

## **Who Needs Nature? The Influence of Employee Speciesism on Nature-Based Need Satisfaction and Subsequent Work Behavior**

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## **Who Needs Nature? The Influence of Employee Speciesism on Nature-Based Need Satisfaction and Subsequent Work Behavior**

### **Abstract**

Scholars have long upheld the notion that exposure to nature benefits individuals. Recently, organizational researchers have theorized that these benefits extend to the workplace, leading to calls for organizations to incorporate contact with nature into employees' jobs. However, it is unclear whether the effects of nature are strong enough to meaningfully impact employee performance, thereby justifying organizations' investments in it. In this research, we draw on self-determination theory to develop a theoretical model predicting that exposure to nature at work satisfies employees' psychological needs (i.e., needs for autonomy, relatedness, and competence), and positively affects their subsequent task performance and prosocial behavior. In addition, we theorize that the effects of nature on need satisfaction are weaker in employees higher on speciesism (i.e., the belief that humans are superior to other forms of life). We test these predictions with a mixed-method approach comprised of an online experiment in the United States (Study 1), a field experiment in Hong Kong (Study 2), a multi-wave, multi-source field study in Taiwan (Study 3), and a multi-wave, multi-source field study (with objective performance scores) in New Zealand (Study 4). Overall, our findings largely support our theoretical model.

**Keywords:** nature exposure; basic need satisfaction; speciesism; self-determination theory

*“We shape not only buildings but also the land, the waters, the air, and other life forms—and they shape us.”*

Gifford (2014, p. 543)

For most of the species’ history, humans lived with almost constant exposure to nature (Wilson, 1984). Millennia of close interactions between nature and humans, according to Wilson’s “biophilia hypothesis,” resulted in an innate “urge to affiliate with other forms of life” (1984, p. 85), such as plants and animals.<sup>1</sup> Yet in the modern world, humans are often disconnected from nature in their daily life (White, 2012; Wolfe, 1979). Indeed, over half of the global population lives in urban areas (World Bank, 2020), spending most of their time indoors (Klepeis et al., 2001; MacKerron & Mourato, 2013). Wilson’s (1984) thesis that humans crave contact with the natural world is thus at odds with the reality that humans spend most of their lives indoors, often divorced from contact with nature.

Since Wilson (1984) formalized the biophilia hypothesis, findings in fields such as public health, architecture, and environmental psychology have lent credence to the notion that humans benefit from nature exposure (Haluza et al., 2014; Hartig et al., 2014). In general, this research indicates that exposure to nature positively impacts outcomes such as mood (e.g., Bratman et al., 2015), cognition (e.g., Berman et al., 2008), and physical well-being (Ryan et al., 2010). Moreover, scholars in adjacent fields have provided limited evidence that some effects of nature exposure may generalize to employees at work (e.g., emotional and cognitive well-being; Raanaas et al., 2011; Zadeh et al., 2014). The beneficial effects of nature exposure have not gone unnoticed by practitioners; for instance, doctors now prescribe exposure to nature to their patients (Lee et al., 2017), city planners now include natural elements in their development plans

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<sup>1</sup>The biophilia hypothesis refers to the prediction that human beings have an innate desire to be in contact with nature, and that they therefore derive benefits from such exposure to other living things (Kellert, 1993; Norton et al., 2021; Ulrich et al., 1990; Wilson, 1984).

(Jones, 2016), and firms design their offices to maximize interaction between employees and nature (Margolies, 2019). Thus, studies of nature exposure outside of the management domain, along with practitioners' espousal of its positive effects, make it evident that employees should benefit from nature exposure in the workplace. However, because exposure to nature occurs at the periphery of many employees' jobs, these findings run counter to some scholars' views that the positive effects of nature exposure may *not* be strong enough to meet employees' psychological needs and impact important work outcomes (Klotz & Bolino, 2021).

Following from the above, there is tension between the positive effects of nature proposed by the biophilia hypothesis and research in adjacent fields, and arguments made by organizational scholars that contact with nature at work is not a fundamental psychological need for employees. This tension can only be resolved by developing and testing theory that explains how employees respond to nature exposure at work. Unfortunately, organizational scholars have been slow to do so, leading our theoretical and empirical understanding of the effects of nature exposure on employees to be outpaced by the implementation of biophilic principles at work. That is, the subtle and spontaneous ways that employees experience nature at work, such as the glow of sunlight through a window or a plant atop one's desk, have proven beneficial for human beings in general, leading to workspaces increasingly being crafted to enhance employees' exposure to nature (e.g., Dul et al., 2011; Kaplan, 1993, Klotz, 2020). However, whether these natural elements actually affect employees' work behavior and performance remains unclear, leaving the "so what" question (Whetten, 1989) regarding the effects of exposure to nature at work on employees unanswered.

To answer this question, we return to the basic premise of the biophilia hypothesis—that nature exposure has meaningful psychological effects on humans and their *basic needs* (Kellert,

1993; McVay et al., 1995; Ulrich et al., 1990), and connect it to research showing that the satisfaction of these basic needs drives crucial work behaviors (i.e., performance and extra-role behaviors; Howard et al., 2016; Van den Broeck et al., 2016). Specifically, we draw upon self-determination theory (SDT; Deci & Ryan, 2000; Ryan & Deci, 2000) to propose that exposure to nature at work can fulfill employees' psychological needs for autonomy, relatedness, and competence. Then, building further from SDT, we explain how the needs satisfaction induced by nature exposure should facilitate task performance and prosocial behavior.

As Norton and colleagues note, biophilic work design involves the “interaction between people and their environment” (2021, p. 13), suggesting that the effects of nature exposure at work may be shaped by employee differences in how they view natural elements (Klotz & Bolino, 2021). However, like other organizational trends that became widespread before being subject to scholarly scrutiny, such as open office designs (Ashkanasy et al., 2014; Norton et al., 2021), the study of employee exposure to nature has proceeded largely without exploring boundary conditions of its effects (Gilbert et al., 2018). Given that nature is suffused with living organisms, employees' feelings—or prejudice—towards other forms of life likely influence the need-satisfying effects of nature exposure at work (Dhont et al., 2019). Indeed, how people view other life forms aligns with the conceptualization of speciesism—the extent to which individuals assign themselves higher status than other forms of life based solely on being human (Caviola et al., 2019). We therefore integrate SDT with research on speciesism (Clark, 1977; Frey, 1988; Singer, 2009), to theorize that the effects of nature exposure on employees may be strengthened, weakened, or even reversed based on employees' level of speciesism.

In developing a model of the need-based effects of nature exposure on employee behavior (see Figure 1), we contribute to SDT (Deci & Ryan, 2000), our understanding of

speciesism (Clark, 1977; Frey, 1988; Singer, 2009), and the work design literature (Morgeson & Humphrey, 2006). First, our study broadens SDT by demonstrating that exposure to nature at work can satisfy employees' basic needs. While SDT sheds light on the factors that contribute to "people's psychological-need satisfaction" (Ryan & Deci, 2000, p. 75) and the biophilia hypothesis suggests that contact with other forms of life should satisfy psychological needs, evidence of this effect is scarce (Klotz & Bolino, 2021). Moreover, whereas SDT-based studies have tended to treat autonomy, relatedness, and competence needs as operating in concert (e.g., Foulk et al., 2019; Lanaj et al., 2016; Lian et al., 2012; Trougakos et al., 2020), we follow guidance to recognize their theoretical differences (Van den Broeck et al., 2016). Toward this end, we develop and test theory that explains the independent effects of nature exposure via employees' autonomy, relatedness, and competence needs, and by doing so, highlight the importance of treating basic needs satisfaction as multidimensional.

Second, our research forges a new link between the organizational sciences and the study of speciesism. The management literature has a rich history of examining how individual differences and beliefs (e.g., prejudice) related to sexism, racism, and other "isms" (Jones et al., 2017) manifest in the workplace. We contribute to this growing body of research by considering how employees' prejudice regarding the importance of the human species relative to other forms of life shapes their performance at work. By doing so, our research also builds upon the study of speciesism in the philosophy literature by examining its theoretical and empirical function in the workplace.

Third, our research advances understanding of not only how employees' work environments affect their basic need fulfilment (e.g., Deci et al., 2017; Norton et al., 2021), but also the interplay of the work context and employee dispositions. Prior work has provided

compelling evidence that contextual and individual characteristics play important roles in shaping the need satisfaction of employees (e.g., Foulk et al., 2019; Lin et al., 2021); however, the majority of this research focuses on the independent effects of these two forces (Deci et al., 2017). Our research extends SDT by examining a case in which contextual and individual characteristics interact to affect employee need satisfaction. Specifically, we highlight how the effects of one increasingly adopted aspect of the physical work context (i.e., biophilic design) will be shaped by the species-related beliefs held by those who are exposed to this nature-based contextual element. We thus examine not only *how* exposure to nature affects employees, but also *for whom* these effects are strongest (Whetten, 1989). In doing so, our work also extends knowledge of how the physical work environment affects employees (Ayoko & Ashkanasy, 2019), and answers calls to more thoroughly consider the role of the physical work context in affecting employees' work outcomes (Johns, 2006).

### **A Self-Determination Theory Perspective on Nature Exposure at Work**

#### **Conceptualizing Contact with Nature at Work**

In the workplace, nature exposure is a broad construct that encompasses all direct contact between employees and any element of the natural world, or any artificial representation of it (e.g., Dul et al., 2011; Korpela et al., 2017; Mcsweeney et al., 2014; Sadick & Kamardeen, 2020). As such, nature exposure at work can include spending time outdoors as part of one's job, working in an office decorated with plants, meeting in a conference room with windows to the outdoors, or even viewing or hearing artificial representations of nature (e.g., natural scenes on a computer monitor or birdsong through office speakers). As highlighted by these examples, exposure to nature at work ranges from conscious immersion with natural settings to subtle contact that only involves one of an employee's five senses coming into contact with a natural

element and remaining below the worker's level of consciousness (Klotz & Bolino, 2021). This aligns with how environmental psychologists have conceptualized contact with nature, as something that can be experienced directly and consciously or passively and without directed attention (Bratman et al., 2012; Bratman et al., 2021; Grinde & Patil, 2009; Klotz et al., 2022).

In their recent theory of biophilic work design, Klotz and Bolino (2021) explained that contact with nature exerts its effects on employees when it fulfills the criteria of being away, extent, and fascination. First, they described how “biophilic work conditions...allow employees to experience the feeling of being away” (p. 242), explaining that nature exposure can give employees a sense of freedom, an occurrence that strengthens the effects of contact with nature at work. Second, they argued that nature is more impactful for employees to the extent that it imbues them “...with a sense of connectedness to the larger world” (p. 243), thereby theorizing that nature exposure can make employees feel more connected to the broader community of living things. Third, they proposed that the more that contact with nature imparts a sense of “fascination and wonder” (p. 242), the stronger its effects will be, indicating that when it is most impactful, nature exposure can foster mental exploration and growth.

In the parlance of the theory of biophilic work design (Klotz & Bolino, 2021), to the degree that nature exposure at work possesses characteristics that foster a sense of freedom from the workplace (i.e., being away), connect employees to a broader community (i.e., extent), and foster mental exploration and growth (i.e., fascination), the potential for it to positively impact employees' and their functioning at work is enhanced. As we describe next, the effects driven by these three characteristics of contact with nature align with the basic needs identified by SDT.

### **Nature Exposure and Employee Need Satisfaction**



To explain how the physical work environment may satisfy employees' basic needs, researchers often invoke SDT (e.g., Greguras & Diefendorff, 2010; Lanaj et al., 2016; Trougakos et al., 2014). Architecture scholars, for instance, have commented on how the design of work environments can affect people's motivation, and satisfaction of their basic needs, based on SDT (Oseland, 2009). Education scholars have also shown that the physical environment has meaningful effects on students' basic needs satisfaction (Sjöblom et al., 2016). These examples align with our proposition that nature exposure at work (as a work design factor; Klotz & Bolino, 2021) can affect employees' psychological need satisfaction.

When articulating SDT (Deci & Ryan, 2000; Ryan & Deci, 2000), theorists argue that employees experience basic needs satisfaction when their needs for autonomy, relatedness, and competence are addressed at work (Foulek et al., 2019). *Need for autonomy* reflects a need for volition and choice over one's behavior, *need for relatedness* represents the need to feel connected to others, and *need for competence* captures the need to experience a sense of mastery within one's life domains (Van den Broeck et al., 2016). To the extent that these needs are met, employees are more able and willing to direct their efforts into their work (Deci et al., 2017). This aligns with the theory of biophilic work design, which proposes that nature exposure at work has important implications for employees' potential to engage in their work (Klotz & Bolino, 2021).

Applying SDT to the study of nature exposure at work also aligns with research in environmental psychology suggesting that such exposure to natural elements helps satisfy individuals' basic psychological needs (e.g., Kellert et al., 2008a). However, *how* contact with nature leads employees to feel psychologically fulfilled has not been explicated, leading some to question the notion that such contact at work can satisfy fundamental needs (e.g., Bratman et al.,

2012). We posit that by highlighting the link between the tenets of SDT and the proposed ways in which biophilic work design affects employees, the need-satisfying effects of nature exposure at work become evident. Moreover, to the extent that nature exposure at work fulfills employees' needs for autonomy, relatedness, and competence, it should facilitate greater investment in their tasks and relationships at work. Below, we explain in detail why nature exposure at work should help satisfy these three basic needs.

### **Nature Exposure and Employee Need for Autonomy**

Need for autonomy is fulfilled when employees feel “free and self-congruent” (Weinstein & Ryan, 2010, p. 224). At work, such fulfillment often results from engaging in voluntary behavior (Gagné & Deci, 2005). Yet, autonomy need satisfaction can also stem from working in settings that “promote and facilitate one’s possibility for being self-initiating and choosing one’s own actions” (Philippe & Vallerand, 2008, p. 81). Toward this end, SDT-based research has theorized that the mere presence of autonomy-promoting elements in the work environment can promote feelings of freedom and self-congruence, thereby satisfying employees’ need for autonomy (Deci et al., 2001; Ganster, 2011; Gatt & Jiang, 2020). We propose that exposure to nature at work can act as such an autonomy-promoting element, because being exposed to nature can shift people’s perspectives in ways that allow them to mentally access settings where they enjoy more freedom. That is, in line with Klotz and Bolino’s (2021) model of biophilic work design, nature exposure at work should fulfill employees’ need for autonomy because it can provide employees with a temporary mental escape from their work context to a setting that facilitates feelings of autonomy.

The psychological shift beyond the current setting that nature exposure induces should facilitate feelings of autonomy for several reasons. First, even subtle forms of nature exposure

can mentally transport individuals to broader natural settings outside of work (Kaplan, 2001), where individuals may feel freer to be themselves and act in ways that align with that freedom (Kellert, 2005; Walker et al., 1998). Second, because people tend to find natural elements intrinsically interesting and pleasant, they place individuals in a psychological state that is more conducive to them pursuing their own goals and interests, thereby bolstering autonomy (Weinstein et al., 2009). Indeed, this has found support in the literature; Weinstein et al. (2009) noted that “nature can bolster autonomy” because such exposure is “naturally interesting and personally satisfying,” which encourages individuals to autonomously pursue goals and “follow their interests” (p. 1316). Thus, exposure to nature at work should trigger a mental shift that helps satisfy employees’ autonomy needs. Finally, because nature exposure often calls to mind outdoor settings it should induce the sense of “prospect”—favorable vantage points from which to observe one’s surroundings (Appleton, 1996; Hagerhall, 2000). Importantly, humans have evolved to seek out prospect, and to experience it as a safe place where they feel free to think and act as they choose (Hartig & Evans, 1993; Nash, 1976; Pohl et al., 2000). Because many workspaces lack such favorable vantage points (e.g., cubicles, Ahrentzen, 1989), the prospect inherent in landscape images, outdoor views, and outdoor access should be salient to employees and imbue them with a sense of autonomy (Stein & Lee, 1995; Straker, 2005). Overall then, natural elements at work can psychologically shift employees to settings where they feel they can be themselves and act with volition, which should contribute to satisfying their autonomy needs.

*Hypothesis 1: Nature exposure at work relates positively to employee autonomy need satisfaction.*

### **Nature Exposure and Employee Need for Relatedness**

Need for relatedness stems from an innate need among humans to affiliate with others (Ryan & Deci, 2000). To this point, relatedness need satisfaction has largely been equated to a

sense of social belonging (Baumeister & Leary, 1995). While this conceptualization certainly aligns with organizational research suggesting that employees' need for relatedness is satisfied when they feel interpersonally connected to, and can interact with, coworkers (Greguras & Diefendorff, 2009; Lanaj et al., 2016; Reis et al., 2000), need for relatedness is not solely confined to the workplace. Indeed, central to the model of biophilic job design is the tenet that since the natural world is filled with connectedness (e.g., the symbiotic relationship between bees and flowering plants), nature exposure can evoke a sense of connectedness to other living organisms (Goldy & Piff, 2020; Klotz & Bolino, 2021). Importantly, this connectedness evoked by exposure to nature has critical interpersonal implications as well, such that it is possible that in the course of being exposed to nature at work, employees become more aware of their connection to the broader world (Neill et al., 2019), including to others at work. Thus, when employees come into contact with nature at work, it should increase their sense of connectedness to living things around them (Kaplan & Kaplan, 1989). And as Klotz and Bolino (2021) note, the connectedness fostered by nature extends to “those within it,” which may include other humans.

Further, we propose that exposure to nature may not only make employees feel more connected to others at work, but this feeling should facilitate opportunities for individuals to get together and develop social connections. Moreover, to the extent that a given setting is suffused with natural elements, it should be a place that attracts people to come together. In general, people find natural settings more desirable than traditional workplaces (Korpela et al., 2001); thus, it stands to reason that natural elements within workplaces will be seen as desirable places by employees, and will be disproportionately likely to be places where workers choose to convene. When employees are exposed to nature at work, then, they should have their needs for relatedness satisfied by feeling and being more connected, because such settings are likely to

contain other people (e.g., coworkers). In sum, because exposure to nature at work fosters connectedness, it should likewise contribute to satisfying employees' relatedness needs.

*Hypothesis 2: Nature exposure at work relates positively to employee relatedness need satisfaction.*

### **Nature Exposure and Employee Need for Competence**

Need for competence is satisfied when individuals feel capable in a given domain (Adams et al., 2017; Elliot et al., 2002). The extent to which this need is satisfied, then, is based on one's *subjective* evaluation of their competence and ability to achieve desired work goals (Deci & Moller, 2005). Thus, self-determination theorists have defined need for competence as "the need to feel a sense of mastery over the [contextual work] environment" or "explore...the environment" (Van den Broeck et al., 2016, p. 1198). The theory of biophilic work design proposes that contact with nature at work fosters a sense of wonder and fascination, while also replenishing employees' cognitive functioning (Klotz & Bolino, 2021). We thus argue that these broad theoretical mechanisms of broadening and restoring employees' cognitive capacity should combine to boost employees perceived sense of competence and mastery in their tasks.

Regarding cognitive broadening, common types of nature exposure at work (e.g., outdoor breaks, a water feature in an atrium) engage multiple senses and provide a relatively immersive experience (e.g., Lim et al., 2020; Selhub & Logan, 2012). Importantly, multisensory experiences encourage mental exploration and learning from the physical environment (Roszak et al., 1995; Watts, 2012). When employees are exposed to nature during their workdays, then, it should spur them to consider alternative ways of completing their work tasks and to learn new ways of working. Through this process of new thinking and learning, individuals' confidence regarding their tasks is heightened (McIntyre & Roggenbuck, 1998; Rappe & Topo, 2007).

Working in the presence of natural elements, then, should facilitate a process of exploration and

learning that results in employees' having greater confidence in their ability to perform their work tasks. This explains why engagement in tasks while being exposed to such natural elements boosts self-esteem relative to performing the same activities separate from nature (Barton & Pretty, 2010; Pretty et al., 2006, 2007). Additionally, employees should feel more capable of performing their work in the presence of natural elements because contact with nature boosts cognitive functioning, rejuvenating employees' capacity to focus on their tasks (Kaplan, 1995). Given that cognitive ability (Schmidt & Hunter, 2004) has been long viewed as a robust predictor of job performance, it stands to reason that the heightened mental capacity that exposure to nature provides will enhance workers' sense of mastery over their tasks. Thus, by broadening and restoring employees cognitive functioning, to the extent that employees are exposed to nature at work, their need for competence should be satisfied.

*Hypothesis 3: Nature exposure at work relates positively to employee competence need satisfaction.*

### **The Moderating Role of Speciesism**

Our theoretical model thus far highlights how nature exposure at work can satisfy three basic needs among employees. However, Klotz and Bolino (2021) propose that employees' personal compatibility with nature is a boundary condition of its effects, and SDT likewise acknowledges that individual differences impact the need-satisfying potential of contextual factors (Deci & Ryan, 1985; 2012). Indeed, people "actively interpret and give psychological meaning to contexts and then act in accordance with their interpretations rather than with objective characteristics of the context" (Ryan & Deci, 2017, p. 219). Thus, employees may be differentially receptive to nature's need-satisfying effects (Deci & Ryan, 2002).

Applying this logic to exposure to nature at work, employees who value nature should be more likely to experience psychological needs satisfaction as a result of contact with it. Because

it relates to the value that individuals place on other life forms (Caviola et al., 2019), then, *speciesism* should play a meaningful role in shaping how employees interpret and respond to exposure to nature. Theorized to exist because humans have more advanced capabilities than many other forms of life (Copp, 2011), speciesism refers to the degree to which one views humans as superior to other forms of life and believes that it is acceptable to treat other forms of life differently than humans (Diamond, 1978; Liao, 2010). Since nature exposure involves contact with various life forms, the status that employees assign themselves relative to other living things should influence the psychological meaningfulness of such contact at work. As such, employees' speciesism should have important implications in terms of the extent to which their basic psychological needs are satisfied upon being exposed to natural elements at work.

Speciesism has been conceptualized and operationalized “a measurable, stable construct with high interpersonal differences” (Caviola et al., 2019, p. 1011; Clark, 1977; Frey, 1988; Singer, 2009). Undergirding the notion of speciesism is prejudice (Dhont et al., 2020). That is, speciesism is fundamentally a prejudice against non-human forms of life, such that individuals higher on speciesism have a tendency toward devaluing non-human living things. However, speciesism can also be seen as an indicator of a general prejudice toward any group dissimilar to the self (Dhont et al., 2020). Stemming from these beliefs, when employees higher on speciesism come into contact with natural elements, they attach relatively little psychological meaning to such nature exposure since they are inclined to assign lower standing to experiences involving non-human forms of life (Fjellstrom, 2002; Kittay & Carlson, 2010; Ryder, 2017). Through the lens of SDT then, speciesism should influence the link between nature exposure at work and autonomy, relatedness, and competence need fulfillment.

**Autonomy needs.** As noted earlier, employees higher on speciesism view non-human natural elements as inferior (Dhont et al., 2019; Horta, 2010). Therefore, rather than evoking a setting where they are free to be themselves and act as they choose, those high on speciesism may experience the mental shift to a natural setting as being transported to a less desirable, more restrictive setting than their work environment. Moreover, compared to employees with lower levels of speciesism, who may regard nature exposure as an inherently interesting experience that enables them to autonomously pursue their desires (Weinstein et al., 2009), those higher on speciesism are predisposed to focus on negative differences between humans and other life forms (e.g., cognitive deficits; Caviola et al., 2019). Thus, when these individuals experience nature at work, they are more likely to consider the shortcomings of natural elements as opposed to experiencing their autonomy-promoting qualities, thwarting the potential for exposure to nature to satisfy their autonomy needs.

*Hypothesis 4a: The effect of nature exposure at work on employee autonomy need satisfaction is moderated by employee speciesism, such that the relationship is weaker when speciesism is higher.*

**Relatedness needs.** Employees higher on speciesism are inclined to “systematically underappreciate” natural elements (Caviola et al., 2019, p. 1012; Copp, 2011; McGinn, 1979), and are therefore less likely to grasp the connectedness that is inherent in nature. Also due to this underappreciation, individuals higher on speciesism are less likely to consider their own connection to natural elements when they are exposed to nature; for these individuals, that connectedness likely comes mainly from other humans, who they view as equivalent (Dhont et al., 2019; Horta & Albersmeier, 2020). In other words, when employees higher in speciesism are exposed to other forms of life at work, they are likely to assume that nonhuman species are unable to create meaningful interactions with them (DeGrazia, 1996). This should diminish the



extent to which these employees experience a sense of social connection to others, and corresponding satisfaction of their relatedness needs following nature exposure at work (Goldy & Piff, 2020). This can be contrasted with employees lower on speciesism, who should be more readily able to recognize and experience the connectedness that contact with nature can call to mind, thereby fulfilling their relatedness needs.

*Hypothesis 4b: The effect of nature exposure at work on employee relatedness need satisfaction is moderated by speciesism, such that the relationship is weaker when employee speciesism is higher.*

**Competence needs.** Per our earlier theorizing, employees' need for competence can be satisfied by exposure to nature at work because it stimulates mental exploration and discovery, fueling a sense of competence that carries over into employees' work tasks. This effect should be particularly strong for employees lower on speciesism because they view natural elements with equal complexity and depth to humans, and therefore see them as worthy of attention. This can be contrasted with employees higher on speciesism, who are unlikely to recognize the potentially challenging and motivating aspects of interacting with nature (Kaplan & Kaplan, 1989; McAvoy et al., 2006; Hartig, 1993). In addition, because those higher on speciesism discount the worth and competence of non-human entities (Misselbrook, 2004), they mentally engage less deeply with natural elements they encounter (Dhont et al., 2019; Wertheimer, 2007). Relative to employees who are lower on speciesism then, such employees should likewise fail to acknowledge and experience the exploration and discovery that nature can elicit, reducing any potential satisfaction of their competence needs stemming from exposure to nature at work.

*Hypothesis 4c: The effect of nature exposure at work on employee competence need satisfaction is moderated by speciesism, such that the relationship is weaker when employee speciesism is higher.*

## **The Effects of Exposure to Nature on Employee Performance and Work Behavior**

SDT provides guidance regarding the workplace implications of the satisfaction of employees autonomy, relatedness, and competence needs (Deci & Ryan, 2008). Two of the most well established effects of psychological needs satisfaction relate to how employees perform their jobs (i.e., task performance, Cerasoli et al., 2016) and how they treat other organizational members (i.e., prosocial behavior, Gagné, 2003; Lin et al., 2019). Drawing from this guidance, we posit that nature exposure at work should ultimately affect how employees approach their job and behave toward coworkers, via the satisfaction of basic psychological needs.

***Task performance.*** According to SDT, the satisfaction of *autonomy needs* stemming from exposure to nature at work has meaningful performance implications (e.g., Ryan et al., 1996; Ryan & Deci, 2000; 2006). Specifically, when autonomy needs are satisfied, employees are “more willing to invest themselves in tasks and work roles” (Chiniara & Bentein, 2016, p. 129; Strain, 1999), which can lead to increased goal attainment at work (e.g., McClean et al., 2021). Indeed, meta-analytic evidence supports the notion that employees perform better at in-role job tasks when autonomy needs are fulfilled (Cerasoli et al., 2016).

The satisfaction of *relatedness needs* as a result of exposure to nature at work should also facilitate task performance (Ryan & Connell, 1989). According to SDT, satisfying relatedness needs motivates individuals to improve and develop themselves to maintain their connection to others (e.g., Ryan & Deci, 2002). At work, the satisfaction of relatedness needs should therefore drive employees to learn to be better coworkers, which should focus their efforts towards improving all aspects of their work activities. This aligns with meta-analytic findings showing that relatedness need satisfaction related to higher task performance (Cerasoli et al. 2016).

Lastly, the satisfaction of *competence needs* resulting from nature exposure at work should facilitate task performance, primarily because satisfying competence needs gives

employees enhanced confidence and perceptions of effectiveness associated with their assigned tasks (Deci & Ryan, 1985; Harter, 1978). That is, feeling competent at work helps employees experience heightened confidence when they perform job tasks (Foulk et al., 2019; Fisher, 1978). Studies have shown a positive relationship between competence need satisfaction and task performance (e.g., Greguras & Diefendorff, 2009), lending credence to the notion that exposure to nature at work should facilitate task performance via competence need satisfaction.

*Hypothesis 5: The indirect relationship between nature exposure at work and task performance is mediated by (a) autonomy, (b) relatedness, and (c) competence needs satisfaction.*

**Prosocial behavior.** Consistent with SDT, when employees' *autonomy needs* are satisfied in response to exposure to nature at work, they feel free to act in ways that align with who they are and in ways that help maintain the environment that has satisfied their autonomy need. As Chiniara and Bentein (2016) note, "the more the autonomy need is satisfied, the more likely it is that voluntary helping behaviors toward co-workers would emerge to preserve and reinforce the growth and advancement of the social context" (p. 129). Further, Gagné and Deci (2005) proposed that when employees feel autonomous, they internalize values that benefit others at work, fostering positive discretionary behaviors directed at others at work (i.e., prosocial behavior; Organ, 1988). Supporting this notion, Lin et al. (2019) found that autonomy need fulfillment spurs prosocial behavior, and Gagné (2003) found that this type of needs satisfaction positively relates to prosocial behavior. Therefore, to the extent that employees' autonomy needs are satisfied as a result of nature exposure at work, they should engage in prosocial behavior.

Satisfying *relatedness needs* helps integrate one's sense of self with the social collective (Ryan & Deci, 2001; Vansteenkiste & Ryan, 2013). As a result, such need satisfaction motivates employees to engage in prosocial behavior toward other group members. Indeed, multiple studies

have found direct support for the positive relationship between the relatedness need satisfaction and prosocial behavior (Pavey et al., 2011; Weinstein & Ryan, 2010). To the degree that employees' need for relatedness is satisfied due to nature exposure, then, they should be more likely to engage in prosocial behavior at work.

Finally, as employees' *competence needs* are satisfied, they become more motivated to contribute more broadly to their social environment (Ryan & Deci, 2002). This motivation often manifests as positive behaviors toward others. Moreover, scholars have advanced the notion that satisfying the competence need is associated with a sense of being "effective in the social world" (Gagné & Deci, 2005, p. 337), which should give employees greater efficacy when it comes to helping others at work. Indeed, a sense of competence in general cultivates prosocial behavior (e.g., Kazdin & Bryan, 1971; Midlarsky, 1984), and competence need satisfaction in particular relates to prosocial behavior toward coworkers (Chiniara & Bentein, 2016). Thus, when employees' competence needs are satisfied due to nature exposure at work, they should be more likely to engage in prosocial behavior.

*Hypothesis 6: The indirect relationship between nature exposure at work and prosocial behavior is mediated by (a) autonomy, (b) relatedness, and (c) competence needs satisfaction.*

Integrating the above, we posit that the interaction of nature exposure at work and employee speciesism will indirectly enhance employee task performance and prosocial behavior through psychological need satisfaction.

*Hypothesis 7: The indirect effect of nature exposure at work on task performance via (a) autonomy, (b) relatedness, and (c) competence need satisfaction is moderated by speciesism, such that the relationship is weaker when speciesism is higher.*

*Hypothesis 8: The indirect effect of nature exposure at work on prosocial behavior via (a) autonomy, (b) relatedness, and (c) competence need satisfaction is moderated by speciesism, such that the relationship is weaker when speciesism is higher.*

## Overview of Studies

To test our theoretical model, we employed what Chatman and Flynn (2005, p. 434) termed a “full cycle research approach,” examining the phenomenon of interest in experimental *and* field settings to establish internal and external validity (see also Tang et al., 2022 for a recent example). Study 1 involves an online experiment (and a validation study for our experimental materials) that examines the internal validity of the first stage of our theoretical model (i.e., the effect of exposure to nature on needs satisfaction and the moderating role of speciesism). Study 2 is a field experiment in Hong Kong, which further tests the validity and robustness of Study 1’s findings via a field experimental design (e.g., Herscovis & Bhatnagar, 2017; Ilies et al., 2013). Finally, we conducted two field studies—one in Taiwan (Study 3) and one in New Zealand (Study 4)—with the aim of further examining the generalizability (i.e., external validity) of our theoretical model while including a more robust set of control variables. Specifically, we test our entire theoretical model using multiple waves of surveys and reports from multiple sources (i.e., employee and supervisor ratings in Studies 3 and 4, and objective performance in Study 4). Our studies were approved by the Texas A&M University’s institutional review board (#IRB2019-1375; #IRB2020-0636M).

### Transparency and openness

We affirm that our study methods adhered to the *Journal of Applied Psychology* methodological checklist. Code and output files of analyses are available at our online repository (OSF) via this URL: [https://osf.io/q6wrb/?view\\_only=f48de7fbd02548248db6662700092f62](https://osf.io/q6wrb/?view_only=f48de7fbd02548248db6662700092f62). Data were analyzed using SPSS version 28, R Studio, and Mplus version 7.4. Study designs and analyses were not preregistered. All the measurement items used in our studies can also be found in the OSF.

## Study 1

### Participants and Procedure

We recruited 219 working adults in the United States (US) via a link in Prolific Academic that directed participants to our online experiment. Thirteen of these individuals did not pass an attention check (“please select strongly agree for this item”), leaving a final sample of 206 participants. Of these, 50.5% were female, their average age was 36.40 years ( $SD = 8.79$ ), and their average tenure with their current organization was 3.66 years ( $SD = 2.45$ ). We randomly assigned participants to either a nature ( $N = 105$ ) or control condition ( $N = 101$ ). Following prior experimental studies (e.g., Weinstein et al., 2009), we utilized an image-priming paradigm to manipulate nature exposure at work. We presented all participants with four photos depicting the physical environment of a workplace. Those in the nature exposure condition were shown pictures of a workplace decorated with abundant natural elements, while those in the control condition were presented with photos of a workplace without any natural elements. Then, we asked the participants to look at each picture for at least 15 seconds and imagine themselves working in the workplace shown in the pictures. After the manipulation, we redirected participants to a survey assessing autonomy, relatedness, and competence needs satisfaction, trait speciesism, manipulation checks, and control variables.

### Nature Exposure Manipulation

We manipulated nature exposure by displaying four pictures of the physical environment of a workplace. In both conditions, participants viewed images of four typical workplace locations: a lobby, a main hallway, a large conference room, and a small meeting cubicle. In the nature exposure condition, these locations were decorated with natural elements (i.e., green plants). In the control condition, these locations contained no natural elements. In both

conditions, the scenes in the photos were approximately matched on lighting, fashion, design, and layout. Each picture was shown for 15 seconds along with a script typically used in imagery exercises. All photos and scripts used in this study are available from the authors upon reasonable request, and Appendix A reports the findings of two studies we conducted to validate the effectiveness of our manipulation and manipulation check measures (see Gino and Pierce [2009] for similar validation procedures).

## Measures

All scales used a 7-point scale (1 = Strongly disagree; 7 = Strongly agree).

***Autonomy need satisfaction.*** We measured autonomy need satisfaction with three items from La Guardia et al. (2000). A sample item is “I feel free to be who I am” ( $\alpha = .96$ ).

***Relatedness need satisfaction.*** We measured relatedness need satisfaction with three items from La Guardia et al. (2000). A sample item is “I feel loved and cared about” ( $\alpha = .96$ ).

***Competence need satisfaction.*** We measured competence need satisfaction using three items from La Guardia et al. (2000). A sample item is “I feel capable and effective” ( $\alpha = .96$ ).

***Speciesism.*** We measured speciesism using five items from Caviola et al. (2019). A sample item is “Morally, other creatures in nature always count for less than humans” ( $\alpha = .82$ ).

***Manipulation check.*** We used a fact-based item as our manipulation check. Participants indicated “Yes” or “No” to the following question: “Are the following four photos similar/same as the ones you saw earlier in this study?”.<sup>2</sup>

***Control variables.*** Given that recent work has posited that nature exposure should affect

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<sup>2</sup> Of note, we also used three items from Kamitsis and Francis (2013) as an alternative manipulation check measure. We modified the three items by asking participants to think about their current feelings and rate their agreement on each item. An example item is “I feel exposure to the natural elements” ( $\alpha = .97$ ). This measure was also validated in the first pilot study reported in Appendix A. Per the recommendation of a reviewer, we reported only the fact-based manipulation item in the main text. However, the three-item measure supported the effectiveness of our manipulation (i.e., a t-test revealed that participants in the nature condition [ $M = 5.15, SD = 1.05$ ] rated their exposure to nature higher than those in the control condition [ $M = 2.43, SD = 1.34$ ],  $t [204] = 16.24, p < .001$ ).

individuals' cognitive energy (Klotz & Bolino, 2021), we controlled for participants' depletion and vigor. We measured depletion using five items from Twenge et al. (2004), as used by Christian and Ellis (2011). A sample item is "At this moment, I feel drained" ( $\alpha = .96$ ). We measured vigor with four items from Parke et al. (2018). A sample item is "At this moment, I feel energetic" ( $\alpha = .99$ ). Of note, inclusion or exclusion of these control variables did not change the pattern of results we report below.

### Study 1: Results

Table 1 presents descriptive statistics, correlations, and reliabilities for all study variables. For the fact-based manipulation check mentioned in the above, we calculated the accuracy rate in each condition. All participants in the nature exposure condition and only 1 of 105 participants in the control condition indicated that they had seen the specific images prior to the study (the inclusion or exclusion of this participant did not change the direction, significance, or effect sizes of our hypothesized relationships). These results indicate that the manipulation was successful. We then conducted a confirmatory factor analysis (CFA) to test the distinctiveness of autonomy, relatedness, competence need satisfaction, and speciesism (nature exposure was not included because it is dichotomous [i.e., 1 or 0]). This model fit the data adequately ( $\chi^2 = 339.23$ ,  $df = 71$ ,  $RMSEA = .14$ ,  $CFI = .91$ ,  $TLI = .89$ ,  $SRMR = .05$ ).<sup>3</sup> Next, we conducted path analysis with Mplus 7.4 (Muthén & Muthén, 2015). As Table 2 shows, there was a significant effect of the manipulation on autonomy ( $B = 1.62$ ,  $SE = .25$ ,  $p < .01$ ), relatedness ( $B = 1.24$ ,  $SE = .23$ ,  $p < .01$ ), and competence need satisfaction ( $B = 1.88$ ,  $SE = .22$ ,  $p < .01$ ), supporting Hypotheses 1, 2, and 3. Specifically, those in the nature exposure condition ( $M_{autonomy} = 5.32$ ,  $SD = 1.18$ ;

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<sup>3</sup> We acknowledge that the RMSEA is slightly higher than conventional standards (e.g., Kline, 2016). However, scholars have encouraged examining model fit decisions based on several fit indices in tandem versus one in isolation (e.g., West et al., 2012; Williams et al., 2020). With the majority of our fit indices meeting conventional standards, we believe that the model fit of our data is adequate for testing our hypotheses.



$M_{relatedness} = 5.34, SD = 1.19; M_{competence} = 5.36, SD = 1.03$ ) reported higher levels of the three types of need satisfaction than those in the control condition ( $M_{autonomy} = 3.59, SD = 2.21; M_{relatedness} = 3.97, SD = 1.91; M_{competence} = 3.40, SD = 1.88$ ). Moreover, the interactive effects of the manipulation and speciesism on autonomy ( $B = -.49, SE = .20, p = .01$ ), relatedness ( $B = -.54, SE = .18, p < .01$ ), and competence need satisfaction ( $B = -.38, SE = .17, p = .02$ ) were significant, providing initial support for Hypotheses 4a-c.

We followed Spiller et al.'s (2013), recommendation to use floodlight analysis to interpret interactions between a categorical predictor variable and a continuous moderator. Thus, we adopted the Johnson-Neyman technique to identify the range(s) of speciesism scores for which the effect of condition was significant (see Shaddy & Lee [2020] and Brochu & Dovidio [2014] for a similar approach). Results indicated that the manipulation positively influenced autonomy need satisfaction for speciesism scores less than the critical value of 4.76 (see Figure 2), relatedness need satisfaction for speciesism scores less than the critical value of 4.33 (see Figure 3), and competence need satisfaction for speciesism scores less than the critical value of 5.60 (see Figure 4). These critical points fell largely above the overall mean speciesism score ( $M = 3.08, SD = 1.21, range = 1\sim 6.4$ ). These results further support Hypothesis 4a-c by indicating that the heightened satisfaction of autonomy, relatedness, and competence needs experienced by those in the nature exposure condition (relative to the control condition) was less present among those higher on speciesism.

### **Study 1: Discussion**

Study 1 provides initial evidence that nature exposure positively relates to employees' autonomy, relatedness, and competence need satisfaction, and that these effects are influenced by individuals' speciesism, such that those with higher levels of speciesism experience lower need

satisfaction from workplace exposure to nature. This study's experimental design offers internally valid support for the first stage of our model. In addition, the two validation studies (see Appendix A) provided evidence of the validity of our experimental materials. Yet, Study 1 is limited in its ability to demonstrate the generalizability of our findings to real work settings and across cultures. Thus, we conducted a field experiment in Hong Kong in Study 2.

## Study 2

### Participants and Procedure

In this field experiment, we collected data from a multinational accounting firm headquartered in Hong Kong. The firm's chief executive officer distributed the study announcement to all employees ( $N = 128$ ) via email, along with a letter assuring them that their responses would be confidential and only used for third-party research purposes. One hundred and ten employees agreed to participate (*response rate* = 85.9%). Of these participants, 55.5% were female, and 76.3% had earned a bachelor's degree or higher. Their average age was 33.00 years ( $SD = 8.96$ ) and their average organizational tenure was 2.55 years ( $SD = 1.52$ ).

The day prior to the study, a member of the author team was physically present in the firm. That evening, after employees had left, this author placed either live plants (nature exposure condition) or office supplies (control condition) on employees' desks (Proyer et al., 2016; Wellenzohn et al., 2016). In this experiment, we adopted a section randomization approach in assigning individuals into the two conditions. Following prior field experiments, we randomly assigned conditions by work sections or divisions (i.e., the left side of the same floor [accounting team] versus the right side of the same floor [administrative and marketing team]), instead of by individuals, to avoid contamination within condition (Chan et al., 2014; Dvir et al., 2002; Langer

& Rodin, 1976). This resulted in 55 employees being assigned to each condition. At the end of the following workday, employees were asked to complete a survey.

### **Nature Exposure Manipulation**

We manipulated exposure to nature by placing either nature-based or non-nature-based materials around employees' computers in their cubicles after the end of the workday. In the nature exposure condition, cubicles were furnished with three live potted plants of the same type and size. The control condition also used three pots, similar to those in the nature exposure condition. Instead of plants, these pots contained office supplies. The pots were placed in the same position in both conditions. See Appendix B for example images of both conditions.

### **Measures**

All scales utilized a 7-point scale (1 = strongly disagree; 7 = strongly agree). We measured autonomy ( $\alpha = .78$ ), relatedness ( $\alpha = .91$ ), and competence need satisfaction ( $\alpha = .70$ ), as well as speciesism ( $\alpha = .84$ ), with the same items as in Study 1.

***Manipulation Check Question.*** For our manipulation check, we measured connectedness to nature with four items from Perrin and Benassi (2009). In the manipulation check validation study (reported as the first pilot study in Appendix A), we found that nature connectedness serves as an effective manipulation check. We adapted the items by asking participants to think about their current feeling and rate their agreement on each item. An example item is "Right now, I feel connected with nature" ( $\alpha = .95$ ).

***Control variables.*** It is possible that our manipulation (i.e., placing potted plants on employees' desks) could be perceived as intrusive, reflected by heightened negative affect (e.g., Allekian, 1974; Evans & Howards, 1973). Thus, we controlled for employees' momentary negative affect using Mackinnon et al.'s (1999) 5-item scale (e.g., "I feel upset";  $\alpha = .91$ ).

## Study 2: Results

Table 3 presents descriptive statistics, correlations, and reliabilities. Participants in the nature exposure condition ( $M = 4.75$ ,  $SD = 1.29$ ) reported higher connectedness to nature than the control condition ( $M = 2.74$ ,  $SD = 1.39$ ),  $t(108) = 7.89$ ,  $p < .01$ , indicating a successful manipulation. As with Study 1, we conducted a CFA to test the distinctiveness of autonomy, relatedness, competence need satisfaction, and speciesism (nature exposure was not included because it is a condition [i.e., 1 or 0]). This model fit the data adequately ( $\chi^2 = 120.79$ ,  $df = 71$ ,  $RMSEA = .08$ ,  $CFI = .94$ ,  $TLI = .92$ ,  $SRMR = .06$ ). We thus proceeded to test our model.

As shown in Table 4, path analyses revealed that the manipulation had a significant effect on autonomy ( $B = .69$ ,  $SE = .19$ ,  $p < .01$ ), relatedness ( $B = .86$ ,  $SE = .19$ ,  $p < .01$ ), and competence need satisfaction ( $B = .53$ ,  $SE = .21$ ,  $p = .011$ ), supporting Hypotheses 1, 2 and 3. Those in the nature exposure condition ( $M_{autonomy} = 5.48$ ,  $SD = .80$ ;  $M_{relatedness} = 5.15$ ,  $SD = .93$ ;  $M_{competence} = 5.56$ ,  $SD = .78$ ) reported higher levels of the three types of need satisfaction than those in the control condition ( $M_{autonomy} = 4.67$ ,  $SD = 1.27$ ;  $M_{relatedness} = 4.25$ ,  $SD = 1.11$ ;  $M_{competence} = 4.92$ ,  $SD = 1.39$ ). Moreover, the interactive effects of the manipulation and speciesism was significant on autonomy ( $B = -.49$ ,  $SE = .19$ ,  $p < .01$ ) and relatedness need satisfaction ( $B = -.52$ ,  $SE = .16$ ,  $p < .01$ ), and marginally significant on competence need satisfaction ( $B = -.35$ ,  $SE = .18$ ,  $p = .053$ ).

Similar to Study 1, we performed floodlight analysis to examine these significant interaction effects. As Figure 5 shows, the nature exposure manipulation positively influenced autonomy need satisfaction for speciesism scores less than 3.26, and relatedness need satisfaction for speciesism scores less than 3.39 (see Figure 6). These critical points fell above the mean speciesism score ( $M = 2.51$ ,  $SD = 1.17$ ,  $range = 1\sim 5.2$ ), indicating that to the extent that

employees had higher levels of speciesism, they did not experience satisfaction of their autonomy and relatedness needs as a result of exposure to nature. Together, these findings provide initial support for Hypotheses 4a and 4b (but not Hypothesis 4c).

### **Study 2: Discussion**

Study 2 supported our prediction that nature exposure positively relates to employees' autonomy, relatedness, and competence need satisfaction, and that the effects for autonomy and relatedness are influenced by employees' speciesism, such that those with high levels of speciesism are less likely to experience the need-satisfying effects of nature exposure at work. While this study complemented Study 1 by offering evidence of the external validity and generalizability of its findings, both Studies 1 and 2 tested the first half of the model without assessing the model's outcome variables (i.e., task performance and prosocial behavior). In addition, it is possible that the manipulation used in this study (i.e., placing plants on employees' desk) may threaten participants' experience of basic needs satisfaction (e.g., autonomy), which would not be the case when nature exposure at work is measured more directly (e.g., in a field survey study). To address these issues, we proceeded to conduct a multi-wave and multi-source field test of our entire model in Study 3.

### **Study 3**

#### **Participants and Procedure**

We collected data in a national enterprise located in Southern Taiwan. With the approval of the Operations Director, we emailed details of the study to all full-time employees ( $N = 216$ ) as well as their immediate supervisors. The major responsibilities of these employees included administrative work pertaining changes of governmental electricity and energy regulations, as well as responding to public inquiries about these regulations.

We collected data over three time points, with an interval of one week between each survey wave. At Time 1, employees reported their nature exposure over the prior week at work, and their speciesism. At Time 2, employees reported their autonomy, relatedness, and competence need satisfaction, and depletion and vigor (control variables) over the prior week at work. At Time 3, the immediate supervisors of the focal employees rated the focal employees' task performance and prosocial behavior over the prior week. Among the 216 employees we contacted initially, 198 completed both the Wave 1 and 2 surveys (response rate = 91.7%). At Time 3, all immediate supervisors (average age = 45.90 years,  $SD = 6.51$ ; average tenure = 5.40 years,  $SD = 2.92$ ; 56.70% male) of these 198 employees provided ratings of the employees' task performance and prosocial behavior, which led to a final sample of 198 employees (average age = 34.60 years,  $SD = 6.73$ ; average tenure = 2.53 years,  $SD = 1.45$ ; 62% male).

## Measures

Unless noted, all scales used a 7-point scale (1 = Strongly disagree; 7 = Strongly agree). Measures were translated into participants' native language (i.e., Taiwanese) using recommended back-translation procedures (Brislin, 1980). Specifically, a bilingual postgraduate student (who was blind to the study hypotheses) was recruited to first translate the measurement items into Taiwanese. Then, another bilingual postgraduate student was asked to translate the Taiwanese version of the items back to English to ensure the consistency of the content and meaning of items across both languages.

### Time 1 Survey (Employee-rated)

***Speciesism.*** We measured speciesism using the same scale as in Studies 1 and 2 ( $\alpha = .95$ )

***Nature exposure.*** We used four items adapted from Largo-Wight et al. (2011). We chose this measure because these four items align with Klotz and Bolino's (2021) theorizing about how

employees experience nature at work and because during informal interviews with supervisors, they confirmed that these items reflect the main ways in which their employees are exposed to nature at work. Participants reported the extent to which they had been exposed to four natural elements over the last week at work: “Artificial elements of nature [such as artificial plants, or artwork or photographs depicting natural scenes or wildlife],” “Living elements of nature within the office [such as live plants or flowers, views of the sky, or views of natural landscapes],” “The sound of natural elements [such as birdsong, running water, rain, or the breeze],” and “Physical contact with elements of nature outside the office [such as breaths of fresh air, the feeling of wind, rain, or sun, or the smell of the forest].” Response options ranged from 1 = “Not much in the prior week at work” to 7 = “A great deal in the prior week at work” ( $\alpha = .82$ ).

### **Time 2 Survey (Employee-rated)**

*Autonomy, relatedness, and competence need satisfaction.* We measured autonomy ( $\alpha = .80$ ), relatedness ( $\alpha = .87$ ), and competence ( $\alpha = .70$ ) need satisfaction with the same three scales as in Studies 1 and 2. The only difference was that we asked the extent to which participants agreed with the listed statement about themselves over the last week at work.

### **Time 3 Survey (Supervisor-rated)**

*Task performance.* Supervisors rated employee task performance over the last week with three items from Griffin et al. (2007), as adapted by Mitchell et al. (2019). A sample item is “[name of focal employee] carried out the core parts of his or her job well” ( $\alpha = .95$ ).

*Prosocial behavior.* Supervisors rated employee prosocial behavior over the last week with three items from Yue et al. (2017). A sample item is “[name of focal employee] willingly assisted other employees in meeting their job requirements” ( $\alpha = .86$ ).

**Control Variables.** We controlled for employees' depletion and vigor. We measured depletion using five items from Twenge et al. (2004), which has been used in Christian and Ellis's (2011) study. A sample item is "Over the last week at work, I felt drained" ( $\alpha = .92$ ). Vigor was measured by four items from Parke et al. (2018). A sample item is "Over the last week at work, I felt energetic" ( $\alpha = .86$ ). Our results are unchanged without these controls.

### **Analytic Strategy**

Since our data have a nested structure (i.e., supervisors rated more than one employee; on average, 6.6 employees were rated by the same supervisor in this sample), we have used the "TYPE=COMPLEX" function in Mplus 7.4 to account for such non-independence. This approach allows intercepts to vary across clusters (Hofmann, 1998) and uses a sandwich estimator (Muthén & Satorra, 1995) to calculate robust standard errors (for examples, see Frieder et al., 2018; Yoon et al., 2021). We followed Preacher et al. (2010) to test mediation and moderated mediation hypotheses with a parametric bootstrap (using 20,000 replications to construct 95% bias-corrected confidence intervals; Selig & Preacher, 2008).

### **Study 3: Results**

Table 5 presents descriptive statistics, correlations, and reliabilities. CFA results revealed that the seven-factor (i.e. nature exposure, autonomy, relatedness, and competence need satisfaction, task performance, prosocial behavior, and speciesism) structure fit the data adequately ( $\chi^2 = 358.95$ ,  $df = 231$ , RMSEA = .05, CFI = .95, TLI = .94, SRMR = .06). Meanwhile, the structural model fit the data adequately as well ( $\chi^2 = 38.16$ ,  $df = 13$ , RMSEA = .10, CFI = .91, SRMR = .07), so we proceeded to test our hypotheses.

The results of our path analyses are reported in Table 6. Supporting Hypotheses 1, 2, and 3, nature exposure positively and significantly associated with autonomy ( $B = .49$ ,  $SE = .08$ ,  $p < .01$ ), relatedness ( $B = .33$ ,  $SE = .10$ ,  $p < .01$ ), and competence need satisfaction ( $B = .34$ ,  $SE$



= .09,  $p < .01$ ). Further, speciesism significantly moderated the positive effect of nature exposure on autonomy need satisfaction ( $B = -.13$ ,  $SE = .05$ ,  $p = .02$ ). As Figure 7 shows, the effect of nature exposure was more positive at lower levels (slope = .68,  $p < .01$ ) than at higher levels of speciesism (slope = .30,  $p < .01$ ). As such, Hypothesis 4a was supported. Speciesism likewise moderated the effect of nature exposure on relatedness need satisfaction ( $B = -.18$ ,  $SE = .08$ ,  $p = .02$ ). As Figure 8 shows, the effect of nature exposure was more positive at lower levels (slope = .61,  $p < .01$ ) than at higher levels of speciesism (slope = .05,  $p = .70$ ), supporting Hypothesis 4b. Speciesism also moderated the effect of nature exposure on competence need satisfaction ( $B = -.18$ ,  $SE = .07$ ,  $p < .01$ ). As Figure 9 shows, the effect of nature exposure was more positive at lower levels of speciesism (slope = .60,  $p < .01$ ) than at higher levels (slope = .07,  $p = .55$ ), supporting Hypothesis 4c.

We tested our indirect effect predictions using the previously mentioned procedure derived from Preacher et al. (2010). As shown in Table 7, nature exposure positively and significantly associated with task performance (indirect effect = .131, 95% CI [.015, .278]) and prosocial behavior (indirect effect = .206, 95% CI [.117, .313]), through autonomy need satisfaction. These results support Hypotheses 5a and 6a, respectively. Meanwhile, nature exposure did not significantly associate with task performance through relatedness need satisfaction (indirect effect = -.003, 95% CI [-.038, .044]), but did significantly and indirectly associate with prosocial behavior (indirect effect = .096, 95% CI [.030, .180]). Thus, Hypothesis 5b was not supported, while Hypothesis 6b was supported. In turn, nature exposure positively and significantly related to task performance through competence need satisfaction (indirect effect = .177, 95% CI [.078, .293]), but not prosocial behavior (indirect effect = .031, 95% CI [-.011, .097]). These results support Hypothesis 5c, but not 6c.

In turn, nature exposure positively associated with task performance, through autonomy need satisfaction, at higher (conditional indirect effect = .081, 95% CI [.005, .220]) and lower levels of speciesism (conditional indirect effect = .184, 95% CI [.023, .365]). Supporting Hypothesis 7a, the difference between these effects was significant (indirect effect difference = -.103, 95% CI [-.219, -.003]). Meanwhile, nature exposure positively associated with prosocial behavior, through autonomy need satisfaction, at both higher (conditional indirect effect = .126, 95% CI [.038, .232]) and lower levels of speciesism (conditional indirect effect = .286, 95% CI [.158, .441]). Supporting Hypothesis 8a, the difference between these effects was significant (indirect effect difference = -.160, 95% CI [-.319, -.025]).

Nature exposure did not significantly relate to task performance through relatedness need satisfaction at either higher (conditional indirect effect = -.001, 95% CI [-.011, .024]) or lower levels of speciesism (conditional indirect effect = -.006, 95% CI [-.082, .072]). Further, the difference between these indirect effects was not significant (indirect effect difference = .006, 95% CI [-.061, .088]), failing to support Hypothesis 7b. Nature exposure did not significantly relate to prosocial behavior through relatedness need satisfaction at higher levels of speciesism (conditional indirect effect = .015, 95% CI [-.070, .062]), but this indirect effect was significant at lower levels of speciesism (conditional indirect effect = .177, 95% CI [.047, .369]). The difference between these indirect effects was significant (indirect effect difference = -.162, 95% CI [-.402, -.017]), supporting Hypothesis 8b.

Finally, nature exposure did not significantly associate with task performance through competence need satisfaction at higher levels of speciesism (conditional indirect effect = .031, 95% CI [-.156, .176]); however, this effect was significant at lower levels of speciesism (conditional indirect effect = .322, 95% CI [.153, .539]). In support of Hypothesis 7c, the

difference between these two effects was significant (indirect effect difference =  $-.291$ , 95% CI  $[-.546, -.048]$ ). The indirect effect of nature exposure on prosocial behavior, via competence need satisfaction, was not significant at either high (conditional indirect effect =  $.005$ , 95% CI  $[-.039, .040]$ ) or low levels of speciesism (conditional indirect effect =  $.056$ , 95% CI  $[-.026, .146]$ ). Further, the difference between these effects was not significant (indirect effect difference =  $-.050$ , 95% CI  $[-.128, .030]$ ), failing to support Hypothesis 8c.

### **Study 3: Discussion**

The results of Study 3 largely supported our model. Specifically, we found positive relationships between nature exposure and the satisfaction of employees' autonomy, relatedness, and competence needs, and our results showed that those with higher levels of speciesism experienced weaker effects of nature exposure at work. In addition, most of our predictions related to the indirect effects of nature exposure on task performance and prosocial behavior, via need satisfaction, were supported. Despite the support for our theoretical model found in Study 3, we sought to test the robustness of these findings in another country and context, using objective measures of task performance.

### **Study 4**

#### **Participants and Procedure**

We collected data in a customer service company in New Zealand. The General Director allowed our research team to email the study design and procedures all service employees in the company ( $N = 196$ ) and invite them to participate. The primary job responsibilities of these customer service representatives involved outreach to customers on behalf of corporate clients.

Similar to Study 3, we used a multi-wave and multi-source design, collecting data at three time points with one week between surveys. At Time 1, employees reported their nature

exposure and their speciesism. At Time 2, employees reported their autonomy, relatedness, and competence need satisfaction, and their depletion and vigor, over the last week at work. At Time 3, each focal employee's immediate supervisor rated the employee's prosocial behavior over the last week, and we obtained objective performance scores from the company's performance monitoring system (Menges et al., 2017). From the initial 196 employees, 162 completed both Wave 1 and 2 surveys (response rate = 82.7%). At Time 3, all immediate supervisors (average age = 43.35 years,  $SD = 4.89$ ; average tenure = 3.96 years,  $SD = 2.62$ ; 52.20% female) of these 162 employees provided ratings of employees' prosocial behavior, leading to a final sample of 162 employees (average age = 34.45 years,  $SD = 6.97$ ; average tenure = 2.62 years,  $SD = 1.37$ ; 61.7% female).

## Measures

Unless noted, all scales used a 7-point scale (1 = Strongly disagree; 7 = Strongly agree).

### Time 1 Survey (Employee-rated)

*Speciesism.* We measured speciesism using the same scale as Studies 1 to 3 ( $\alpha = .95$ ).

*Nature exposure.* We measured nature exposure with the same four items as Study 3 (1 = Not much in the prior week at work; 7 = A great deal in the prior week at work) ( $\alpha = .76$ ).

### Time 2 Survey (Employee-rated)

*Autonomy, relatedness, and competence need satisfaction.* We measured autonomy ( $\alpha = .85$ ), relatedness ( $\alpha = .86$ ), and competence ( $\alpha = .93$ ) need satisfaction as in Study 3.

### Time 3 Survey (Supervisor-rated)

*Prosocial behavior.* We invited the supervisor of the focal employee to provide ratings on their prosocial behavior using the same scale as in Study 3 ( $\alpha = .71$ ).

### Time 3 Objective Data

**Objective performance.** We obtained data from the company's automated performance monitoring system regarding the focal employee's objective performance over the last week. Specifically, we followed Menges et al.'s (2017) approach to divide employees' actual weekly output (i.e., number of customers contacted) by the work expectation (i.e., number of expected contacts). For example, if an employee has a weekly expectation to contact 60 clients and actually contacted 80 clients, the objective performance score would be  $80 \div 60 = 1.33$ .

**Control variables.** We controlled for employees' depletion ( $\alpha = .95$ ) and vigor ( $\alpha = .92$ ) using the same scales as in Studies 1 and 3. Our results are unchanged without these controls.

### **Analytic Strategy**

Since our data have a nested structure (i.e., each supervisor rated more than one employee; on average, 7.0 employees were rated by the same supervisor in this sample), we followed the same analytic approach as in Study 3. We first conducted a CFA. Results from this test provided mixed support for our hypothesized factor structure ( $\chi^2 = 836.44$ ,  $df = 377$ , RMSEA = .09, CFI = .87, TLI = .85, SRMR = .10). Following suggestions to investigate potential sources of misfit (Williams et al., 2020), our inspection revealed that a primary source of misfit was the nature exposure measure, which is arguably formative rather than reflective (Edwards & Bagozzi, 2000). Subsequently excluding this measure from our model resulted in adequate fit ( $\chi^2 = 578.04$ ,  $df = 278$ , RMSEA = .08, CFI = .90, TLI = .88, SRMR = .08). However, given that our prior studies found adequate support for our hypothesized model with the same or similar measures of nature exposure (e.g., Study 3), we believe that the full model—including nature exposure—demonstrates a sufficient level of distinctiveness to proceed to hypothesis testing.

### **Study 4: Results**

Table 8 provides descriptive statistics, while Table 9 reports path analytic results. The overall structural model demonstrated adequate fit to the data ( $\chi^2 = 23.97$ ,  $df = 11$ , RMSEA = .09,

CFI = .98, SRMR = .07). Hypotheses 1, 2, and 3 were supported; nature exposure positively related to autonomy ( $B = .44$ ,  $SE = .11$ ,  $p < .01$ ), relatedness ( $B = .60$ ,  $SE = .10$ ,  $p < .01$ ), and competence need satisfaction ( $B = .61$ ,  $SE = .11$ ,  $p < .01$ ). Hypotheses 4a and 4b, which posited a moderating effect of speciesism on the effect of nature exposure on autonomy ( $B = -.11$ ,  $SE = .04$ ,  $p = .01$ ) and relatedness need satisfaction ( $B = -.15$ ,  $SE = .04$ ,  $p < .01$ ), respectively, were supported. As Figure 10 shows, the effect of nature exposure on autonomy need satisfaction was not significant at higher levels of speciesism (slope = .26,  $SE = .15$ ,  $p = .08$ ); this effect was significant at lower levels of speciesism (slope = .62,  $SE = .11$ ,  $p < .01$ ). Meanwhile, as shown in Figure 11, the effect of nature exposure on relatedness need satisfaction was significant at higher (slope = .35,  $SE = .14$ ,  $p = .01$ ) and lower (slope = .84,  $SE = .10$ ,  $p < .01$ ) levels of speciesism. Hypothesis 4c, which predicted a similar moderating effect on the relationship between nature exposure and competence need satisfaction, was not supported ( $B = -.04$ ,  $SE = .04$ ,  $p = .25$ ).

Table 10 reports the indirect and conditional indirect effects linking nature exposure to both employee task performance and prosocial behavior. Hypotheses 5a and 5b failed to find support, as nature exposure did not significantly and indirectly associate with task performance through either autonomy (indirect effect = .01, 95% CI [-.04, .04]) or relatedness need satisfaction (indirect effect = .00, 95% CI [-.04, .05]). However, Hypothesis 5c found support, as nature exposure significantly and indirectly associated with employee task performance through competence need satisfaction (indirect effect = .06, 95% CI [.02, .11]).

Hypothesis 6a failed to find support, as nature exposure was not significantly associated with prosocial behavior through autonomy need satisfaction (indirect effect = -.04, 95% CI [-.13, .03]). In contrast, nature exposure was significantly associated with prosocial behavior, through relatedness (indirect effect = .10, 95% CI [.02, .20]) and competence need satisfaction

(indirect effect = .22, 95% CI [.12, .36]). Thus, Hypotheses 6b and 6c were supported.

Finally, Hypotheses 7 and 8 posited a series of conditional indirect effects. Hypotheses 7a and 7b failed to find support, as speciesism did not moderate the indirect effect of nature exposure on task performance through either autonomy need satisfaction (indirect effect difference = -.00, 95% CI [-.05, .05]) or relatedness need satisfaction (indirect effect difference = -.00, 95% CI [-.04, .04]). However, Hypothesis 7c was supported, as speciesism moderated the indirect effect through competence need satisfaction (indirect effect difference = -.05, 95% CI [-.10, -.01]). Failing to support Hypothesis 8a, speciesism did not moderate the indirect effect of nature exposure on prosocial behavior through autonomy need satisfaction (indirect effect difference = .03, 95% CI [-.02, .11]). Hypotheses 8b and 8c did find support, as speciesism moderated the indirect effect via relatedness (indirect effect difference = -.08, 95% CI [-.15, -.03]) and competence need satisfaction (indirect effect difference = -.18, 95% CI [-.31, -.08]).

#### **Study 4: Discussion**

As in Study 3, the results of Study 4 provided strong support for our predictions that nature exposure at work positively relates to employees' needs satisfaction and that speciesism serves a moderator that influences the positive relationship of nature exposure on (autonomy and relatedness) needs satisfaction. Although the results related to the back half our of model were more mixed, between Studies 3 and 4, we nonetheless found evidence that the satisfaction of all three basic needs stemming from nature at exposure at work does predicts task performance and prosocial behavior. We now turn to discussing the implications of our findings.

#### **General Discussion**

Exposure to nature has been theorized to provide considerable benefits to human beings in their daily lives (e.g., Hartig et al., 2014). Although scholarly literatures outside of the management domain converge to suggest that nature exposure is largely beneficial for

individuals, whether these effects are strong enough to generalize to the workplace, where nature is often present at the periphery of employees' work lives, remains an open question. Moreover, although organizational scholars have begun to explore the implications of nature exposure for how employees feel at work (e.g., Dul et al., 2011; Korpela et al., 2017; Mcsweeney et al., 2014), some organizational theory has raised questions about whether employee feelings stemming from nature exposure at work have meaningful effects on employees' work behavior and outcomes (Klotz & Bolino, 2021). As such, there is a tension between the demonstrated positive impact of nature exposure on individuals and the questions about the strength of these potential effects in the work domain. At their core, these questions ultimately lead to the issue of the extent to which nature exposure is a meaningful work design characteristic.

Drawing upon SDT (Deci & Ryan, 2000; Ryan & Deci, 2000) and research on speciesism (Clark, 1977; Frey, 1988; Singer, 2009), we sought to address this tension and establish some consensus (Hollenbeck, 2008) with regard to the impact of nature exposure at work by building and testing theory that explains *how* nature exposure affects employee behavior and performance and *who* responds to nature exposure at work (Whetten, 1989). Using a mixed-method approach (i.e., online experiment, field experiment, and field studies) across multiple cultures (i.e., US, Hong Kong, Taiwan, and New Zealand), our hypotheses were largely supported; we found that nature exposure satisfies employees' three forms of basic need satisfaction (i.e., autonomy, relatedness, and competence), which subsequently increased their task performance and prosocial behavior. Our findings further revealed that employees with high levels of speciesism are less likely to experience the need-satisfying effects of exposure to nature because these individuals tend to see themselves as superior to other forms of life (Copp, 2011). Below, we discuss the theoretical and practical implications of our findings.



## Theoretical Implications

First, by developing and testing a theoretical model describing how the satisfaction of autonomy, relatedness and competence needs transmits the effects of nature exposure to employees' behavior and performance at work, we extend the theoretical reach of SDT in the organizational literature. Specifically, we provide evidence of a new, yet common, antecedent of employees' basic need satisfaction at work—exposure to nature. The meaningfulness of this examination was heightened because we focused on the independent effects of nature exposure on employees' autonomy, relatedness, and competence need satisfaction (Gagné & Deci, 2005), and we found differences in the effects of exposure to nature on these three needs. In doing so, our research follows recent advocacy from SDT theorists, who note that “combining the needs into an overall need satisfaction measure runs contrary to SDT’s conceptualization of the three basic needs as separate, non-compensatory entities” (Van den Broeck et al., 2016, p. 1222). Towards this end, our research highlights the value of taking a more granular approach to SDT by treating the three basic needs distinctively (Greguras & Diefendorff, 2009; Van den Broeck et al., 2016) to more thoroughly understand the impact of work characteristics on employees.

Along similar lines, our research offers another contribution related to the advancement of SDT. Van den Broeck and colleagues (2016) recommended future research draw on new theoretical perspectives to extend SDT. Although we primarily adhere to the theoretical framework of SDT in explicating our hypotheses and arguments, we integrate insights from theory on biophilic work design (Klotz & Bolino, 2021) as well as the philosophical perspective of speciesism (Singer, 2009) to enhance the explanatory power of SDT in the workplace. Furthermore, by examining our model across both individualistic and collectivistic cultures—US, Hong Kong, Taiwan, and New Zealand, we meet Van den Broeck et al.’s (2016) challenge

to conduct “more research in non-individualistic cultures” (p. 1224) in order to enhance the cross-cultural validity of SDT. Overall, not only did we adopt a mixed-method approach to increase both external and internal validity of our findings (Chatman & Flynn, 2005), we strived to assess our study variables with different operationalizations—ranging from capturing our predictor with both experimental conditions and measures, to assessing our dependent variables with both scale-based and objective measures. In multiple ways, then, our research responds to recent advocacy to increase the robustness, contribution, and validity of SDT research.

Second, we found evidence across all four studies that speciesism influences the extent to which nature exposure affects employees. By drawing theoretical insights from the speciesism literature and applying them to the phenomenon of workplace nature exposure, we open another new avenue for considering how differences in philosophical beliefs (e.g., speciesism) may shape employees’ psychological and behavioral reactions towards workplace conditions. More broadly, our theorizing and findings also extend our understanding of how employee beliefs concerning the differential treatment of people due to their group membership (i.e., “-isms”) unfold in the workplace. Beyond the implications for management research, we regard this as an important issue for organizational decision makers—who are increasingly incorporating natural elements into workplaces (Klotz & Bolino, 2021)—because this suggests that the return on these investments will differ depending on employees’ levels of speciesism.

Third, our findings have important implications for the workplace design literature, which tends to place little emphasis on the consequences of employees’ physical work environment (Morgeson & Campion, 2003). By providing evidence of how exposure to the natural elements that surround employees’ jobs may affect their task performance and prosocial behavior, we expand our current understanding of the extent to which the physical work

environment affects work outcomes. In doing so, our findings enrich existing work design models, which tend to focus on the physical demands, work conditions, and ergonomics of work (Ayoko & Ashkanasy, 2019; Humphrey et al., 2007), by adding natural elements as a consequential aspect of employees' physical work environment.

Finally, the findings across our four studies provide evidence of meaningful nuance with regard to the need-satisfying effects of nature exposure at work. That is, while we consistently found that speciesism and nature exposure at work interact to predict autonomy and relatedness need satisfaction as hypothesized, speciesism seems to be less influential in shaping the effect of nature exposure on competence need satisfaction. These findings may suggest that viewing other life forms as inferior may restrict one's ability to gain a sense of freedom and relatedness when exposed to nature, but have less of an effect on how one feels in terms of competence. Beyond the implications for our understanding of speciesism, these different needs-based effects underscore the importance of Van den Broeck and colleagues' (2016) recommendation of "ceasing the practice of combining the three basic needs" because these three needs "are not interchangeable" (p. 1222). By providing evidence that each of the basic needs has unique implications for understanding the antecedents of employees' psychological need satisfaction, our findings further enrich how we study SDT.

### **Practical Implications**

Gaining an understanding of the antecedents of employee need satisfaction is important to managers and organizational leaders, given that to the extent that their psychological needs are met, employees perform better (Deci et al., 1989). Beyond these instrumental reasons, most leaders seek to provide followers with a workplace that is fulfilling, rather than draining (e.g., Graves & Luciano, 2013). However, many established sources of need satisfaction, such as

flexible work arrangements (Shockley & Allen, 2010), training and development (Taormina, 2009), and supportive work environments (Lanaj et al., 2016), require substantial investments and time, which are not always available in resource-constrained organizations (McClellan et al., 2021). Our findings suggest an additional avenue for managers looking to satisfy employees' basic needs at work. That is, because there are many ways to expose employees to nature, ranging from outdoor space for breaks to simply including nature-based artwork in meeting rooms (Kellert et al., 2008b), it represents a fairly accessible means by which managers can design work settings to satisfy employees' needs and enhance their performance and behavior.

In addition, our findings indicate that employees higher on speciesism reap fewer benefits of nature exposure at work. This is particularly important in light of Klotz and Bolino's (2021) observation that jobs differ in the extent to which they bring employees into contact with nature. For managers of employees whose job gives them more extensive exposure to nature, speciesism may prove meaningful in determining their fit, fulfillment, and performance in such kind of job. Indeed, a primary goal of the selection process is to identify employees who fit a work environment (Greguras & Diefendorff, 2009; Swider et al., 2015). This is for good reason, as fit perceptions are associated with higher individual performance and organizational commitment (Kristof-Brown et al., 2005). As such, our speciesism findings are critical for HR professionals and leaders who recruit, select, and manage individuals whose jobs expose them to nature.

### **Limitations and Future Directions**

In this research, we employed a mixed-method approach (e.g., Tang et al., 2023; Yam et al., 2022) to examine the impact of nature exposure on employees' outcomes. Although this set of studies has noteworthy strengths in terms of both internal and external validity, it is not without limitations. First, although we used multiple operationalizations of nature exposure,

those in Studies 3 and 4 were largely subjective. While these materials have been used in prior research (e.g., Arendt & Matthes, 2016; Mayer et al., 2009; Weinstein et al., 2009), we encourage researchers to also use objective measures of nature exposure. As one example, Beekhuizen et al. (2013) used global positioning systems to track participants' locations to determine their exposure to nature. Relatedly, our use of multiple studies, conducted across cultures, highlights potential questions about the impact of culture on the effects of nature exposure. Indeed, as Gelfand et al. (2017) note, recent years have demonstrated scholarly movement toward a deeper understanding of cultural norms, including individualism versus collectivism; this may have implications for our study of the need-satisfying effects of nature at work. For example, much of our theorizing regarding nature exposure involved its ability to foster a sense of connectedness and community; to the extent that a culture places less emphasis on this community (e.g., lower collectivism; Hofstede, 1980) the capacity of nature exposure to satisfy employees' relatedness needs may be reduced. Examining this potential may be a fruitful avenue for future research to examine what Gelfand and colleagues term "complex Culture x Context interactions" (2017, p. 519).

Second, it should be noted that some of the measures in our study were self-reported (e.g., independent variables and mediators), creating the possibility that our results are influenced by common method bias (Podsakoff et al., 2012). To reduce this concern, we obtained supervisors' ratings of employee performance and prosocial behavior in Study 3. In Study 4, we went one step further, and assessed employees' task performance by collecting objective data from the company's database. While these steps should mitigate concerns about common method bias and improve confidence in our findings, we nonetheless encourage researchers to replicate our findings using additional operationalizations of our measures.

Third, we drew from SDT to explain why nature exposure is crucial for employees' basic needs satisfaction. However, other theoretical approaches hold promise for understanding how employees respond to nature. For example, an identity perspective may be useful to study how nature might shape the relationship-based identity construction process (Flynn, 2005). Given the restorative effects of natural environments (Kaplan & Kaplan, 1989; Klotz & Bolino, 2021), employees who are exposed to nature at work may construct a more relational identity that leads to more harmonious relationships in the workplace. In addition, future research could consider examining how nature exposure at work may affect employee stress appraisals (e.g., De Bloom et al., 2014). It is possible that employees with different individual differences may appraise nature exposure in different manners (i.e., challenge versus hindrance stress appraisal).

Fourth, by integrating SDT with research of speciesism, we highlighted the novel role of speciesism as a moderator of the relationship between nature exposure and basic needs satisfaction. In addition to this individual difference, other contextual factors might influence the impact of nature exposure on employees. For example, deficiencies in other work characteristics, such as threatening working conditions, might play a crucial role in determining whether nature exposure is effective among employees (Klotz & Bolino, 2021). In addition, when companies support environmentally-friendly policies and advise employees to adhere to these rules (e.g., use electronic documents rather than paper), employees may more deeply internalize the value of protecting and conserving natural resources as part of their identity after exposure to nature (Whitmarsh & O'Neill, 2010).

Finally, we would like to acknowledge that the nature exposure items that we used in Studies 3 and 4 might seem to be more formative than reflective (Coltman et al., 2008). To this point, we re-ran the path analyses using summated scores of the nature exposure items for

Studies 3 and 4. The results were consistent using the formative and reflective approaches. However, due to concerns with the validity of formative measurement (e.g., Howell et al., 2007), some have argued for a more conservative approach to modeling such constructs. To this end, we follow recent research highlighting that in the case when both approaches work in similar fashion (i.e., summing vs averaging), “more harm may result from modeling constructs as formative when reflective specifications are plausible alternatives” (Chang et al., 2016, p. 3184). Thus, we report the findings with modelling the average scores of the items measuring nature exposure.

### **Conclusion**

Drawing from SDT, biophilic work design, and speciesism literatures, we developed a theoretical model explaining how nature exposure at work helps satisfy employees’ basic needs, and ultimately contributes to better work performance and cultivates prosocial behavior, and how employees with high levels of speciesism are less likely to benefit from nature exposure at work. We then tested this model across a series of experiment and field studies in four different countries (i.e., US, Hong Kong, Taiwan, and New Zealand), and the results provided support for most of our predictions. These findings extend our understanding of the role that nature plays in employees’ work lives and in organizational functioning, and we hope they spark additional research that further broadens our knowledge of how nature exposure at work impacts employees and more broadly the workplace.

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**Table 1**  
*Descriptive Statistics (Study 1)*

	Mean	SD	1	2	3	4	5	6	7	8
1. Manipulation (0 = control, 1 = nature exposure)	-	-	-							
2. Autonomy need satisfaction	4.48	1.96	.44*	(.96)						
3. Relatedness need satisfaction	4.67	1.72	.40*	.52*	(.96)					
4. Competence need satisfaction	4.40	1.79	.55*	.45*	.40*	(.96)				
5. Speciesism	3.08	1.21	-.02	-.06	-.08	-.12	(.95)			
6. Depletion (control variable)	2.76	1.61	-.26*	-.16*	-.21*	-.22*	.27*	(.95)		
7. Vigor (control variable)	4.04	1.69	.17*	.14*	.08	.10	-.03	-.01	(.99)	
8. Manipulation x Speciesism (interaction)	-.01	.82	-.01	-.14*	-.18*	-.16*	.68*	.07	-.02	-

*Note.*  $N = 206$ . Coefficient alpha estimates of reliability are in parentheses on the diagonal.

\*  $p < .05$ .

**Table 2**  
*Path Analysis (Study 1)*

Variables	Outcome variables					
	Autonomy need satisfaction		Relatedness need satisfaction		Competence need satisfaction	
	<i>B</i>	<i>SE</i>	<i>B</i>	<i>SE</i>	<i>B</i>	<i>SE</i>
Manipulation (0 = control, 1 = nature exposure)	1.62*	.25	1.24*	.23	1.88*	.22
Speciesism	-.07	.10	-.08	.09	-.14	.09
Manipulation × Speciesism	-.49*	.20	-.54*	.18	-.38*	.17
Depletion (control variable)	-.08	.08	-.14†	.07	-.09	.07
Vigor (control variable)	.08	.07	.02	.06	.01	.06
R <sup>2</sup>	.23		.21		.33	

*Note.*  $N = 206$ .

\*  $p < .05$ , †  $p < .10$

**Table 3**  
*Descriptive Statistics (Study 2)*

	Mean	SD	1	2	3	4	5	6	7	8
1. Manipulation (0 = control, 1 = nature exposure)	-	-	-							
2. Connectedness to nature (manipulation check)	3.74	1.67	.61*	(.95)						
3. Autonomy need satisfaction	5.07	1.13	.36*	.46*	(.78)					
4. Relatedness need satisfaction	4.70	1.11	.41*	.42*	.61*	(.91)				
5. Competence need satisfaction	5.24	1.68	.27*	.39*	.68*	.68*	(.70)			
6. Speciesism	2.51	1.17	-.08	-.11	-.08	.03	-.03	(.84)		
7. Negative affect (control variable)	2.37	1.15	-.20*	-.26*	-.28*	-.15	-.25*	.03	(.91)	
8. Manipulation x Speciesism (interaction)	-.05	.81	-.06	-.18	-.22*	-.17	-.13	.70**	-.05	-

*Note.*  $N = 110$ . Coefficient alpha estimates of reliability are in parentheses on the diagonal.

\*  $p < .05$ .



**Table 4**  
*Path Analysis Results (Study 2)*

Variables	Outcome variables					
	Autonomy need satisfaction		Relatedness need satisfaction		Competence need satisfaction	
	<i>B</i>	<i>SE</i>	<i>B</i>	<i>SE</i>	<i>B</i>	<i>SE</i>
Manipulation (0 = control, 1 = nature exposure)	.69*	.19	.86*	.19	.53*	.21
Speciesism	-.06	.08	.05	.08	-.01	.09
Manipulation × Speciesism	-.49*	.16	-.52*	.16	-.35†	.18
Negative affect (control variable)	-.24*	.08	-.10	.08	-.22*	.09
R <sup>2</sup>	.24		.25		.14	

Note. *N* = 110.

\* *p* < .05, †*p* < .10

**Table 5**  
*Descriptive Statistics (Study 3)*

	Mean	SD	1	2	3	4	5	6	7	8	9	10	11	12	13
1. Nature exposure	5.83	0.79	(.82)												
2. Autonomy need satisfaction	5.29	0.86	.41*	(.80)											
3. Relatedness need satisfaction	5.61	1.04	.19*	.23*	(.87)										
4. Competence need satisfaction	5.17	0.98	.21*	.36*	.18*	(.70)									
5. Depletion (control variable)	3.97	1.49	-.04	-.18*	-.24*	-.22*	(.92)								
6. Vigor (control variable)	5.19	1.07	.16*	.21*	.20*	.09	.03	(.86)							
7. Task performance	4.83	1.24	.10	.33*	.14*	.51*	-.36*	-.01	(.95)						
8. Prosocial behavior	5.54	0.93	.23*	.53*	.49*	.34*	-.38*	.19*	.34*	(.86)					
9. Speciesism	2.98	1.52	-.04	-.03	-.13*	.00	.32*	-.06	.01	-.21*	(.95)				
10. Employee age (years)	34.6	6.71	.03	-.08	-.11	-.06	.04	.01	.00	-.20*	.04	-			
11. Employee gender (0 = female, 1 = male)	0.62	0.49	-.08	-.09	.05	-.06	-.04	.01	-.06	.01	.03	-.03	-		
12. Employee organizational tenure (years)	2.53	1.45	-.05	-.14*	-.01	-.04	.07	-.05	-.06	-.01	-.05	.09	.07	-	
13. Nature exposure x Speciesism (interaction)	-0.05	1.52	.26*	-.07	-.18*	-.17*	.07	-.03	-.06	-.21*	.04	.10	.03	.10	-

*Notes:*  $N = 198$ . Coefficient alpha estimates of reliability are in parentheses on the diagonal.

\*  $p < .05$ .

**Table 6**  
*Path Analysis Results (Study 3)*

	Outcome Variable													
	Autonomy need satisfaction		Relatedness need satisfaction		Competence need satisfaction		Depletion		Vigor		Task performance		Prosocial behavior	
	<i>B</i>	<i>SE</i>	<i>B</i>	<i>SE</i>	<i>B</i>	<i>SE</i>	<i>B</i>	<i>SE</i>	<i>B</i>	<i>SE</i>	<i>B</i>	<i>SE</i>	<i>B</i>	<i>SE</i>
<b><i>Study Variables</i></b>														
Nature exposure	.49*	.08	.33*	.10	.34*	.09	-.08	.14	.25*	.11	-.09	.12	-.02	.07
Speciesism	-.00	.04	-.07	.06	.01	.05	.31*	.08	-.03	.08				
Nature exposure × Speciesism	-.13*	.05	-.18*	.08	-.18*	.07	.08	.09	-.06	.07				
Autonomy need satisfaction											.27*	.12	.42*	.07
Relatedness need satisfaction											-.01	.06	.29*	.07
Competence need satisfaction											.52*	.07	.09	.07
Depletion (control variable)											-.20*	.05	-.13*	.04
Vigor (control variable)											-.08	.07	.04	.05
R <sup>2</sup>	.20		.10		.10		.11		.03		.35		.48	

Notes: *N* = 198. Estimates reflect unstandardized coefficients.

\* *p* < .05.

**Table 7**  
*Summary of Hypothesized Indirect Effects (Study 3)*

	Indirect Effect	Conditional Indirect Effect
<i>Nature exposure</i> → <i>autonomy need satisfaction</i> → <i>task performance</i>	<b>.131 [.015, .278]</b>	
High Speciesism (+1 SD)		<b>.081 [.005, .220]</b>
Low Speciesism (-1 SD)		<b>.184 [.023, .365]</b>
Difference		<b>-.103 [-.219, -.003]</b>
<i>Nature exposure</i> → <i>relatedness need satisfaction</i> → <i>task performance</i>	-.003 [-.038, .044]	
High Speciesism (+1 SD)		-.001 [-.011, .024]
Low Speciesism (-1 SD)		-.006 [-.082, .072]
Difference		.006 [-.061, .088]
<i>Nature exposure</i> → <i>competence need satisfaction</i> → <i>task performance</i>	<b>.177 [.078, .293]</b>	
High Speciesism (+1 SD)		.031 [-.156, .176]
Low Speciesism (-1 SD)		<b>.322 [.153, .539]</b>
Difference		<b>-.291 [-.546, -.048]</b>
<i>Nature exposure</i> → <i>autonomy need satisfaction</i> → <i>prosocial behavior</i>	<b>.206 [.117, .313]</b>	
High Speciesism (+1 SD)		<b>.126 [.038, .232]</b>
Low Speciesism (-1 SD)		<b>.286 [.158, .441]</b>
Difference		<b>-.160 [-.319, -.025]</b>
<i>Nature exposure</i> → <i>relatedness need satisfaction</i> → <i>prosocial behavior</i>	<b>.096 [.030, .180]</b>	
High Speciesism (+1 SD)		.015 [-.070, .062]
Low Speciesism (-1 SD)		<b>.177 [.047, .369]</b>
Difference		<b>-.162 [-.402, -.017]</b>
<i>Nature exposure</i> → <i>competence need satisfaction</i> → <i>prosocial behavior</i>	.031 [-.011, .097]	
High Speciesism (+1 SD)		.005 [-.039, .040]
Low Speciesism (-1 SD)		.056 [-.026, .146]
Difference		-.050 [-.128, .030]

*Notes:*  $N = 198$ . Unstandardized coefficients reported. Moderated mediation finds support when the confidence interval for the difference between two conditional indirect effects excludes zero (Preacher et al., 2007). Indirect effects in boldface indicate effects significant at the 95% level (95% bias-corrected CI shown).

**Table 8**  
*Descriptive Statistics (Study 4)*

	Mean	SD	1	2	3	4	5	6	7	8	9	10	11	12	13
1. Nature exposure	4.94	1.09	(.76)												
2. Autonomy need satisfaction	5.11	1.17	.38*	(.85)											
3. Relatedness need satisfaction	4.48	1.21	.51*	.75*	(.86)										
4. Competence need satisfaction	4.88	1.29	.51*	.75*	.63*	(.93)									
5. Depletion (control variable)	3.59	1.70	-.30*	.05	-.06	-.07	(.95)								
6. Vigor (control variable)	5.04	1.48	.44*	.08	.17*	.14*	-.60*	(.92)							
7. Task performance (objective indicator)	0.79	0.45	.09	.21*	.16*	.25*	.01	.04	-						
8. Prosocial behavior	4.89	1.07	.64*	.49*	.56*	.66*	-.26*	.38*	.06	(.71)					
9. Speciesism	3.55	1.69	-.28*	-.04	-.11	-.18*	.77*	-.65	-.02	-.31*	(.95)				
10. Employee age (years)	34.45	6.95	.03	-.01	.03	.00	.20*	-.02	-.04	.01	.06	-			
11. Employee gender (0 = female, 1 = male)	0.38	0.49	.01	.03	.02	.05	-.06	.04	.04	.03	-.09	-.05	-		
12. Employee organizational tenure (years)	2.62	1.37	.09	-.11	.04	-.02	.20*	-.04	-.16*	-.05	.18*	.16*	-.04	-	
13. Nature Exposure x Speciesism (interaction)	-0.51	1.96	.10	-.14	-.19*	-.01	-.10	.14	.03	.05	-.09	-.03	.05	.09	-

*Notes:*  $N = 162$ . Coefficient alpha estimates of reliability are in parentheses on the diagonal.

\*  $p < .05$ .

**Table 9**  
*Path Analysis Results (Study 4)*

	Outcome Variable													
	Autonomy need satisfaction		Relatedness need satisfaction		Competence need satisfaction		Depletion		Vigor		Task performance		Prosocial behavior	
	<i>B</i>	<i>SE</i>	<i>B</i>	<i>SE</i>	<i>B</i>	<i>SE</i>	<i>B</i>	<i>SE</i>	<i>B</i>	<i>SE</i>	<i>B</i>	<i>SE</i>	<i>B</i>	<i>SE</i>
<b><i>Study Variables</i></b>														
Nature exposure	.44*	.11	.60*	.10	.61*	.11	-.14	.09	.37*	.08	-.03	.05	.28*	.09
Speciesism	.04	.05	.01	.05	-.03	.06	.75*	.06	-.50*	.07	.01	.04	-.01	.06
Nature exposure × Speciesism	-.11*	.05	-.15*	.04	-.04	.04	-.02	.05	.05	.05				
Autonomy need satisfaction											.01	.04	-.08	.08
Relatedness need satisfaction											.00	.04	.16*	.07
Competence need satisfaction											.09*	.04	.36*	.06
Depletion (control variable)											.00	.04	-.02	.04
Vigor (control variable)											.02	.03	.10	.07
R <sup>2</sup>	.19		.31		.26		.59		.44		.06		.58	

Notes:  $N = 162$ . Estimates reflect unstandardized coefficients.

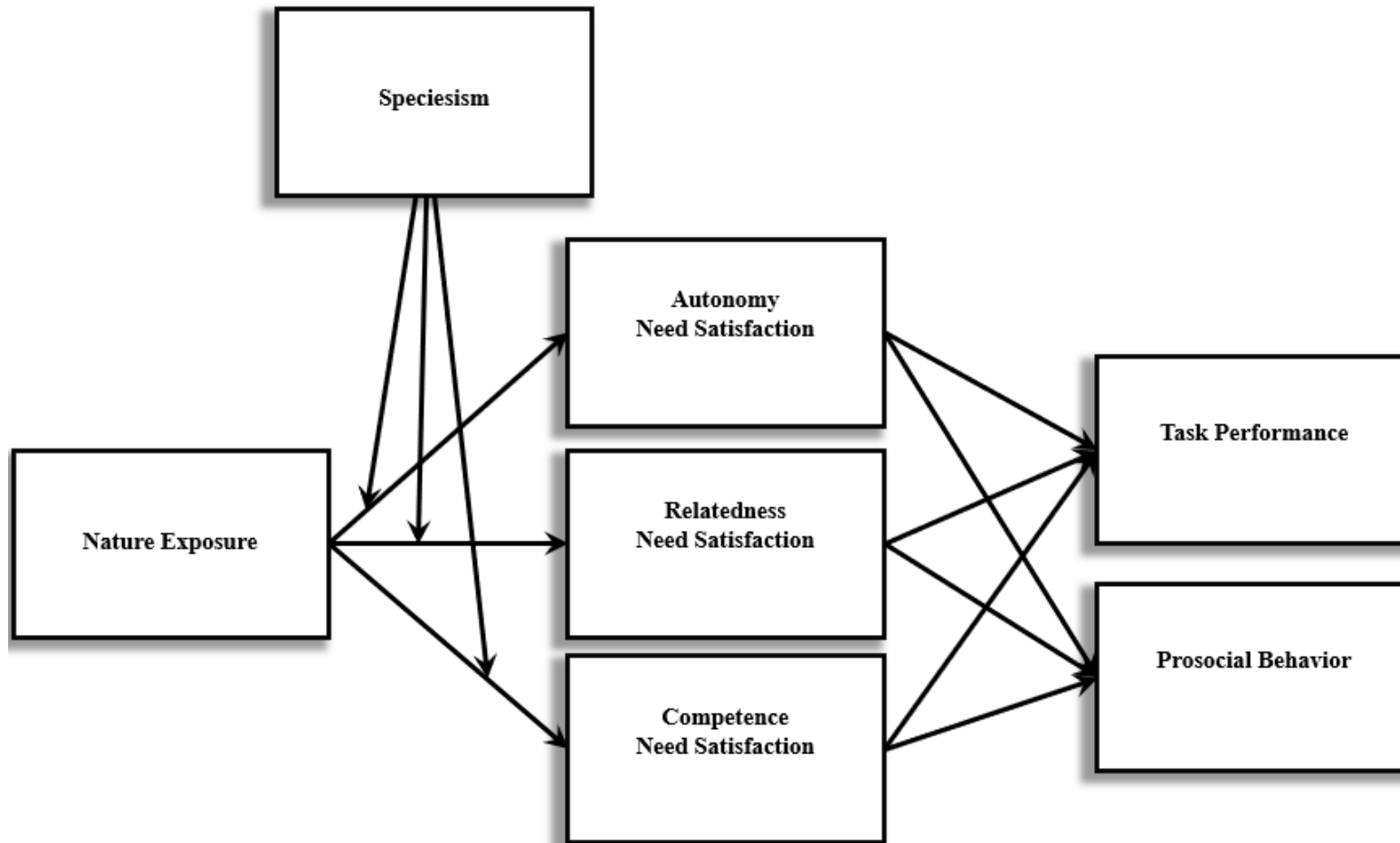
\*  $p < .05$ .

**Table 10**  
*Summary of Hypothesized Indirect Effects (Study 4)*

	Indirect Effect	Conditional Indirect Effect
<i>Nature exposure</i> → <i>autonomy need satisfaction</i> → <i>task performance</i>	.005 [-.035, .037]	
High Speciesism (+1 SD)		.003 [-.018, .026]
Low Speciesism (-1 SD)		.007 [-.046, .056]
Difference		-.004 [-.048, .021]
<i>Nature exposure</i> → <i>relatedness need satisfaction</i> → <i>task performance</i>	.001 [-.043, .048]	
High Speciesism (+1 SD)		.000 [-.026, .033]
Low Speciesism (-1 SD)		.001 [-.060, .065]
Difference		-.000 [-.039, .040]
<i>Nature exposure</i> → <i>competence need satisfaction</i> → <i>task performance</i>	<b>.055 [.016, .109]</b>	
High Speciesism (+1 SD)		<b>.033 [.007, .080]</b>
Low Speciesism (-1 SD)		<b>.078 [.021, .150]</b>
Difference		<b>-.045 [-.104, -.010]</b>
<i>Nature exposure</i> → <i>autonomy need satisfaction</i> → <i>prosocial behavior</i>	-.036 [-.134, .030]	
High Speciesism (+1 SD)		-.021 [-.114, .013]
Low Speciesism (-1 SD)		-.050 [-.174, .046]
Difference		.029 [-.021, .114]
<i>Nature exposure</i> → <i>relatedness need satisfaction</i> → <i>prosocial behavior</i>	<b>.095 [.016, .196]</b>	
High Speciesism (+1 SD)		<b>.055 [.004, .162]</b>
Low Speciesism (-1 SD)		<b>.134 [.028, .245]</b>
Difference		<b>-.078 [-.151, -.029]</b>
<i>Nature exposure</i> → <i>competence need satisfaction</i> → <i>prosocial behavior</i>	<b>.219 [.117, .361]</b>	
High Speciesism (+1 SD)		<b>.130 [.029, .273]</b>
Low Speciesism (-1 SD)		<b>.309 [.184, .476]</b>
Difference		<b>-.178 [-.309, -.080]</b>

*Notes:*  $N = 162$ . Unstandardized coefficients reported. Moderated mediation finds support when the confidence interval for the difference between two conditional indirect effects excludes zero (Preacher et al., 2007). Indirect effects in boldface indicate effects significant at the 95% level (95% bias-corrected CI shown).

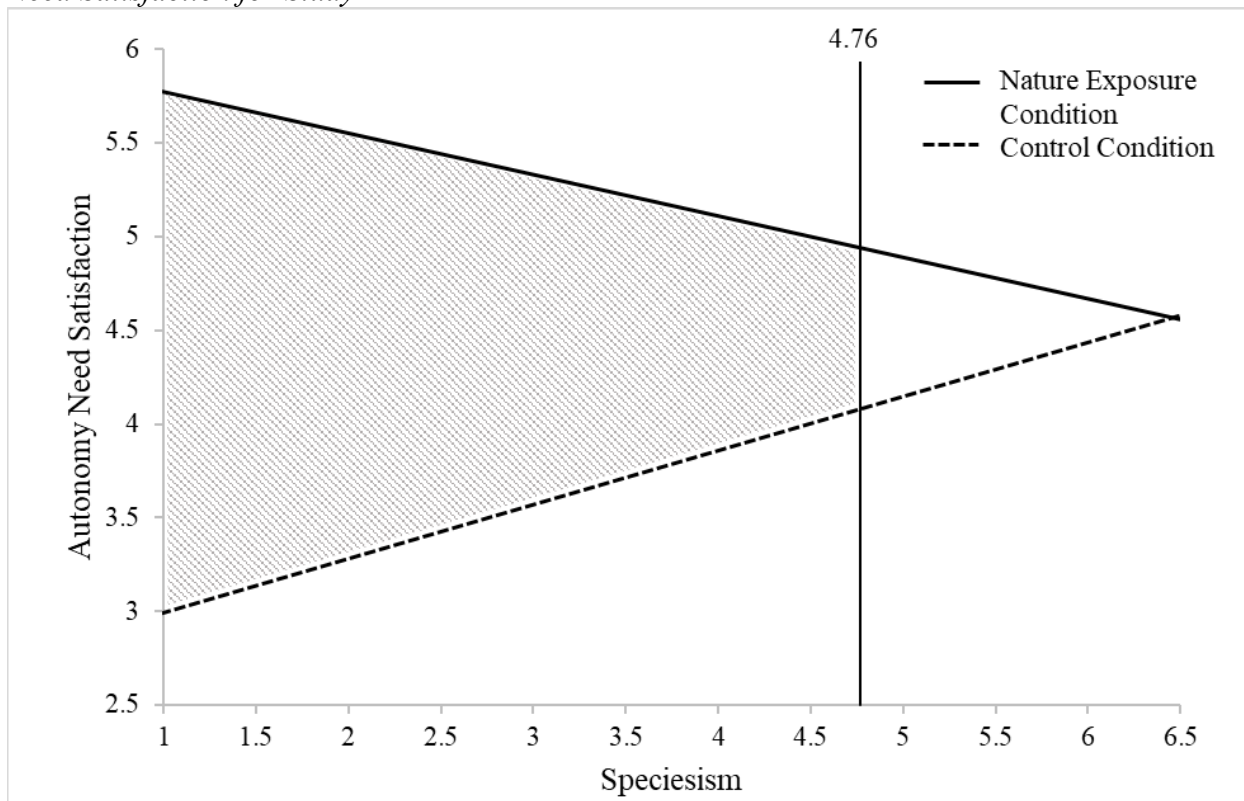
**Figure 1**  
*Hypothesized Model*





**Figure 2**

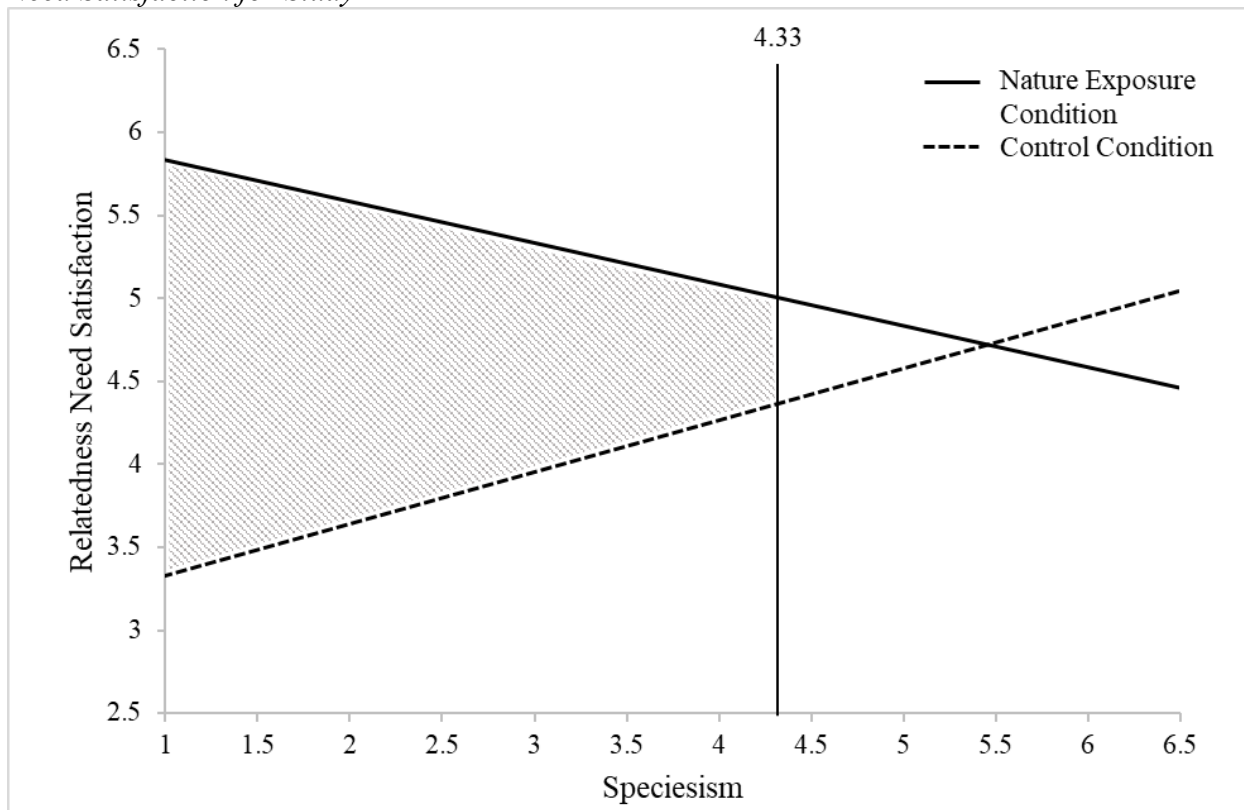
*Moderating Effect of Speciesism on the Relationship between Nature Exposure and Autonomy Need Satisfaction for Study 1*



*Note:* 4.76 is the critical point obtained from the floodlight analysis. More specifically, the shaded area in the figure indicates that when the value of speciesism is lower than 4.76, individuals in the nature exposure condition perceived significantly higher autonomy need satisfaction than individuals in the control condition. On the contrary, the unshaded area indicates that when the value of speciesism is higher than 4.76, there is no statistical difference in autonomy need satisfaction between individuals in the nature exposure condition and control condition.

**Figure 3**

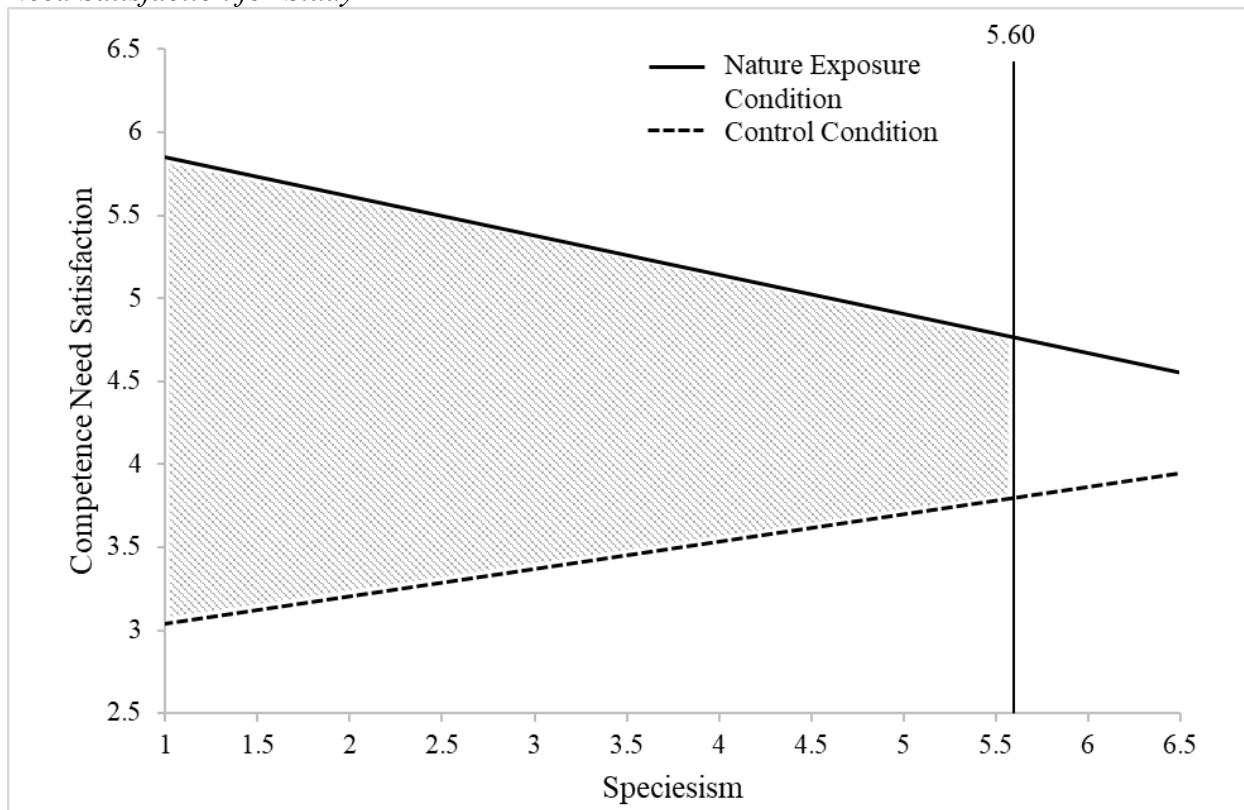
*Moderating Effect of Speciesism on the Relationship between Nature Exposure and Relatedness Need Satisfaction for Study 1*



*Note:* 4.33 is the critical point obtained from the floodlight analysis. More specifically, the shaded area in the figure indicates that when the value of speciesism is lower than 4.33, individuals in the nature exposure condition perceived significantly higher relatedness need satisfaction than individuals in the control condition. On the contrary, the unshaded area indicates that when the value of speciesism is higher than 4.33, there is no statistical difference in relatedness need satisfaction between individuals in the nature exposure condition and control condition.

**Figure 4**

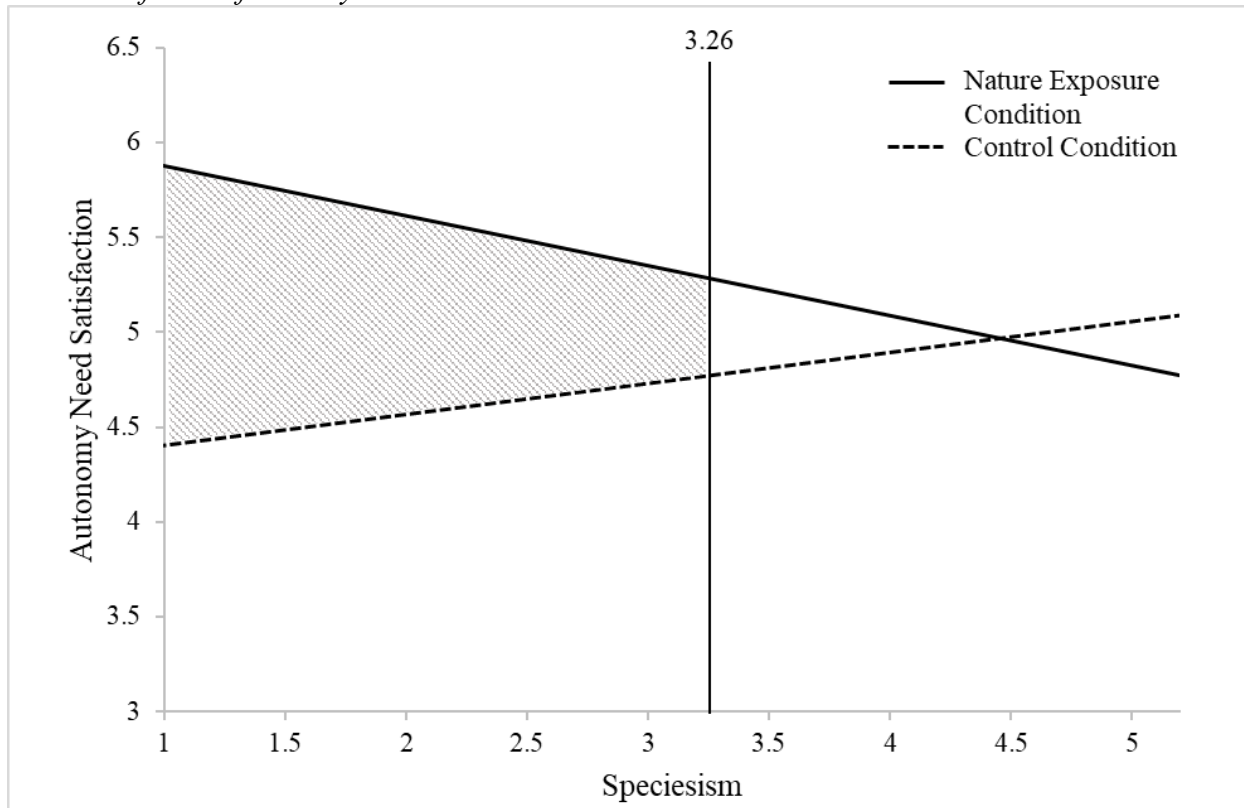
*Moderating Effect of Speciesism on the Relationship between Nature Exposure and Competence Need Satisfaction for Study 1*



*Note:* 5.60 is the critical point obtained from the floodlight analysis. More specifically, the shaded area in the figure indicates that when the value of speciesism is lower than 5.60, individuals in the nature exposure condition perceived significantly higher competence need satisfaction than individuals in the control condition. On the contrary, the unshaded area indicates that when the value of speciesism is higher than 5.60, there is no statistical difference in competence need satisfaction between individuals in the nature exposure condition and control condition.

**Figure 5**

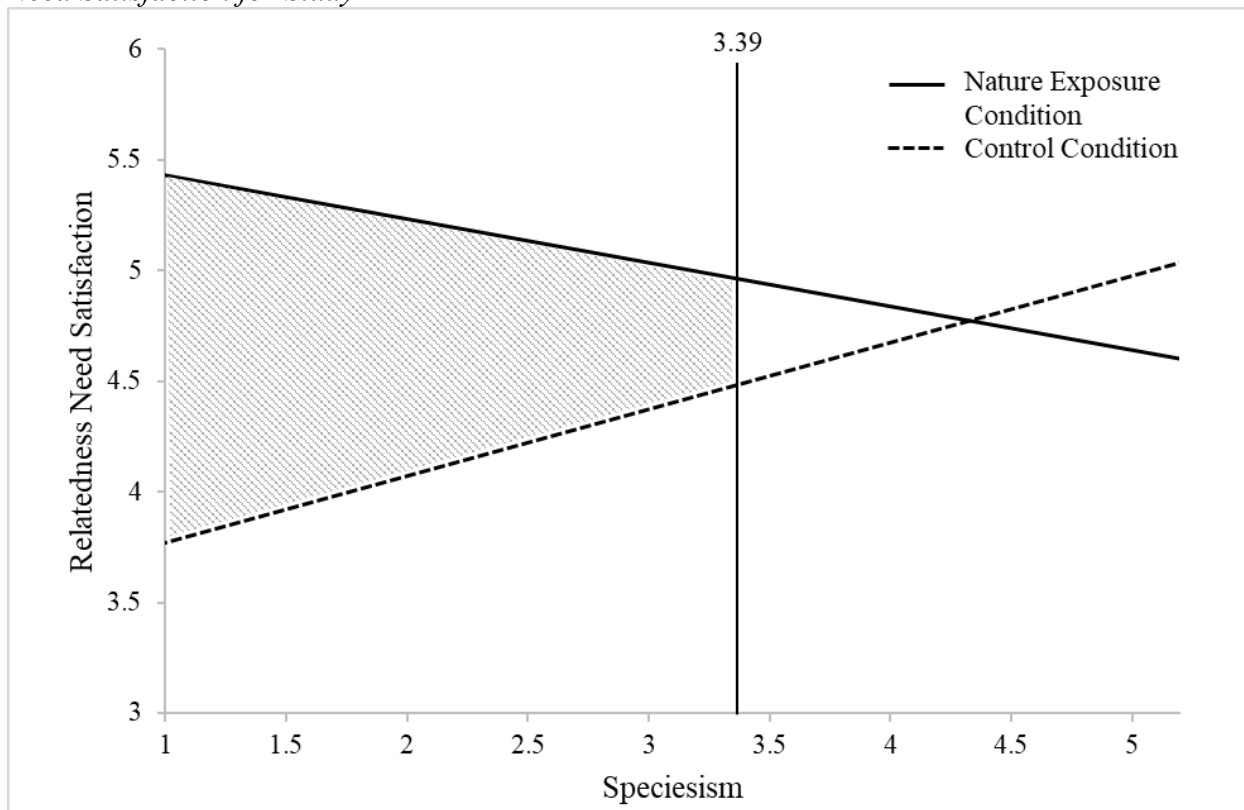
*Moderating Effect of Speciesism on the Relationship between Nature Exposure and Autonomy Need Satisfaction for Study 2*



*Note:* 3.26 represents the critical point obtained from the floodlight analysis, which “would give significant results on one side and non-significant results on the other side” (Spiller et al., 2013: 283). More specifically, the shaded area in the figure indicates that when the value of speciesism is lower than 3.26, individuals in the nature exposure condition perceived significantly higher autonomy need satisfaction than individuals in the control condition. On the contrary, the unshaded area indicates that when the value of speciesism is higher than 3.26, there is no statistical difference in autonomy need satisfaction between individuals in the nature exposure condition and control condition.

**Figure 6**

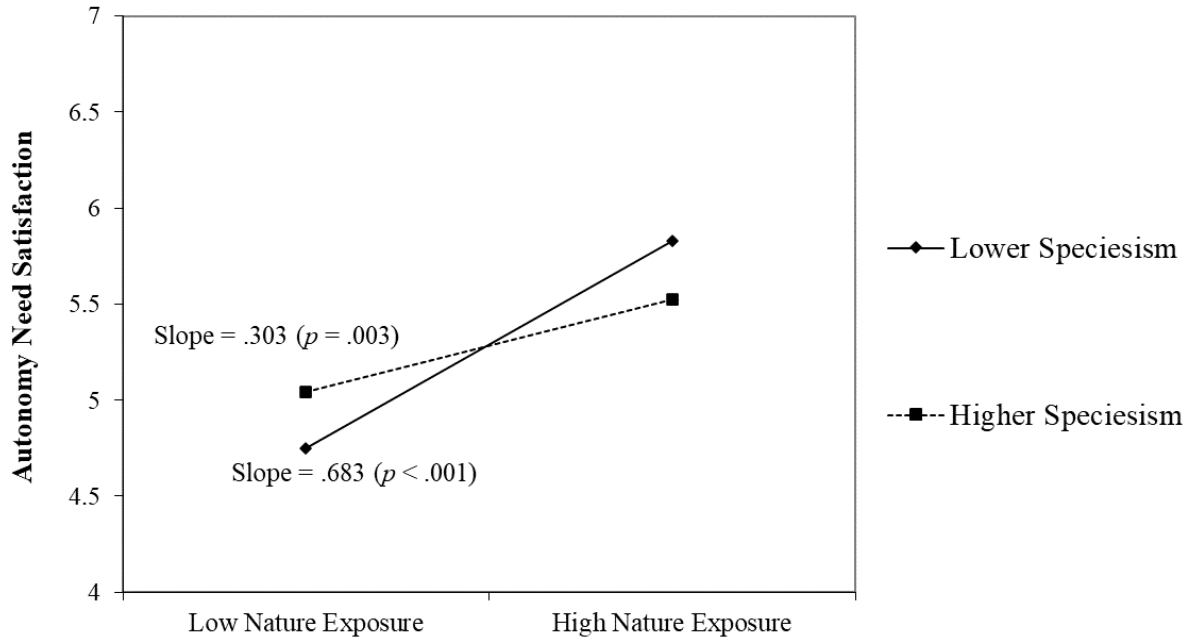
*Moderating Effect of Speciesism on the Relationship between Nature Exposure and Relatedness Need Satisfaction for Study 2*



*Note:* 3.39 is the critical point obtained from the floodlight analysis. More specifically, the shaded area in the figure indicates that when the value of speciesism is lower than 3.39, individuals in the nature exposure condition perceived significantly higher relatedness need satisfaction than individuals in the control condition. On the contrary, the unshaded area indicates that when the value of speciesism is higher than 3.39, there is no statistical difference in relatedness need satisfaction between individuals in the nature exposure condition and control condition.

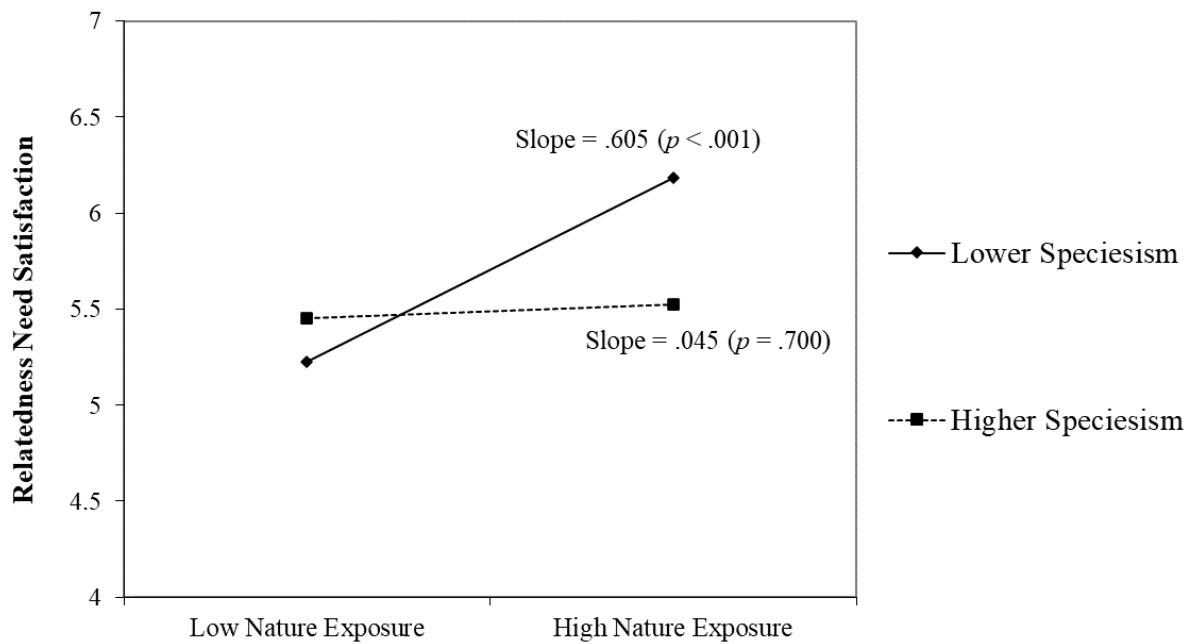
**Figure 7**

*Moderating Effect of Speciesism on the Relationship between Nature Exposure and Autonomy Need Satisfaction for Study 3*



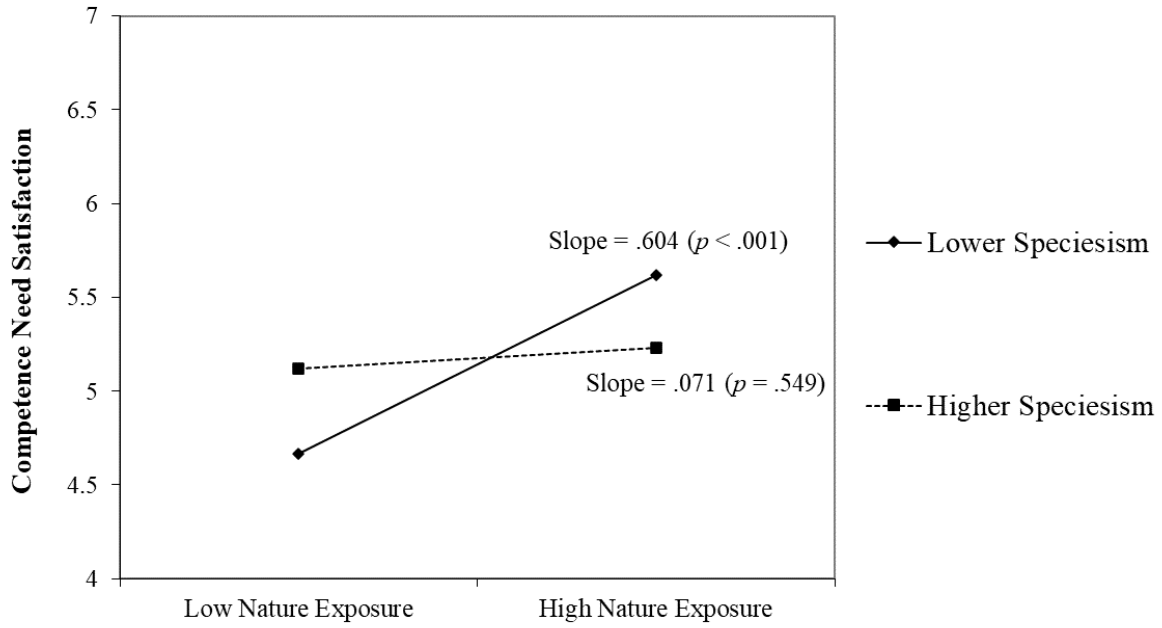
**Figure 8**

*Moderating Effect of Speciesism on the Relationship between Nature Exposure and Relatedness Need Satisfaction for Study 3*



**Figure 9**

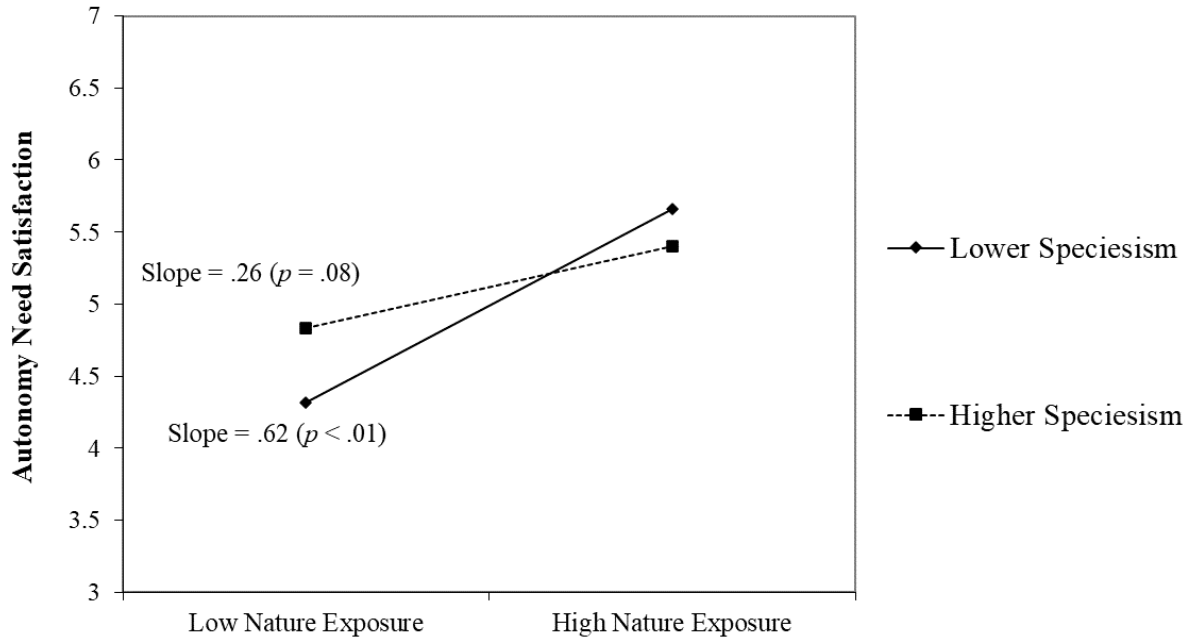
*Moderating Effect of Speciesism on the Relationship between Nature Exposure and Competence Need Satisfaction for Study 3*





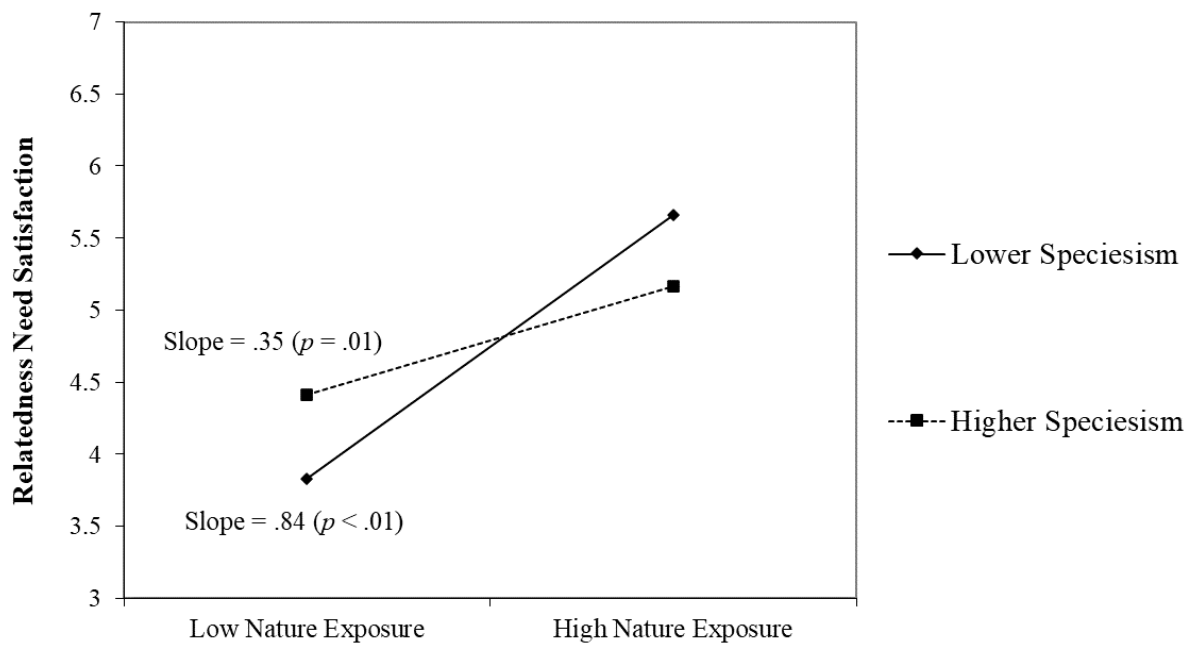
**Figure 10**

*Moderating Effect of Speciesism on the Relationship between Nature Exposure and Autonomy Need Satisfaction for Study 4*



**Figure 11**

*Moderating Effect of Speciesism on the Relationship between Nature Exposure and Relatedness Need Satisfaction for Study 4*



## Appendix A

### *Nature Exposure Manipulation Study 1*

A total of 99 full-time employees from the US recruited from Prolific Academic participated in this pilot study. We asked participants to complete an online study after reading participation information in which confidentiality and anonymity were ensured. Participants were informed that the study was a research project to understand physical environment at work. When participants started the online survey, they were told to view four photos depicting the physical environment of a workplace. To better engage participants, the most typical four workplace scenes were selected to be presented in the photos: a lobby, a main hallway, a large conference room and a small meeting cubicle (same as those used in Study 1).

We randomly assigned participants to the nature ( $N = 49$ ) or the control condition ( $N = 50$ ). In the nature exposure condition, we visually presented participants with four photos of a workplace decorated by various natural elements. In the control condition, we displayed four pictures of a workplace without integrating any natural element. The pictures across two conditions are approximately matched on layout, complexity, picture solution, and picture size.

Immediately after viewing the pictures of the workplace, we asked participants to complete questionnaires consisting of a set of manipulation checks and control variables. We employed *three* different manipulation checks to examine the effectiveness of our nature exposure manipulation. First, we asked participants to report their experienced nature connectedness level based on the 4-item scale (Perrin & Benassi, 2009), which was later used in Study 2 (field experiment). Sample items included “At this moment, I feel a sense of oneness to natural elements” and “At this moment, I feel connected with nature” ( $\alpha = .98$ ). Second, we asked participants to report their perceived nature exposure using the 3-item scale adapted from Kamitsis and Francis (2013), which was also used in Study 1. Sample items included “At this moment, I feel exposure to natural elements” and “I have been exposed to natural elements” ( $\alpha = .96$ ). The response scale for both nature connectedness and nature exposure ranged from 1 = “strongly disagree” to 7 “strongly agree”. Third, we adopted a fact-based manipulation check by asking participants “are the following four photos similar/same as the ones you saw earlier in this study?” Participants need to indicate “Yes” or “No” for this question. Overall, correlation analyses revealed that the three different manipulation checks were highly interrelated.

Following the manipulation checks, participants were then required to provide ratings on certain control variables to ensure that the differences between the two conditions are primarily triggered by the presence (absence) of natural elements. Specifically, we assessed participants’ perceptions of certain elements of the presented workplaces (i.e., the amount of light present, fashion, and design). To this point, we measured light present by using “The workspaces that I just saw in the photos are well-lighted”, fashion by “The workspaces that I just saw in the photos are modern and fashionable”, and design by “The workspaces that I just saw in the photos are well-designed” (see Gino & Pierce, 2009, wherein their Study 2 has adopted a similar validation procedure). The response scale ranged from 1 = “strongly disagree” to 7 = “strongly agree.”

## Results

We performed an independent t-test to examine whether participants viewing different pictures across two conditions differed in their perceived nature connectedness and nature

exposure. Results indicated that those in the nature exposure condition ( $M = 4.70$ ,  $SD = 1.67$ ) reported stronger nature connectedness than those in the control condition ( $M = 2.98$ ,  $SD = 1.57$ ) ( $t = 5.31$ ,  $p < .01$ ). Similarly, those in the nature exposure condition ( $M = 5.01$ ,  $SD = 1.51$ ) also reported a higher level of nature exposure than those in the control condition ( $M = 2.64$ ,  $SD = 1.39$ ) ( $t = -8.14$ ,  $p < .01$ ). For the fact-based manipulation check, we specifically calculated the accuracy rate in each condition. 42 of 47 participants (89.4%) in the nature exposure condition and no participants (0%) in the control condition indicated that they had seen the workplace with natural elements.

In addition, we found that our manipulation did not affect perceived environmental lightness ( $M_{nature} = 5.66$ ,  $SD = 1.19$ ;  $M_{control} = 5.78$ ,  $SD = 1.20$ ;  $t = -.50$ ,  $p = .62$ ), fashion ( $M_{nature} = 5.62$ ,  $SD = 1.55$ ;  $M_{control} = 5.74$ ,  $SD = 1.26$ ;  $t = .43$ ,  $p = .67$ ) and design ( $M_{nature} = 5.50$ ,  $SD = 1.47$ ;  $M_{control} = 5.40$ ,  $SD = 1.34$ ;  $t = -.35$ ,  $p = .72$ ) across the two conditions. The results indicate that our manipulation did not induce changes in alternative environmental characteristics that would explain the observed effects. Together, these findings suggest that our manipulation of nature exposure is effective and valid.

### *Nature Exposure Manipulation Study 2*

A total of 160 full-time employees from the US recruited from Prolific Academic participated in this study. Similar to the pilot study, we asked participants to complete an online study after reading participation information in which confidentiality and anonymity were ensured. Participants were told to view four photos depicting the physical environment of a workplace. To better engage participants, the most typical four workplace scenes were selected to be presented in the photos: a lobby, a main hallway, a large conference room and a small meeting cubicle (same as those used in Study 1). We randomly assigned participants to the nature exposure condition ( $N = 80$ ) or the control condition ( $N = 80$ ). Specifically, in the nature exposure condition, we visually presented participants with four photos of a workplace decorated by various natural elements. In the control condition, we displayed four pictures of a workplace without integrating any natural element.

Then, we asked participants to complete manipulation checks. Specifically, participants reported their perceived nature exposure level based on the 4-item scale (Largo-Wight et al., 2011), which was also used in Studies 3 and 4. Participants then reported the extent to which they were exposed to natural elements based on the workplace shown in the photos that they viewed. Sample items included “Artificial elements of nature [such as artificial plants, or artwork or photographs depicting natural scenes or wildlife],” and “Living elements of nature within the office [such as live plants or flowers, views of the sky, or views of natural landscapes].” ( $\alpha = .96$ ). The response scale ranged from 1 = “strongly disagree” to 7 “strongly agree.”

## **Results**

We performed an independent t-test to examine whether participants viewing different pictures across two conditions differed in their perceived nature exposure. Results indicated that those in the nature exposure condition ( $M = 5.83$ ,  $SD = .87$ ) reported a higher level of perceived nature exposure than those in the control condition ( $M = 2.48$ ,  $SD = 1.28$ ) ( $t = 19.29$ ,  $p < .01$ ). These findings suggest that our manipulation of nature exposure is effective and valid.

**Appendix B**

*Sample Manipulation of Employees' Desks in Nature (Left) and Control (Right) Conditions in Study 2*

