casual account for how positive social interactions have their effects and 3) by enlarging the range of dependent variables affected by the positive social interactions embedded in each of these theories.

**Leader-member exchange (LMX).** This research domain focuses on the conditions that allow for high-performing linkages between superiors and subordinates (Graen & Cashman, 1975; Liden & Graen, 1980). Based on the idea of role-making (e.g., Kahn, Wolf, Quinn, Snoek, & Rosenthal, 1964), LMX focuses on the quality of leader-member exchanges (e.g., contributions made, loyalty and affect exchanged (Dienesch & Liden, 1986) and its effects on the kinds of role relationships formed between a leadership pair and resulting satisfaction, performance, progress (Graen & Uhl-Bein, 1995) and delegation (Schriesheim, Neider, & Scandura, 1998). Interest in leader-member exchanges grew from the observation that leaders behaved differently in relationships with different subordinates, and these differences had important consequences (Graen, 1976).

By linking positive connections to physiological resourcefulness, we see that the social exchanges that take place in LMX may have more lasting effects and be impacted by other relationships in ways that researchers have not yet considered. One example of how the antecedents can be expanded is consideration of the baseline physiological resourcefulness that people bring to an LMX. The positive connection-physiology link suggests that the leader and members' relationships with others (e.g., peers or family members) fortify or diminish their physiological resourcefulness, which in turn shapes what each party brings to their dyadic



linkage. Research would suggest that the number and quality of positive connections that each person has entering a LMX shapes how much capacity they have to offer contributions, build loyalty and create affection.

This, in turn, highlights a different mechanism for understanding positive exchanges. It may be that positive LMXs are particularly beneficial for subordinates with poor quality and quantity connections because they provide physiological bolstering that they are not receiving in other connections. Subordinates who have many positive connections may not benefit physiologically from LMXs, but instead through other mechanisms, such as the goods exchanged. This physiological perspective provides a fresh perspective on the LMX debate about whether leaders should differentiate among their members (Sparrowe & Liden, 1997), by providing researchers with an additional way of looking at the contribution of a positive LMX.

A focus on the physiology of positive connections also suggests researchers might look beyond exchange currencies as the only way that quality-in-connection is created. It urges consideration of how positive social interactions create their own vitality through the way that the exchange of valued resources (e.g., loyalty or positive affect) translates into enhanced physiological resourcefulness. Physiological resourcefulness, in turn, may enhance people's ability to interrelate in other currencies (e.g., a heightened capacity to make contributions, experience loyalty, and feel and express positive emotions) which translate into desired outcomes in LMX.

**Mentoring.** Another fruitful area of dyadic research on relationships focuses on mentoring at work. Launched by Kram's book in 1985, mentoring research focuses on the practices, processes and outcomes of formal and informal developmental connections between bosses and subordinates (most often) and peers as well. In prototypical mentoring research, someone who is older provides socio-emotional, career and/or role modeling support to a person

who is younger or less experienced (Scandura, 1992). More recently, images of mentoring are more mutual and generative, with mentor-mentee relationships taking all kinds of forms and evolving as the needs and situations of mentor and protégé change over time (Ragins & Verbos, 2006). Meta-analyses of empirical work find that having mentoring relationships is related to a protégée's career and job satisfaction, and impacts career outcomes such as promotions and raises (Allen, Eby, Poteet, Lentz, & Lima, 2004). Increasing workforce diversity and hiring practices that facilitate career success for individuals from diverse demographic backgrounds have put mentoring practices in the spotlight, further propelling mentoring research and interest (e.g., Blake, 1997; Noe, 1988; Ragins & Cotton, 1999; Thomas, 1993). In addition, the recent extension of thinking about mentoring as a single dyadic relationship to one that is more connected to a developmental network (e.g., Higgins & Kram, 2001) has opened up how researchers consider the structure and process of mentoring.

Seeing the links between positive connections and the body opens up new possibilities for theorizing the mechanisms through which mentoring has its effects in work organizations, as well as suggesting both shorter-term and longer-term impacts of this form of positive work connection. It is clear from the research that psychosocial support affects protégées differently than career-based support, but the mechanisms that explain this effect are unclear (Allen et al., 2004). Our review suggests that psychosocial support which involves providing acceptance, confirmation, friendship etc., may have a stronger tie to bodily changes in the protégé, and in both people if the connection is mutually positive. Thus, the power of psychosocial support in building ties that deliver enhanced objective and subjective career outcomes may be due, in part, to the health-enhancing effects of the connection on the neuroendocrine, cardiovascular and immune systems. At the same time, this link emphasizes the major cost of not having the positive connection that is possible in a mentoring relationship. Thus, the physiology-social interaction

link also emphasizes the opportunity cost of not having effective mentoring, which may even be more consequential than previously theorized.

In addition, this link also suggests that mentoring relationships can have big impacts when they create the physiological signature of positive connection. A mentoring relationship might function in the way that immediate supervisors affected the traffic enforcement agents in Karlin et al.'s (2003) study, in which having a positive relationship with an immediate supervisor helped to attenuate the physiological effects of high stress work situations, even when the immediate supervisor isn't physically present to provide support. Future research might consider tracking longer-term effects of mentoring (or other support-based relationships at work) on an individual's health and other health-related outcomes.

**Interpersonal helping and relational practice.** Research also has focused on the content and form of interpersonal helping and the difference it makes in work organizations. Interpersonal helping, whether in dyads or teams, is increasingly important because of the heightened interdependence and dynamics of work. Some call interpersonal helping a relational practice to emphasize the centrality of relationships to the knowledge and skill involved in this form of interpersonal behavior (Fletcher, 1999). Others locate interpersonal helping under the umbrella of prosocial behavior (Brief & Motowild, 1986), citizenship behavior (Organ, 1988) or contextual performance (Organ, 1997). No matter where it appears, interpersonal helping describes the behaviors involved in providing assistance, aid and/or emotional support to another person in need in an organization. The needs can be big (e.g., funding for a major technological innovation) or they can be miniscule (e.g., needing details about the history of a new project). In fact, they may not even be noticed by the person receiving help until the other provides it.

Considering the empirical linkages between positive connections and the body suggests that acts of helping can build resourcefulness in another person beyond simply the delivery of

needed assistance. As was the case for theories of LMX and mentoring, consideration of the physiology-relationship link suggests there may be additional mechanisms to consider when explaining why positive interactions create desirable outcomes. An embodied view of helping suggests that helping can be fortifying for both the help giver and receiver because of the physiological changes that accompany relationships. However, physiological resourcefulness may be built through different mechanisms for each party. Recent research suggests that giving help may have more beneficial effects on health than receiving it (Brown, Nesse, Vinokur, & Smith, 2003). However, positive physiological effects may only occur in the receiver if he or she perceives the help as desirable or useful (Deelstra et al., 2003). As was the case with LMX and mentoring literatures, a focus on the physiological effects of positive connections suggest that different forms of helping may be more potent and long-lasting if they have the core ingredients of positive connections.

If we consider patterns of interpersonal helping and their possible effects on the body, we also get a new angle on what contributes to capabilities at the unit or organizational level. When considering how dyadic behaviors build an individual's health, one can see new possibilities for how collaboration, coordination or other relational capabilities get built and sustained at a more macro level. For example, one sees new possibilities for understanding the development of coordination capability when helping is a normal and expected part of everyday task behavior. Gittel (2003) describes the excellence achieved by Southwest Airlines' plane departure teams and attributes it in part, to the mutual helping, shared goals and shared knowledge that are part of what she calls relational coordination. The physiology-connection link says that this heightened collective capacity to coordinate through relationships is partially due to the increased resourcefulness of people in these positive relationships because of how they enable human physiology. One could imagine that this kind of coordination advantage sustains and replenishes

itself through the positive relationships which nourish human capability by reducing negative physiological effects and increasing positive physiological effects.

### **Future Research Possibilities**

Consideration of the LMX, mentoring and helping literatures exposes several research possibilities opened up by consideration of the physiological effects of positive connections at work. First, we see that by tracing the effects of positive connections on the body, we gain new leverage into understanding the mechanisms through which interactions between people translate into desirable outcomes such as subordinate growth and development, increased career opportunities, or more effective task execution. The focus on the body shifts attention to the resources created within a human body (through a strengthening of the cardiovascular, immune, and neuroendocrine systems), as opposed to focusing on the exogenous resources that people in a relationship exchange, as a causal force that explains how positive connections produce desirable outcomes. Thus, one contribution of this embodied view of positive connections is to increase the range of causal mechanisms considered in explaining why and how positive connections have their effects.

At the same time, a focus on human physiology clearly opens up the range of outcomes considered when talking about relational dynamics in organizations. An obvious example would be to consider how LMX, mentoring and helping relationships actually affect employee health, perhaps considering physiological health such as the frequency of colds and days absent, but also more serious health implications such as disease rates or rates of mortality. In addition, one might consider the health-building effects of these positive connections by considering how relational behaviors like LMX, mentoring and interpersonal helping increase individual thriving (Spreitzer et al., 2006), human flourishing (Keyes & Haidt, 2003) or psychological well-being (Diener, Suh, Lucas & Smith, 1999).

Finally, consideration of the positive connection-human physiology linkage opens up new research opportunities for understanding how organizational contexts affect human capability and health through how they shape interactions and opportunities for building positive connections. For example, with this lens, one might consider how different organizational structures (e.g., levels of hierarchy, divisional groupings), reward systems or socialization processes make the building of positive connections between people more or less likely, thus paving the way for the building of human health through the physiological pathways we have outlined in this paper.

### **Expanding Scholarship about the Physiological Substrates of Social Interactions at Work**

Current research on the physiology of positive social interactions provides a solid foundation for our claim, but also prompts a number of important questions that organizational scholars are well-placed to answer. The answers to these questions have important implications for issues central to organizational scholarship. We focus on four. First, we consider which connections have positive physiological effects and why. Second, we assess the effects of multiple connections of varying qualities. Third, we reflect on how physiology can help us understand the micro-processes that occur in relationships (i.e., relationship conflict and trust repair), especially because they have provided important insights in non-work relationships. Finally, we look at how these findings prompt us to think in new ways about the interconnections of work, home and other life domains.

First, several cardiovascular and immune studies found that some but not all work relationships are associated with physiological outcomes. This raises the important question, which work relationships matter and why? The handful of studies that both assess specific relationships and integrate physiological measures of social relationships in their larger social contexts are the most informative in suggesting answers to this question. For example, Kiecolt-

Glaser and Newton (2001) argued that people are physiologically sensitive to those relationships which they view as important to the self. In their review of the literature on U.S. marital relationships, they argue that women are more likely to have self-construals characterized by relational interdependence compared to men, which they use to explain women's greater physiological sensitivity to marital relationships. In an example from medical anthropology, Dressler and colleagues (1997) found that the degree to which people's social support is "culturally consonant" with the cultural ideal of social support is a better predictor of blood pressure than is the general availability of social support.

Based on these studies, one could hypothesize that individuals are physiologically affected by relationships that are socially and culturally constructed as meaningful to the self. This explanation would be consistent with the Levy et al. (1990) finding; breast cancer patients may see emotional support from their doctors as rewarding or particularly diagnostic of their ability to recover from surgery. In seeking to understand which work relationships and connections are likely to benefit health, organizational scholars can turn to familiar theories, such as social identity theory (Tajfel & Turner, 1986), and both qualitative and quantitative research methods to try to understand what makes a relationship meaningful to the self in organizations, and how much this varies across organizations, industries, and cultural contexts. For workers who work outside of formal organizations, such as independent contractors or temporary employees (Barley & Kunda, 2004; Blatt & Ashford, 2004), the constellation of people who compose one's relational context may be especially important given the lack of interpersonal relationships enabled by a formal organization, in part because of the physiological boost that positive work relationships provide.

Second, employees' relational contexts are full of connections and relationships, some of which have beneficial physiological effects, while others are likely to be neutral or harmful.

Future research can examine individuals' full relational constellation (Higgins & Kram, 2001) for its cumulative physiological effects. For example, researchers can examine how protective or health-enhancing one positive relationship can be in the context of a toxic work environment (Frost, 2003; Kahn, 2001), perhaps helping to explain why having one friend at work can make such an important difference in work satisfaction (e.g., Harter, Schmidt, & Keyes, 2003).

Organizational scholars can also build on social network research (e.g., Wellman & Wortley, 1990). Social ties, a foundational element of social networks, vary by quality as well as their location in a larger network structure (Baker, Cross, & Wooten, 2003). The study of social networks has the advantage of having multiple ways to think about structural aspects of social interactions. One social network application of the physiology-social interaction link is to help explain the formation of networks in organizations. For example, OT is hypothesized to increase feelings of calmness and decrease feelings of anxiety; in animal models, it has also been shown to cause the seeking out of additional social contact (Taylor, 2002; Uvnäs-Moberg, 1998). People may seek out interactions with people with whom they experience physiological resourcefulness, and avoid people with whom they become physiologically depleted. Another application would be to consider how the physiological processes underlying positive social interactions affect processes like diffusion. In addition to standard mechanisms of information and influence, we might consider how social interactions generate physiological reactions that make people more or less open to adopting a new behavior or practice, through processes such as trust. Finally, consideration of physiological affects of social interactions introduces new ways of thinking about pivotal ideas like reciprocity in ways that better specify how and why reciprocity effects persist.

Current research on social interactions at work cannot tell us much about the micro-processes underlying work relationships. Recent scholarship on work relationships has begun to



examine these dynamics (e.g. trust repair, Pratt & Dirks, 2006), and based on the study of non-work relationships (Gottman, 1998; Kiecolt-Glaser et al., 2003), we might expect this would be a useful area to integrate physiological measures. The quality of two coworkers' relationship may vary substantially over time, punctuated by disagreements and conflicts that provide internal challenges to the relationship, as well as "bonding experiences" that bring people closer together, like working very well together on a successful project.

Researchers may be able to uncover how peoples' physiology marks such critical interactions and examine whether that physiological reaction is invoked by simply recalling that interaction. For example, some research has shown that the memory of an interaction can invoke the physiological markers associated with that individual (Bloor, Uchino, Hicks, & Smith, 2004; Uvnäs-Moberg, 1998). If the physiological effects of positive social interactions can be evoked through recall and memory, then this may help explain why a relationship can be generative over long periods of time, or in spite of infrequent contact. It may also help explain how and why people have difficulty recovering from a relationship conflict (Sias, Heath, Perry, Silva, & Fix, 2004). The degree to which organizations prompt people to recall prior work relationships may amplify both positive and negative physiological effects of relationships.

Finally, one underlying theme in the literature is that when work relationships do have a physiological imprint, they can last beyond the work day. We know from research on non-work relationships that they, too, have lasting physiological effects (Kiecolt-Glaser & Newton, 2001; Medalie & Goldbourt, 1976). Recent research has shown that relationships are one key pathway through which work & non-work domains connect (e.g., Adam, 2005; Greenhaus & Powell, 2003). These findings illustrate that the boundaries researchers, as well as organizational members, draw between work and non-work are actually quite porous.

For organizational researchers, considering the physiological effects of work relationships provides us with a new window into understanding why and how work and non-work contexts affect one another. For example, we can see how relationships in one domain engender either appetitive or aversive relational processes, which may carry over – intentionally or not – into other domains. As people transition from one domain to another, they use a variety of techniques to either amplify or diminish their psychological states (Ashforth, Kreiner, & Fugate, 2000; Nippert-Eng, 1996). By understanding that there is a physiological substrate to these transitions, in addition to cognitive, behavioral and physical ones, we have a new way of considering the effectiveness of these techniques. From a practical standpoint, we may be able to help employees think about the more effective ways to manage, or self-regulate, these transitions.

### **PRACTICAL IMPLICATIONS OF IMPLEMENTING THE RESEARCH AGENDA**

We have outlined an ambitious research agenda. The broader availability, increased quality and decreased intrusiveness of physiological measures makes the time ripe for integrating them into organizational research. However, it is also an agenda that requires using a type of data unfamiliar to many organizational researchers. What are the key issues that organizational researchers should be aware of if they decide to enter these unfamiliar waters? How can organizational researchers incorporate physiological measures into their research agendas? We briefly overview several key issues and suggest some resources and strategies for incorporating human physiological measures into an organizational research agenda.

One of the key issues in using physiological data for research is thinking carefully about the meaning of the data itself: What construct is the physiological data intended to represent? What is the theoretical purpose of including physiological data in a study? We mention this first because, to those who are unfamiliar with it, physiological data can have a powerful aura of

providing “hard data” about the “truth,” not unlike the way that medical doctors and their diagnoses have a legitimacy that is not always earned by the quality of the particular doctor or the state of medical science. Physiological data, like any other kind of data, has its own sources of measurement error, and has additional concerns of the cost and difficulty of measuring them.

One truism of physiological data is that “physiological systems are subsystems of the organism that have their own characteristics and their own basic functions. They follow their own basic laws and are only loosely coupled with each other and with other response systems such as psychological and behavioral reactions” (Semmer, Elfering, Grebner, 2004: 225). This statement has a number of implications, including the importance of both understanding and taking into account the multiple purposes of any one physiological variable, and having clarity about the relationship between physiological data and other domains of analysis, including psychological, behavioral, and social. We will unpack each of these implications below.

To illustrate, we can consider the example of the hormone cortisol. As we discussed in the neuroendocrine section, cortisol is released under stress and then returns to baseline levels, which, as we saw in Heinrichs and colleagues’ (2003) study, is governed by other hormones, such as OT. Cortisol is also present in the body throughout the day in a strong diurnal pattern. The diurnal pattern itself is influenced by both “trait” or stable factors, and “state” or time-varying factors. One study found that between 24 – 36% of variation in morning cortisol levels was due to stable factors, about 62 to 74% was due to state factors, and the rest was due to measurement error (Shirtcliff, Granger, Booth, & Johnson (2005) as cited in Adam (2005). All three ways of measuring cortisol – cortisol spikes, recovery from them, and diurnal patterns of cortisol all are associated with health outcomes, though different ones.

This simple example has a number of research implications. First, it shows the importance of taking into account the multiple functions of physiological measures when

designing a study. If one is interested in measuring cortisol spikes in reaction to stress (e.g., Fischer, Calame, Dettling, Zeier, & Fanconi, 2000), it is important to control for the time of day – the diurnal pattern. If one is interested in explaining the “state” variation in diurnal patterns of cortisol (e.g., Adam, 2005), then it is important to take multiple measures throughout the day, in order to compare not just levels but changes in the levels (or slopes), to measure psychological and social variables that might contribute to cortisol spikes, and ideally to measure more than one day to see if the *pattern* is stable. These factors informed our decision to exclude the cortisol data reported in the study by Evans and Steptoe (2001); they measured cortisol only twice over the course of a day (which would allow them to capture only two points of a nonlinear pattern), and compared individuals’ absolute levels, not slopes. However, we did include Adam and Gunnar’s (2001) study which measured cortisol 6 times over the course (which did allow them to capture the diurnal variation) and analyzed the *pattern* of cortisol responsivity (e.g., the slopes). (Similar concerns led us to exclude certain cardiovascular studies; see footnote 2.)

Second, it is critical to understand that the relationship between different domains of analysis (the social, psychological, physiological, behavioral) are often more complicated than one would expect. The relationships between levels are “loosely coupled” because of the multiple functions all physiological measures have in the body. As a result, it should not be surprising to learn that the correlations between physiological data, self-rated health, physician-rated health, subjective experiences of one’s body (e.g., symptoms) and measures of subjective well-being are generally quite low (Brief et al., 1993; Pennebaker, 1983; Semmer, Grebner, & Elfering, 2004). For example, a fascinating study of nurses and physicians focused on cortisol reactions (as a measure of physiological measure of stress) and paper and pencil measures of subjective stress (Fischer et al., 2000). Interestingly, 70% of the cortisol spikes occurred when participants were not aware of psychological stress, but instead occurred in reaction to routine

events, such as nurses' handover to the next shift or residents' presentation of a patient at rounds. The lack of correlation does not mean that the measures should be disregarded or ignored, but it points to the importance of clarifying and testing one's assumptions about the relationship between constructs and variables in various domains, especially when working across such broad levels of analysis levels.

Each of the issues mentioned here in relation to cortisol could be said about any physiological measure or construct (e.g., allostatic load). In a sense, the guidelines provided here are no different than those for any research design; careful attention to conceptualization and measurement is always a necessity (Singleton & Straits, 1999). What should be clear is that interpreting physiological data requires coupling it with other kinds of data (Semmer, Elfering, & Grebner, 2004). Most important for research about positive connections is self-report data that captures peoples' subjective views of the quality of connections and relationships.

There are also a number of research design issues to consider. First, as the cortisol example illustrated, the research design must reflect the characteristics of the physiological parameter being studied. Second, as the current literature indicates, some physiological measures are easier to assess in naturalistic settings than others, which has implications for the feasibility of research designs. There is a longer tradition of cardiovascular measures in naturalistic settings, while neuroendocrine measures have been more often assessed in the laboratory. Some of the most innovative immune studies (though not necessarily focusing on social interactions) have been field studies (e.g., Marucha, Kiecolt-Glaser, & Favagehi, 1998). Some organizational research has aptly demonstrated innovative combinations of the two (e.g., Schaubroeck & Ganster, 1993). No matter what the research design, there are often sets of standard control variables that are essential to making sense of the data, including medication and current health

status, smoking and caffeine intake, physical activity, among others (Cacioppo, Tassinari, & Berntson, 2000; Kiecolt-Glaser & Glaser, 1988).

This brief overview of the practical considerations of using physiological data in research can only scratch the surface of this complex topic, just as ten paragraphs on survey methodology or ethnography would. Stepping back from the specific considerations of measurement and research design, the research agenda that we have outlined requires interdisciplinary collaboration. The abundance of scholarship and knowledge on the physiology of social interactions that has developed in the last twenty years has occurred in large part through the collaboration of experts from many fields (e.g., Ohio State's Institute for Behavioral Medicine Research). In classic fish-scale fashion (Campbell, 1969), scientific innovation has occurred through the overlapping of fields. Our hope is that this paper will provoke interest in a physiological perspective on social interactions in organizations, prompting continuing innovations across fields.

## **CONCLUSION**

Relationships at work are a keystone construct in theories of human behavior within organizations (Bradbury & Lichtenstein, 2000; Brass, 1985; Gersick, Bartunek & Dutton, 2000; Kahn, 1998; Pfeffer & Baron, 1994). A focus on the physiological correlates and effects of positive social interactions adds a critical new dimension to understanding why and how they affect organizational life. It documents and explains the variety of ways that social interactions with others leave lasting imprints through how they affect the functioning of key bodily systems. We have focused on the beneficial effects of positive connections because of the robustness of the finding in study of non-work relationships and because we believe it allows us to advance several important conversations in organizational research.

The physiological perspective has allowed us to paint a picture of individuals not only as cognitive processors (e.g., Walsh, 1995) and emotion conductors (e.g., Barsade, 2002), but as physiologically embodied and connected to others in vital ways. It pushes us to understand how the quality of social interactions can build human capacity in organizations. In essence, it provides us with a new way of considering the importance and effects of the relational landscape of organizations. It also joins research that highlights the importance of peoples' subjective experience of their work. Our paper provides evidence that peoples' subjective experience of their connections with others can have immediate, enduring and consequential effects on their bodies. In this way, our focus on the body as physiology affirms the fundamentally important effect of work contexts—for better or for worse. We see this depiction as a theoretical and practical view that more completely recognizes employees' embodied existence as complicated and consequential bearers of the effects of organizational systems and the social interactions they cultivate.

<b>Table 1: Cardiovascular Studies with Relationship Measures and Frequent Day and Evening Cardiovascular Measures</b>				
<b>Study</b>	<b>Work Context &amp; Participants</b>	<b>Positive Relationship Construct and Measure</b>	<b>Physiology Measure</b>	<b>Results</b>
Undén, et al. (1991).	148 members of 7 occupational groups (31 women): physicians, teachers, musicians, policemen, train engineers, prison personnel, saw mill workers.	5 items intended to operationalize a three-part definition of social support: high quality relationships with coworkers, good working environment, strong group cohesion: "I have a good relationship with supervisor," "I am getting on well with my coworkers," "There is a pleasant atmosphere at my workplace," "There is a good group cohesion at my workplace," "There are often conflicts and arguments at work." (No Cronbach's $\alpha$ provided.)	SBP, DBP, HR measured every five minutes for 24-hour period, including one normal work day.	<i>Support: effects of work relationships during and after work</i> - Higher perceived social support associated with lower HR during work, leisure and sleep. SBP not associated with SS. - Subjects with low social support had higher SBP than those with high or mid-levels of support.
Landsbergis, et al. (1994).	262 men at 8 New York City worksites.	4 items for co-worker support (competent co-workers, friendly co-workers, co-workers helpful in getting the job done, co-workers taking a personal interest in me), and 4 items for supervisor support (getting people to work together, supervisor helping in getting the work done, supervisor pays attention to what I am saying, supervisor concerned about welfare of those under him or her). Based on modified Job Content Questionnaire (Karasek et al., 1985). (Cronbach's $\alpha = .70$ ) Source of support not separated in analysis.	24-hour ambulatory SBP and DBP on one normal work day.	<i>Inconsistent support.</i> - High SS did not have a main effect on SBP or DBP. Did not report HR. - High SS had mild but inconsistent effects under high job strain conditions.
Ituarte, et al. (1994).	120 employees of universities, hospitals, city and county offices, and private firms in the Pittsburgh metropolitan area. (26 Black men, 30 White men, 34 Black women, 30 white women.)	6 items for coworker and work supervisor support with social support subscale of Job Content Questionnaire (Karasek et al., 1985). Items not specified. (Cronbach's $\alpha = .84$ ) Source of support not separated in analysis.	24-hour ambulatory SBP, DBP, HR on one normal work day. <i>Dependent variable:</i> Nocturnal dipping: Calculated by subtracting nighttime BP from daytime BP. Higher scores indicate more dipping.	<i>Support: effects of positive work relationships on nocturnal dipping.</i> - In partial correlation analysis, greater work SS was significantly associated with nocturnal systolic dipping. No difference in work SS between black and white participants. (Researchers interest was in racial differences so no further analysis was conducted on work social support.)
Evans & Steptoe. (2001).	61 nurses and 32 accountants (53 women)	Replication of Undén et al., 1991 (see summary above.) (Cronbach's $\alpha = .76$ )	HR, SBP and DBP measured 5 times during the day and evening with self-monitoring equipment, on 3 normal work days and 2 leisure days	<i>Support: effects of work relationships during and after work</i> - High SS associated with lower HR during day and evening of work days. Not related to SBP and DBP.



Rau, et al. (2001).	75 working men from small Swedish town with borderline hypertension; 74 age-matched healthy controls.	4 items regarding the possibility of interacting with coworkers and habits of seeing colleagues outside of work. (No further information provided.) (No Cronbach's $\alpha$ provided.)	SBP, DBP, HR taken every 15 minutes for 24 hours on one workday.	<i>Support: effects of work relationships during and after work</i> - High SS related to lower HR at work, night and during recovery at night. SBP and DBP not related to SS. The effects did not differ by hypertension status.
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**Table 2: Cardiovascular Studies with Relationship Measures and Frequent Day (only) Cardiovascular Measures**

Study	Work Context & Participants	Positive Relationship Construct and Measure	Physiology Measure	Results
Karlin, et al. (2003).	70 NYC traffic agents (36 women).	Perceived emotional support from (1) coworkers (7 items) ( $\alpha = .83$ ), (2) immediate supervisors (16 items) ( $\alpha = .77$ ), (3) unit supervisors (7 items) ( $\alpha = .86$ ). Based on a modified Job Content Questionnaire (Karasek et al. 1985). Items included those listed in Landsbergis et al. (1994), as well as “My coworkers care about me,” “The people I work with encourage each other to work together,” “My supervisor gives me credit for things I do well,” “My supervisor cares about me,” “My supervisor appreciates me.”	SBP, DBP, HR; collected during one eight hours workday. Measured every 15 minutes.	<i>Support: both main and buffer effects</i> - For women, immediate supervisor support associated with lower SBP and DBP (not HR). - For men, coworker support was negatively associated with lower SBP level (not DBP and HR). - Under high stress conditions, immediate supervisor and coworker support were both associated with lower SBP.
Wager, et al. (2003).	28 female healthcare assistants. 13 worked for two supervisors who they viewed very differently; 15 worked for supervisors whom they viewed similarly.	47-item supervisor interactional style. Items included “My supervisor encourages discussion before making a decision,” “I am treated fairly by my supervisor.” (Cronbach’s $\alpha = .98$ ) Supervisor interactional style is defined as the manner in which information, meanings, and feelings are conveyed to the subordinate through the communication of both verbal and nonverbal messages. Four factors of the instrument: consideration, interpersonal fairness, social maturity, empowerment.	SBP and DBP measured every 30 minutes over three 12-hour periods: working with (1) favorably perceived supervisor, (2) less favorably perceived supervisor, (3) a non-work day.	<i>Support:</i> - Within-group difference: Higher SBP and DBP when working for less favored supervisor compared to favored supervisor. - Between group difference: SBP and DBP increases significantly higher for experimental group working for less favored supervisor compared to highest SBP and DBP day for control group.

<b>Table 3: Cardiovascular Studies with Connection Measures and Frequent Cardiovascular Measures</b>				
<b>Study</b>	<b>Work Context &amp; Participants</b>	<b>Positive Connections Construct and Measure</b>	<b>Physiology Measure</b>	<b>Results</b>
Brondolo, et al. (2003).	104 employees or students at a New York City medical center and its affiliated school (65 women). Mean age=30 (SD=7.70, range=18-46).	<i>Positive interactions:</i> Participant's interaction exceeded individual's average positive intensity score (rating of interaction as pleasant, friendly, agreeable) (Cronbach's $\alpha = .94$ ) <i>Negative interactions:</i> anger, discomfort, upset or tension in interaction (Cronbach's $\alpha = .84$ )	BP and HR measured every 20 minutes throughout one workday, with participants recording information about social interactions and activities at the time of BP & HR readings. (Random sampling of social interactions.)	<i>Positive interactions associated with lower increases in DBP and SBP compared to negative interactions.</i> - Participants had an average of 16 interactions (SD=8.13, range=2-36) with others at time of cuff inflation, with an average of 4.34 (SD=4.6, range=0-27) negative interactions, and 9.35 SD=5.92, range=1-29) positive interactions that exceeded average positive intensity score.
Holt-Lunstad, et al. (2003).	102 participants (53 women). 86% were employed, others were full-time students. Included nontraditional college students (working and attending school.) Mean age=24 (range=18-46.).	- Individuals' general feelings of positivity and negativity about the interaction partner. - Perceptions of interaction: positive affect, negative affect, intimacy, self-disclosure.	BP 5 minutes into social interactions, in which the two people were mutually engaged with one another, that lasted at least that long on 3 days (approx. 12 hour days). Data collection occurred on two work/school days and one non-work/school day. (Event-contingent sampling of social interactions.)	<i>Partial support: positive interactions had lower cardiovascular reactivity than ambivalent connections, but same as negative ones</i> - Participants had an average of 6.3 interactions/day. M=2.14 (13.1%) interactions occurred with coworkers; M=.62 (3.7%) with boss; M=.13 (1.09%) with client or customer. - Work relationships were viewed more negatively than interactions with nonwork relationships, and were associated with lower positive affect, greater negative affect, lower intimacy and lower self-disclosure. - A covariate for work versus nonwork interactions did not predict SBP, DBP or HR. - Participants in ambivalent interactions had higher SBP and DBP, but not HR, compared to all other relationship categories.

<b>Table 4: Immune and Neuroendocrine Studies</b>				
<b>Study</b>	<b>Work Context &amp; Participants</b>	<b>Positive Connection Measure</b>	<b>Physiology Measure</b>	<b>Results</b>
Levy, et al. (1990).	61 breast cancer patients (from a larger sample of 120), who recently completed surgery.	Perceived emotional support from family members, doctors, nurses, and others. Five sources of support considered: spouse or intimate other, family member, friend, nurse, doctor. [Measure was specifically designed for sample of breast cancer patients.] (Cronbach's $\alpha = .79$ to $.95$ )	NK activity	Higher perceived emotional support from spouse and doctor associated with lower NK cell lysis in cancer patients. Perceived emotional support from a nurse was not associated with NK cell lysis.
Theorell, Orth-Gomer, & Eneroth. (1990).	49 subjects (10 women) from six occupations (musician, air traffic controller, physician, freight handler, waiter, mechanic).	Availability and adequacy of social support, including but not limited to work relationships. [Measured once and used as a constant. The analysis did not separate sources of support.] Based on measure by Orth-Gomer and Undén, 1987.	Measures of immunoglobulin G measured 4 times over the course of one year. <i>(Immunoglobulin G changes as a result of long-lasting stressors, not short-term ones.)</i>	Job strain (psychological demands and decision latitude) was associated with higher levels of immunoglobulin G for participants with low levels of SS but not for those with intermediate or high levels of social support.
Adam & Gunnar. (2001).	70-middle class women of 2-year old children in Minnesota.	Composite measure based on 4 relationship measures: Adult Attachment Interview; Social Closeness scale from the Multidimensional Personality Questionnaire; Relationship with Spouse Scale of the Parenting Stress Index; Family Supports and Stresses Scale. Combined construct defined as "the extent to which the participant tends to have positive feelings about relationships and effectively uses them for support and comfort." (194)	Salivary cortisol measured 6 times a day for 2 days, (from just before wake-up to just before sleep).	More positive relational functioning predicts higher morning cortisol values and steeper decline in cortisol values over the course of the day.
Heinrichs, et al. (2003).	37 healthy men in laboratory setting. Trier Social Stress Test (5-minute mock job interview with an unknown panel, followed by a 5 minutes public mental	Best friend providing support in preparation for task, or alone. Instructions to friend were to be as helpful as possible during 10-minute preparation for speech task and offer both instrumental and emotional support.	Intranasal oxytocin.	Oxytocin and social support has buffering effect on cortisol levels (SS and OT had lowest levels of cortisol during and after task; no SS (alone) and no OT had highest levels). Associated psychological measures also followed patterns; when participant had SS and OT (one or both), they showed increasing calmness and decreasing anxiety scores during stress process;

	arithmetic task).			subjects without SS and placebo experienced decreased calmness and increased anxiety.
Kosfeld et al. (2005).	121 male students in trust experiment; 61 males students in risk experiment.	<p><i>Trust experiment:</i> Participants assigned to role of “investor” or “trustee.” Both are given initial amount of 12 monetary units (MUs). Investor allocates 0,4,8,12 MUs to trustee. Trustee allocates amount to return to investor. Investor pay-off is calculated as [initial amount-transfer to trustee+ amount received from trustee]. Trustee pay-off is calculated as [initial amount + 3(transfer from investor)-amount returned to investor].</p> <p><i>Risk experiment:</i> “Investor” allocates 0,4,8,12 MUs to a “project.” Amount returned randomly determined (not by another person). Pay-off distribution same as in trust experiment.</p> <p><i>Both:</i> Half of the participants given OT, half given placebo. Repeated four times, always with different “trustee” or “project.”</p>	Intranasal OT versus intranasal placebo (with same inactive ingredients as OT).	<ul style="list-style-type: none"> <li>- OT affected the amount investors’ transferred in trust experiment only, not in the risk experiment.</li> <li>- OT did not affect back-transfer amount of trustee (in trust experiment).</li> <li>- Participants’ optimism about outcome does not vary across conditions, so OT does not appear to affect peoples’ beliefs about others.</li> </ul>
Zak, Kurzban, & Matzner. (Forthcoming).	82 male and female students in California; lab experiment.	<p><i>Social signal of trust:</i> investor conveyed trust to their partner by choosing the amount of money given to the trustee; presumably the trustee perceived the exchanged amount as a signal of their investors’ good intentions.</p> <p><i>Control:</i> the amount exchanged was publicly and randomly assigned; the trustee knew that the exchange involved no beneficent intentions on the part of the first-mover.</p>	Oxytocin (plasma). Blood drawn after subjects made their decision in game.	<ul style="list-style-type: none"> <li>- Trustee’s OT levels twice as high when received social signal of trust compared to purely exchange-based relationship condition.</li> <li>- Trustee transferred back to investor 53% of the money received, compared to no money in control condition.</li> </ul>

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