Physical Warmth Promotes Interpersonal Proximity?
A Moderating Role of Attachment

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Abstract

There is emerging evidence showing a psychological link between physical warmth and the perception of interpersonal proximity. However, it is not clear whether such a link can be generalized to overt behaviours. The present study examined whether physical warmth is associated with interpersonal proximity in perceptions and behaviours and explored the role of attachment in predicting the results of warmth priming. A total of 105 undergraduates completed a perceptual focus task and a step-stop task successively. The results showed that in the warm condition (vs. in the cold condition), participants exhibited closer interpersonal proximity in both perceptions and overt behaviours. However, the relation was significant only among participants characterized by insecure attachment with high anxiety. In conclusion, the link between physical warmth and interpersonal proximity is moderated by attachment.

Keywords: physical warmth, interpersonal proximity, attachment, embodied cognition

Introduction

Interpersonal relationships are of crucial importance in the formation of human character (Ho, 1998) and the positioning of a person in a given social network (Fiske, 1992; Ho, 1993) and are positively related to mental health (Centeno & Fernandez, 2020). They can be abstract but also have many external manifestations. Experimental studies have found that the proximity between two persons is one of the most ubiquitous correlates of friendly relationships in natural environments (Hare, 1962). Interpersonal proximity may function psychologically as a performance of positive relationships (Montoya, Kershaw, & Prosser, 2018; Rosenfeld, 1965). As a consequence, many researchers have shown interest in interpersonal proximity. Currently, there is emerging evidence showing a psychological relation between physical warmth and interpersonal proximity. In the present study, we attempted to confirm this relation in both perceptions and overt behaviours and whether it was moderated by attachment.

Regarding the antecedents of interpersonal proximity, most previous studies have shown the importance of personal traits (e.g., Perry, Nichiporuk & Knight, 2015) and culture (e.g., Remland, Jones & Brinkman, 1995; Suvilehto et al., 2019). For example, Holland (2004) and his colleagues found that, compared with controls, participants primed with the independent self sat further away from a hypothetical stranger in the waiting room (Holland et al., 2004). It was also found that individuals with disordered personality preferred greater social distance in interactions (Fineberg et al., 2018). In addition, numerous investigations have found a link between culture and proxemic behaviours by comparing individuals' behaviours in contact and noncontact cultures (Swidrak et al., 2020), which supports the idea that optimal interpersonal proximity is also affected by social context.

Differently, embodiment theorists have emphasized the importance of physical warmth in promoting social proximity. Embodied cognition underlines the substantial dualism between the brain and body, claiming the influence of physical experience on cognition (Borghi & Cimatti, 2010; Rold & Federico, 2018). Thus, according to embodiment theory, physical temperature can affect interpersonal relationship construal, perception, and prosocial behaviours (e.g., Fay & Maner, 2019; Ijzerman & Semin, 2009; Lynott et al., 2017; Williams & Bargh, 2008a, 2008b). For instance, people who live in colder climates engage in higher levels of affiliation-seeking (Ijzerman et al., 2018). Participants also perceived more intimacy with a known other when they were handed a warm beverage than when they were handed a cold one (Ijzerman & Semin, 2009).

However, the finding that physical warmth promotes interpersonal proximity does not hold true all the time. As attachment has been found to be associated with the way people perceive and manage their social relationships with close others, several studies have reported the moderating role of attachment (e.g., Ijzerman, Karremans, Thomsen, & Schubert, 2013; Vess, 2012).

For example, in the study by Fay and Maner (2012), participants first completed a self-assessment of their attachment using the Experiences in Close Relationships Questionnaire – Revised (ECR-R; Fraley, Waller, & Brennan, 2002). Their attachment was evaluated in the dimensions of attachment anxiety and attachment avoidance. Attachment anxiety manifests as interpersonal dependence and worry about close relationships, whereas attachment avoidance reflects personal independence and avoidance of intimacy (Ascone, Schlier, Sundag, & Lincoln, 2019). Then, participants were asked to estimate the spatial proximity between objects and themselves. The results showed that participants perceived a warm object as being physically closer than a cold object. However, the effect was significant only among groups with low attachment avoidance and groups with high attachment anxiety (Fay & Maner, 2012).

In the study by Ijzerman and his colleague (2013), they asked children to report their friendship relations according to the four-category attachment scale (Bartholomew, 1900). Based on two attachment dimensions, the children were classified into more detailed attachment categories. The dismissive avoidant category featured high avoidance and the anxious preoccupied category high anxiety. Those who exhibited both attachment avoidance and anxiety towards intimate relationships were placed in the fearful avoidant category. The three types above constitute insecure attachment patterns; the fourth category was secure attachment. Individuals with secure attachment exhibit both low anxiety and low avoidance of intimacy. A previous study found that children who related to their friends with a secure attachment style were more generous towards their peers in the dictator game when they were in the warm condition rather than in the cold condition. However, this effect was absent for children who related to their friends with an insecure attachment style (Ijzerman et al., 2013).

Both studies show a moderating role of attachment; however, they are inconsistent with regard to how attachment moderates the relationship between physical warmth and interpersonal proximity. In the study by Fay and Maner (2012), the effect of physical warmth was significant among those low in attachment avoidance and those high in attachment anxiety; such persons can be found in the

secure, fearful and preoccupied groups. However, in the study by Ijzerman and his colleague (2013), the effect of warmth on prosocial behaviours was only significant among secure groups. This means that the outcome of the former study was broader than that of the latter. One reason for the inconsistency may be the difference between dimensional perspectives and categorical perspectives. Dimensions emphasize individual differences while neglecting behavioural organization, whereas categories retain a broad description of the archetype while giving up continuity (e.g., Fraley et al., 2015; Gleeson & Fitzgerald, 2014). Thus, in the present study, we seek to explore the moderating role of attachment by combining the two perspectives.

Moreover, it is still not clear whether the influence of physical warmth on proximity can be extended to overt behaviours, since prosocial attitudes and perceptions are not always equal to prosocial behaviours (Ajzen et al., 2018; Schuman & Johnson, 2003). In addition, the spatial distance from objects in the previous study was used to gauge the relationship between individuals and the physical environment (e.g., Fay & Maner, 2012). It cannot simulate interpersonal interaction and explain the relationships between individuals and social contexts. Thus, the present study attempts to examine the effect of physical warmth on interpersonal proximity in both perceptions and overt behaviours with more ecologically valid methods.

The present study

The purposes of the present study are twofold. One purpose is to examine whether there is a psychological link between physical warmth and interpersonal proximity. Based on previous studies (e.g., Willemse, Heylen, & Erp, 2015; Williams, & Bargh, 2008a), we supposed that warmer physical temperature is associated with closer interpersonal proximity in both perceptions and overt behaviours.

The second objective is to explore how attachment moderates the relation between physical warmth and interpersonal proximity. As previous studies have pointed out, physical warmth is not expected to make a difference among individuals with high attachment avoidance, since such people always withdraw from intimacy and psychologically distance themselves from others in any circumstance (Tidwell, Reis, & Shaver, 1996). However, anxious individuals may strongly desire intimacy and be especially motivated to maintain closeness, since they are eager but lack secure affiliations (Feeney & Collins, 2001). Thus, consistent with Fay and Maner (2012), we assume that

the effect of physical warmth may be most observable among individuals with high attachment anxiety. However, departing from previous studies (Fay & Maner, 2012; Ijzerman et al., 2013), the effect of physical warmth on interpersonal proximity among secure groups is assumed to be insignificant. The effect of different temperature conditions may be counteracted, since physical warmth may encourage secure groups to be more prosocial, while physical coldness may urge them to seek proximity (Bowlby, 1969; Choi, Chang, Lee, & Chang, 2016; Inagaki, Hazlett, & Carmen, 2019). Thus, in summary, we believe that the interaction effect of physical warmth and attachment on interpersonal proximity is significant only among insecure groups exhibiting high attachment anxiety.

To accomplish the objectives above, the present study made two improvements. First, we extended the investigation by measuring both the perception and the overt behaviour of interpersonal proximity. Considering that embodiment has only recently developed into a theoretical approach in social psychology (e.g., Niedenthal et al., 2005; Schubert & Semin, 2009), it is still not clear whether the link between physical experience and cognition can be observed in social interaction. Some embodied social cognition studies have begun to explore the link among physical experience, psychological perception and overt behaviour. For example, Tiihonen and his colleagues (2017) examined the relation between ambient temperature and violent crimes; Guéguen and Lamy (2013) explored whether passers-by would remind the subject of falling objects under different natural lighting conditions. However, most empirical studies on interpersonal proximity are still limited to perception and cognition. For instance, Williams and Bargh (2008a) revealed that experiencing a tactile sensation of warmth made people perceive a stranger as having a warmer personality; Ijzerman and Semin (2009) found that warmth made people perceive greater closeness to their friends and caused them to adopt a more relational perspective (see also Ijzerman, Karremans, Thomsen, & Schubert, 2013; Schilder, Ijzerman, & Denissen, 2014). All these findings are related to the perception of interpersonal proximity. However, an individual's perception does not always align with his or her actual behaviours. For example, positive attitudes towards prosocial donations do not always translate into donation behaviours (Anker, Feeley, & Kim, 2010). Moreover, the use of scenario and self-report methods to measure prosocial perception may introduce the potential limitations of social desirability bias and low psychological realism (Tsang & Jo-Ann,

2006). As Baumeister, Vohs, and Funder (2007) noted, current psychological research generally fails to pay attention to actual behaviours. A more rational approach to implementing embodiment would be to consider outcome measures that are linked directly to behaviours (Meier, Schnall, Schwarz, & Bargh, 2012). Thus, in the present study, the perception and overt behaviour of interpersonal proximity were both measured to extend the investigation on embodied social cognition.

Second, we sought to examine the moderating effect of attachment by combining dimensional and categorical perspectives. Many researchers have used categorical methods because the typology of attachment provides a broad description of the archetype of the category, and the classification system can distinguish among various manifestations of attachment insecurity (Gleeson & Fitzgerald, 2014). In addition, it is obvious that people can be best understood and compared in terms of their belonging to one category or another (Fraley et al., 2015). However, dimensional approaches may be statistically advantageous. For example, dimensional methods can track individual differences continuously, which can provide more information and facilitate tracing of the progress of attachment development (Verhage et al., 2020). However, as Bartholomew (1900) pointed out, the four-category model allows for complexity in describing the attachment patterns expected in adults, and perhaps a more rational practice is to allow the two perspectives to coexist and complement each other (Shi, Wampler, & Wampler, 2014). Therefore, in the present study, we combine the dimensional perspective and categorical perspective of attachment to test whether the two methods are consistent with each other and provide a more convincing view of the moderating effect of attachment.

In summary, we carried out two tasks to advance the literature. In Task 1, we examined whether physical warmth and attachment influence participants' perceptions of interpersonal proximity. In Task 2, we further explored the association by measuring the shortest acceptable interpersonal physical distance between strangers.

Method

Participants

One hundred and five undergraduates (41 males, 64 females) with an average age of 19.66 years (*SD* = 1.82 years) were randomly assigned to one of two temperature priming conditions. All participants provided consent and received seven yuan as compensation. Questions on demography were answered prior to the study.

Procedure and Materials

First, participants completed a self-assessment of their attachment using the Experiences in Close Relationship Scale (ECR) (Brennan, 1998). The ECR is a 36-item self-report instrument that utilizes a 7-point Liker-type scale (1 = *strongly disagree* to 7 = *strongly agree*). Based on the ECR scale, four prototypical attachment types are defined in two dimensions: attachment anxiety and attachment avoidance. The former relates to beliefs on self-worth, and the latter is related to taking risks in approaching or avoiding other people (Bartholomew, 1998). The relations among the four categories and two dimensions are shown in Figure 1. The category rated the highest is considered to be the best-fitting attachment pattern for the individual (Bartholomew & Horowitz, 1991). Details of the classification can be found in Brennan's (1998) study. Both 18-item subscales displayed good reliability in the present study (attachment anxiety: $\alpha = 0.86$, attachment avoidance: $\alpha = 0.90$).

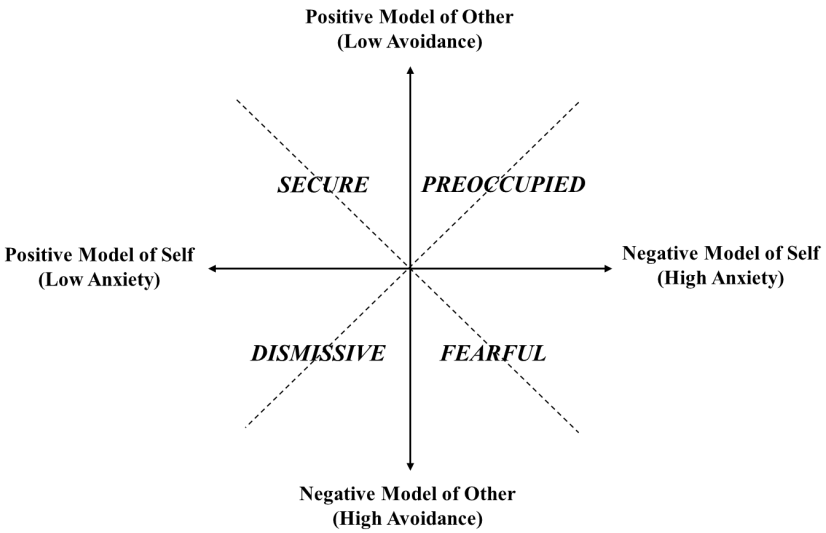

Figure 1 The Relations among the Dimensions and Categories of Attachment

Subsequently, participants were exposed to a physical temperature prime by being asked to briefly hold a cup of water, either warm (over 55 °C, *N* = 54) or iced (below 10 °C, *N* = 51). As a

cover story, we pretended to be commissioned by the manufacturer to ask customers for their advice on a new paper cup product. Thus, a questionnaire was developed with questions such as 'Do you like its design?' and 'How likely are you to buy this cup?'. This pretence was used to avoid suspicion about the manipulation and proved to be effective.

Furthermore, a perceptual focus task (Kimchi & Palmer, 1982) was conducted to examine the association between physical warmth and the perception of interpersonal proximity. For simplicity, nine questions from the original study were randomly selected and used to create a new questionnaire ($\alpha = 0.73$). In each trial, participants were asked to judge intuitively which option was more similar to the target object. As seen in Figure 2, for instance, Option A was a larger square made up of four smaller squares, and Option B was a large triangle made up of three small triangles. Choosing A (same properties) indicates that the participant adopted an individual perspective, while choosing B (same pattern) indicates a relational perspective, since the target object was a large triangle made up of three squares. Participants received 1 point for choosing the individual perspective and 2 points for choosing the relational perspective. Therefore, the higher the scores they received were, the more relational their perspective was. Consistent with previous studies (Ijzerman, & Semin, 2009; Schilder, Ijzerman, & Denissen, 2014), we assume that people in the warm condition, compared with those in the cold condition, perceive closer interpersonal proximity and take a more relational perspective.

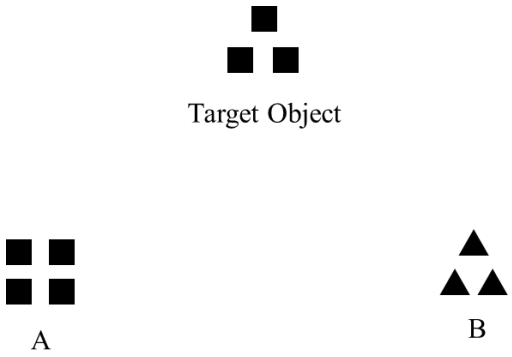

Figure 2. Example of an item used in the perceptual focus task.

Finally, the step-stop task was conducted to extend our investigation to overt behaviours. In this task, the shortest acceptable interpersonal distance of each participant when he or she interacted with strangers was measured and analysed. We supposed that individuals with secure attachment could tolerate a shorter interpersonal distance than those with insecure attachment during interactions with strangers. Moreover, when in the cold condition, insecure groups rather than secure

groups would tend to withdraw, exhibiting larger interpersonal distances. During the process, each participant was guided to a well-lit corridor and met an assistant of the same gender. The assistant was a stranger to the participants and was blinded to the temperature manipulation. Standing squarely face to face with the participant, the assistant moved step by step towards him or her. The original interpersonal distance was three metres, and the length of each step was approximately 38 cm, close to the stride length of a normal adult. After each step, participants needed to say 'go on' if they could still tolerate a shorter distance or say 'stop' if they felt awkward and uncomfortable. Finally, the distance between the participant and the assistant was measured using a band tape. Participants were not required to maintain eye contact with the assistant during the approach.

Statistical analysis

Temperature was the between-subjects factor. The average score of the perceptual-focus task was the dependent variable in Task 1, and the interpersonal distance was the dependent variable in Task 2. The gender, height and eyesight of the participants were statistically controlled.

All the data analyses were executed in *SPSS* 24.0, and the regression was performed using Process version 3.3 by Hayes (2017).

Results

Data from six participants were excluded because they did not complete all the questions. As a result, 99 participants' data were analysed. The perception of the temperature in the two conditions was significantly different, t (1, 97) = -20.54, $p < .001$, indicating an effective manipulation.

First, as shown in Table 1, the correlation analysis in Task 1 indicated that the association between temperature and the perception of interpersonal proximity was not significant, $r = .01$, $p = .92$.

Subsequently, to explore whether attachment anxiety and attachment avoidance could moderate the influence of physical warmth on the perception of proximity, a regression analysis was conducted. As Table 2 shows, the interaction of temperature and attachment anxiety was significant, B = .008, $SE = .003$, $p = .023$. As seen in Figure 3, people with low attachment anxiety preferred closer interpersonal proximity in the cold condition than in the warm condition. However, the opposite pattern appeared for people with high attachment anxiety. They perceived greater interpersonal proximity in the cold condition than in the warm condition.

Moreover, in the present study, the Johnson-Neyman technique (Johnson & Fay, 1950) was

applied to determine in which regions of attachment the moderating effect of warmth on proximity is significant and non-significant. The most common method for probing interactions is to test simple slopes at specific levels of the predictors (Bauer & Curran, 2005). However, the J-N technique is a more general method. The key advantage of the J-N technique is that regions of significance provide an inferential test for any possible simple slope of the focal predictor variable (Bauer & Curran, 2005), enabling tracking of continuous change in the simple slopes. As seen in Figure 4, when attachment anxiety was at a low level [-40.18, -23.18], the simple slope of the temperature on interpersonal proximity was negative. As anxiety increased to the interval [-19.60, 40.57], the simple slope became positive, which indicated that people who feel warm adopt a more relational perspective. In summary, the effect of physical warmth on participants' interpersonal proximity was significantly moderated by both high and low attachment anxiety.

When individuals were classified into the four attachment categories according to the attachment dimensions, following Brennan (1998), over 30% of participants were difficult to classify since no single type clearly had the highest score. For example, a participant who received 12 points for secure, 13 points for dismissive and 18 points for both fearful and preoccupied would be difficult to classify into the fearful or the preoccupied attachment style. As seen in Figure 11 and Figure 12, based on attachment anxiety and avoidance, the discriminant analysis showed that those participants were mostly within the interval of ± 0.25 standard deviations in the coordinate plane. As a result, individuals with a z score between -0.25 and 0.25 in any attachment dimension were placed in the disordered group (N = 33) and excluded from subsequent analyses, since the current study aimed to compare the differences between typically secure and insecure groups (N secure = 26, N insecure = 40; N fearful = 18; N preoccupied = 12; N dismissive = 10; 24 males, 42 females; Cold water: N = 30; Warm water: N = 36).

Then, ANOVA was conducted to examine the moderating effect of attachment style (secure vs. insecure) on the relation between temperature (warm vs. cold) and the perception of proximity. No main effect of temperature was found, F (1, 64) = 0.40, p =. 53, η_p^2 =. 006. However, the temperature interacted with attachment style, F (1, 64) = 5.98, p = .02, η_p^2 =. 09. As seen in Figure 5, the simple effects analyses showed that participants with insecure attachment adopted a more individual perspective in the cold condition (M = 1.45, SE = .06) than in the warm condition (M = 1.66, SE = .06), t = -2.66, p < .05, which indicates a perception of less interpersonal proximity. However, for

participants with secure attachment, there was no significant difference in perceptions of proximity between the cold condition (M = 1.69, SE = .081) and the warm condition (M = 1.56, SE = .07), p = .251. More precisely, as seen in Figure 6, the interaction effect was significant only among participants with preoccupied attachment, in which category high attachment anxiety is prominent. For those with high attachment anxiety, the perception of proximity in the cold condition (M = 1.30, SE = .11) was significantly less than that in the warm condition (M = 1.63, SE = .11), p < .05.

As in Task 1, first, the correlation analysis in Table 1 shows that the effect of temperature on interpersonal proximity was also not significant in Task 2, r = -.14, p = .17. Subsequently, regression analysis was conducted to test the moderating effect of attachment dimension. As seen in Table 3, a significant interaction between temperature and attachment anxiety was found, B = -1.47, SE = .51, p < .05. As Figure 7 shows, the interaction was such that in the cold condition, participants with high anxiety maintained greater interpersonal distance than participants with low anxiety. However, in the warm condition, there was no significant difference in interpersonal proximity. Moreover, as seen in Figure 8, the simple slope was significantly negative when the anxiety score was above 4.18, but it was not different from 0 in the 95% confidence interval when the anxiety score was below 4.18. Thus, only for participants with high attachment anxiety did feelings of physical warmth lead them to exhibit closer interpersonal distance from a stranger.

Furthermore, as in Task 1, using the subsample data (n = 66), ANOVA was conducted to test the moderating effect of attachment style on the relation between temperature and the acceptable distance from a stranger. No main effect of temperature was found, F (1, 64) = 1.22, p = .27, η_p^2 = .02. However, the temperature interacted with attachment style in interpersonal distance, F (1, 64) = 7.10, p < .01, η_p^2 = .10. The results of the simple effects analyses shown in Figure 9 indicate that participants with insecure attachment maintained greater interpersonal distance in the cold condition (M = 89.38, SE = 10.02) than in the warm condition (M = 53.39, SE = 9.06), t = 2.35, p < .01. However, there was no significant difference in distance between the cold condition (M = 36.38, SE = 12.82) and the warm condition (M = 48.50, SE = 10.98) among participants with secure attachment, p = .48. For greater specificity, univariate analyses of the four attachment styles were conducted. As seen in Figure 10, the moderating effect of attachment was significant only among the fearful and preoccupied groups, both of which featured high attachment anxiety. For the fearful group, the interpersonal distance maintained in the cold condition (M = 123.61, SE = 14.38) was significantly

greater than in the warm condition (M = 77.46, SE = 11.47), $p < .05$. For the preoccupied group, the difference in distance between the cold condition (M = 75.92, SE = 15.53) and the warm condition (M = 20.67.30, SE = 15.53) was also significant, $p < .05$.

Finally, after controlling for temperature, the partial correlations of the two tasks showed consistency between perceptions and overt behaviours of proximity when participants had insecure attachment, r = .396, p = .013, indicating that the relation between perceptions and overt behaviours of interpersonal proximity was consistently moderated by attachment.

General Discussion

The present study examined whether physical warmth is linked with interpersonal proximity and whether attachment plays a significant moderating role in this relation.

The findings supported our hypotheses. First, people with insecure attachment styles perceived and exhibited more interpersonal proximity in the warm condition than in the cold condition, whereas people with secure attachment showed no difference. Second, a significant interaction existed between physical warmth and attachment anxiety but not between physical warmth and attachment avoidance. Participants with high attachment anxiety exhibited more interpersonal proximity in both their perceptions and overt behaviours in the warm condition than in the cold condition. Thus, physical warmth promotes interpersonal proximity only when people exhibit insecure attachment and high anxiety. Third, the consistency between perceptions and behaviours of interpersonal proximity can be observed only among insecure groups, which means that the relation between embodied temperature perceptions and overt behaviours may also be moderated by personal attachment.

The effects of physical warmth on interpersonal proximity are easy to understand. Warmth may signal that individuals are socially affiliated, leading to social proximity in interpersonal interactions. Coldness signals that individuals are socially disconnected and insecure, which may decrease trust levels and increase interpersonal distance (Panksepp, 1998).

In contrast to previous studies, the present study found a significant interaction between physical warmth and insecure attachment with high anxiety. However, the effect was absent among individuals with low attachment anxiety. There are several possible explanations. First, interpersonal proximity can be considered a simulation of psychological distance between individuals (Williams & Bargh, 2008b), which is more implicit than prosocial intention. For those with secure attachment, the secure and warm feeling that caregivers induce is so profound and impressive that it may be difficult for the environment to influence such persons' original proximity towards others (Bowlby, 1969). Second, the self-assessment of attachment could have primed attachment security in secure groups, which may have decreased their psychological response to threat and weakened the negative effect of physical coldness (Stupica, Brett, Woodhouse, & Cassidy,

2019). Third, unlike prosocial behaviours such as positive comments or generous giving, seeking proximity is just a strategy adopted by secure groups to relieve feelings of insecurity. Thus, secure groups are likely to actively seek close proximity when threatened or distressed by coldness (Case, Conlon, & Maner, 2015; Gillath, Karantzas, & Lee, 2018), leading to no significant difference in interpersonal proximity under the two temperature conditions. Last but not least, according to previous studies, insecure groups tend to require additional support to increase their security, whereas individuals with secure attachment tend to reappraise the context and reinterpret events in a mild way when in negative situations both in terms of perception and behaviour (Baldwin, Siavash, & Adams, 2019). Thus, when in the cold condition, people with secure attachment are more likely to adapt to the external environment, while people with insecure attachment are passively affected by their surroundings.

The current study is the first to explore the influence of physical warmth on both the perception and overt behaviour of interpersonal proximity, which extends the embodied social investigations on interpersonal proximity from perceptions to overt behaviours. As a function of cognitive activity is to predict, guide and explain behaviour, cognitive mechanisms such as perception must be understood in terms of their ultimate contribution to situation-appropriate behaviours (Halali, Meiran, & Shalev, 2016). Thus, the understanding of the cognitive process governing the effects of physical warmth on interpersonal proximity is insufficient. When in the cold condition, individuals may have similar goals, such as proximity maintenance, but may achieve these goals through different behavioural means (Bowlby, 1969). For example, individuals with secure attachment may turn to their attachment figures and seek proximity positively, while people with high attachment anxiety desire proximity but hesitate to take action (Feeney & Collins, 2001). Thus, in the present study, we explored the influence of physical warmth on interpersonal proximity in terms of both perceptions and overt behaviours. The most important finding is the consistency between perceptions and behaviours among individuals with insecure attachment. This means that the influence of factors in the physical environment, such as temperature, is more profound for those with insecure attachment than for those with secure attachment, which can be observed in both perceptions and overt behaviours. In other words, it may be possible to improve individuals' behaviours through the physical environment.

The present study also examines the moderating effect of attachment by combining dimensional and categorical approaches to attachment. In previous studies, the different methods seemed to be contradictory and provided inconsistent outcomes regarding the moderating effect of attachment. However, in the current study, the effect was significant among insecure groups featuring high attachment anxiety, such as the preoccupied and fearful groups. This essentially means that, rather than being contradictory, the categorical perspectives and dimensional perspectives can complement and reinforce each other to some extent. In the present study, categorical methods provided the specific range of insecure groups, while dimensional methods emphasized the characteristic of high attachment anxiety. The combination of both methods made the moderating effect of attachment more convincing. Considering that the sample was small when classified into four attachment categories, further investigations can improve the statistical power by recruiting more participants.

Moreover, when assessing attachment with categorical methods, it was difficult to classify some participants into one best fitting attachment style. The possible reasons for the dilemma above are twofold. On the one hand, our participants were all young adults whose attachment patterns may be in a transitional period. According to infant attachment research, an ambivalent and self-contradictory attachment pattern is parallel to secure and avoidant attachment patterns, which may develop into specific insecure attachment styles when infants grow up (Bretherton, 1985; Cassidy, & Berlin, 1994; Intrieri, & Margentina, 2017). Thus, considering that the development from infant attachment to adult attachment is a gradual process (Bowlby, 1969; Fraley & Roisman,2019), it is possible that many participants still had ambivalent attitudes towards affiliation, making it difficult to classify them. Moreover, in the Adult Attachment Interview (AAI), the researchers kept the ambivalent and anxious category (Main, George, & Kaplan, 1985), which means many adults still exhibit this attachment pattern. On the other hand, apart from interaction with caregivers, people can also develop relationship-specific attachment styles that are capable of adjusting to the divergent interpersonal experiences they have had (e.g., Collins, Guichard, Ford & Feeney, 2004; Fraley, Heffernan, Vicary & Brumbaugh, 2011). Thus, even if a person has a secure foundation with his or her parents, experiences with peers may lead the person to feel insecure in the context of non-familial relationships (Fraley & Roisman, 2019). For instance, young adults in romantic relationships identified their partner as their primary attachment figure (Julal, Carnelley, & Rowe,

2017). However, as fledging relationships, romantic attachments may not yet be sufficiently secure (Hadden, Smith, & Webster, 2014).

In conclusion, the present study has offered insight into the relation between physical warmth and interpersonal proximity and how attachment moderates this relationship. It also suggests paying more attention to the influence of the physical environment on insecure individuals with high attachment anxiety. One important practical suggestion of the present study is that we can promote interpersonal harmony by manipulating people's perceptions of physical temperature. For example, insurance canvassers and salesmen may experience more success in promoting their products when dressed in warm suits. Similarly, to shorten the psychological distance between visitors and counsellors, the ambient temperature can be increased slightly or the indoor surroundings can be decorated with warm colours. This may help considerably, as people who ask for help are usually overwhelmed with anxiety and insecurity. In contrast, we can also make people feel unconsciously distant from others by creating feelings of physical coldness, which is useful in situations requiring privacy, such as banking. When depositing and withdrawing money, we are always at risk of personal information being snooped and stolen. Thus, on these occasions, keeping distant from strangers rather than behaving intimately may be a better option.

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Tables and Figures

Table 1

Description Analysis and Correlation Analysis

Variable	*M*	*SD*	1	2	3	4	5	6	7
Temperature [a]	-	-	-						
Average score on Task 1	1.59	.27	.01	-					
Interpersonal distance (cm)	55.35	.50	-.14	.02	-				
Age	19.63	1.83	-.05	.10	.06	-			
Height (cm)	168.82	8.41	-.21*	.03	.01	-.08	-		
Gender [b]	-	-	.12	-.09	-.07	.08	-.78**	-	
Eyesight [c]	-	-	.02	.16	.10	-.31**	.04	-.09	-

Note. $N = 99$. Temperature, gender and eyesight were encoded as dummy variables. Temperature [a]: 0 = cold condition, 1 = warm condition; Gender [b]: 0 = male, 1 = female; Eyesight [c]: 0 = not short sighted, 1 = short sighted.

Table 2

Moderator Analysis: Two Dimensions of Attachment in the Perceptual Focus Task

Effect	Estimate	*SE*	95% CI		*p*
			LL	*UL*	
Fixed effects					
Intercept	1.592	.027	1.538	1.645	.000
Temperature[a] (X)	.005	.054	-.102	.112	.923
Attachment Anxiety (W)	-.002	.002	-.006	.001	.237
Attachment Avoidance (V)	.001	.002	-.002	.004	.668
X×W	.008	.003	.001	.015	.023
X×V	.000	.003	-.006	.006	.931

Note. Total $N = 99$, CI = confidence interval; *LL* = lower limit; *UL* = upper limit.

[a] 0 = cold condition, 1 = warm condition.

Table 3

Moderator Analysis: Two Dimensions of Attachment in the Step-stop Paradigm

Effect	Estimate	*SE*	95% CI		*p*
			LL	*UL*	
Fixed effects					
Intercept	55.286	3.978	47.387	63.186	.000
Temperature [a] (X)	-11.346	7.967	-27.166	4.474	.158
Attachment Anxiety (W)	.556	.256	.047	1.065	.033
Attachment Avoidance (V)	.609	.229	.154	1.065	.009
X×W	-1.467	.511	-2.8481	-.453	.005
X×V	.182	.457	-.726	1.089	.692

Note. Total $N = 100$, CI = confidence interval; *LL* = lower limit; *UL* = upper limit.

[a]0 = cold condition, 1 = warm condition.

Figure 3

The Moderating Effect of Attachment Anxiety in the Perceptual Focus Task

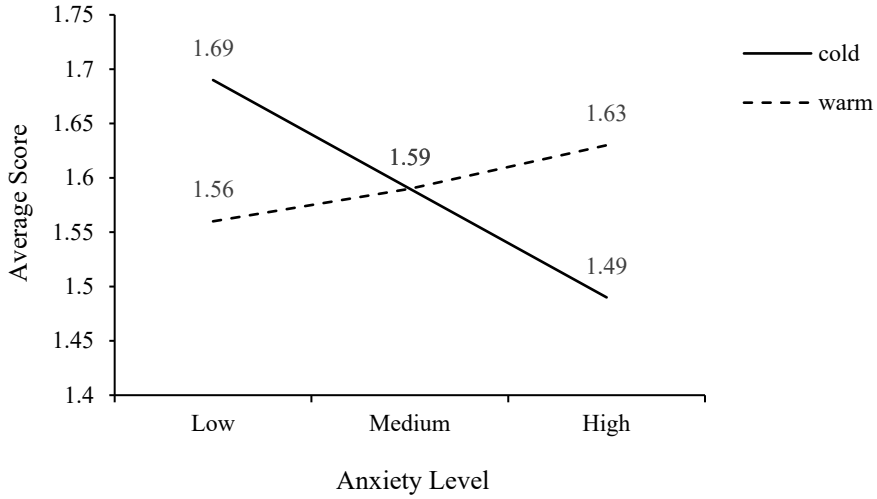
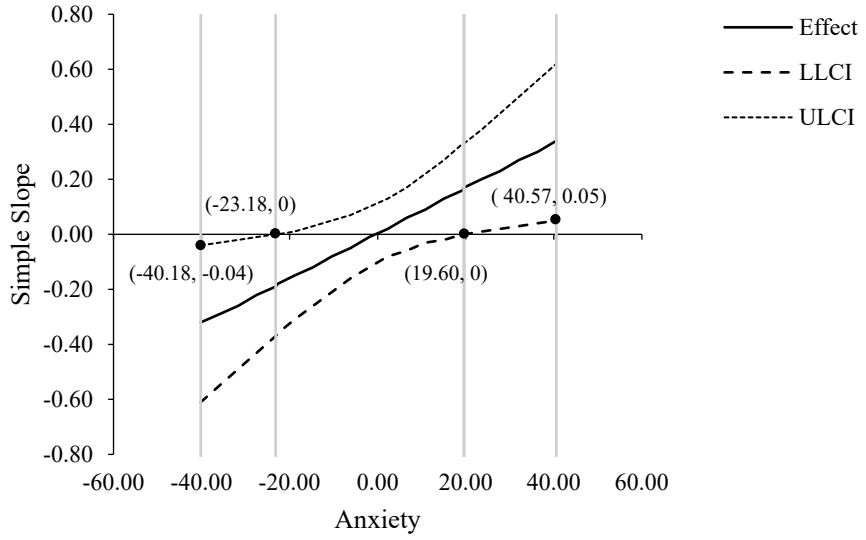


Figure 4

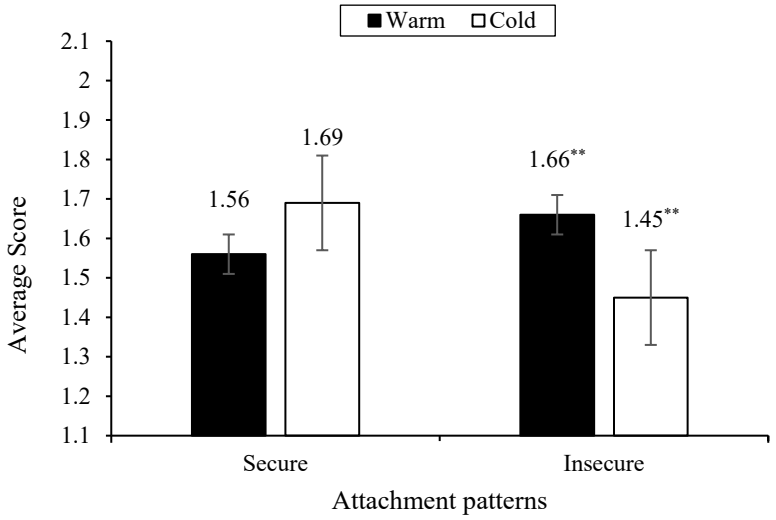
The Simple Slope of the Moderating Effect of Attachment Anxiety in the Perceptual Focus Task



Note. *LLCI* = lower limit confidence interval; *ULCI* = upper limit confidence interval.

Figure 5

The Average Score on the Perceptual Focus Task in the Secure and Insecure Groups

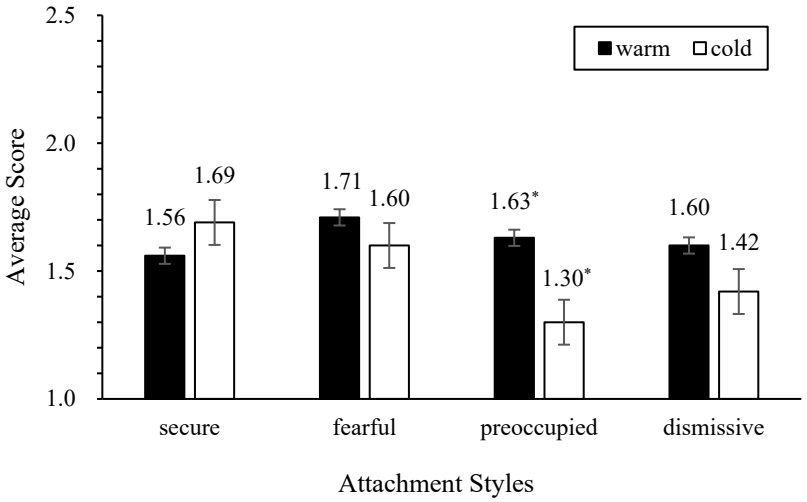


Note: Average ECR Scale scores were calculated for participants in different temperature conditions and with attachment patterns. Error bars show standard errors.

** $p < .01$

Figure 6

The Average Score on the Perceptual Focus Task for the Four Categories



Note: Average ECR Scale scores were calculated for participants in different temperature conditions and with attachment patterns. Error bars show standard errors.

* $p < .05$

Figure 7

The Moderating Effect of Attachment Anxiety in the Step-stop Paradigm

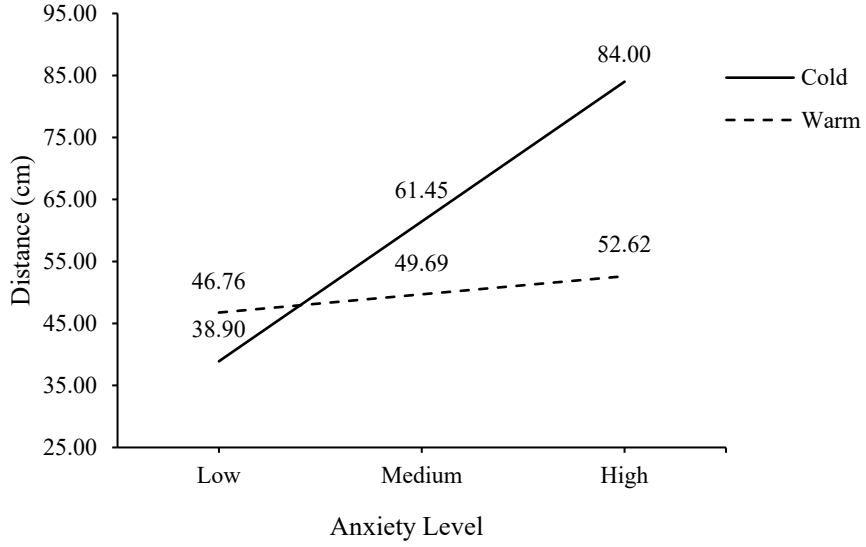
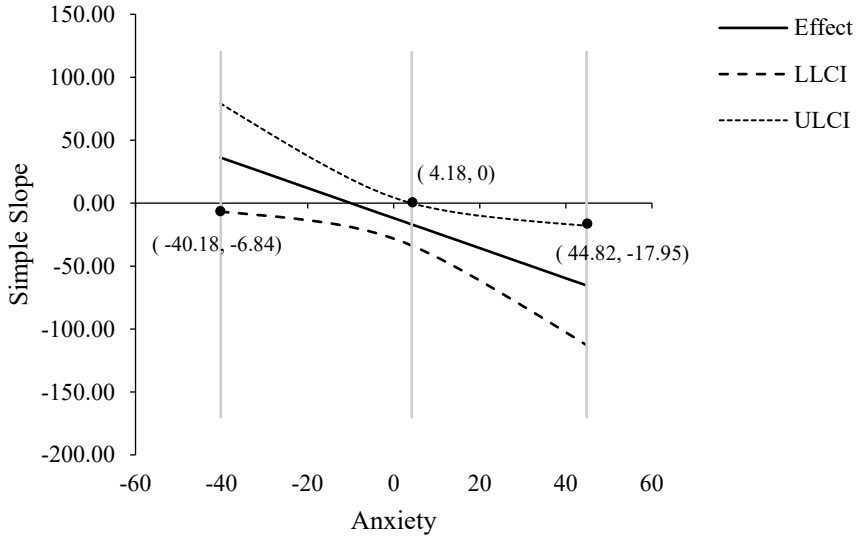


Figure 8

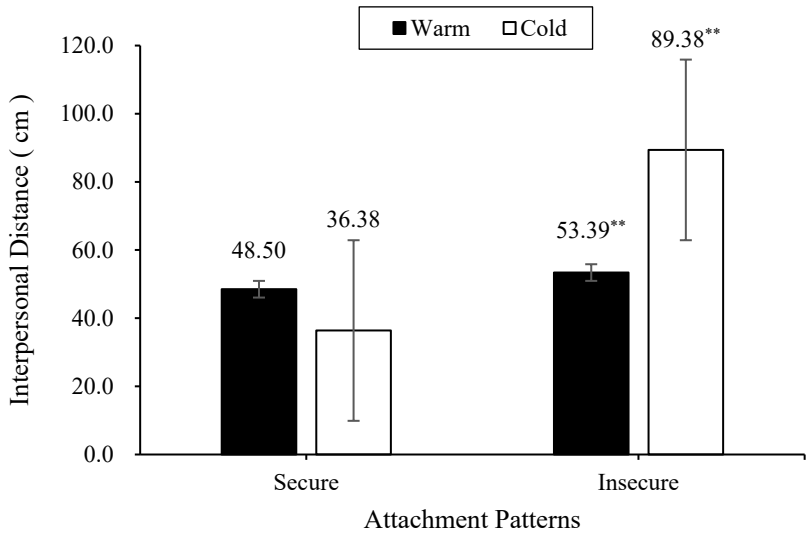
The Simple Slope of the Moderating Effect of Attachment Anxiety in the Step-stop Paradigm



Note. *LLCI* = lower limit confidence interval; *ULCI* = upper limit confidence interval.

Figure 9

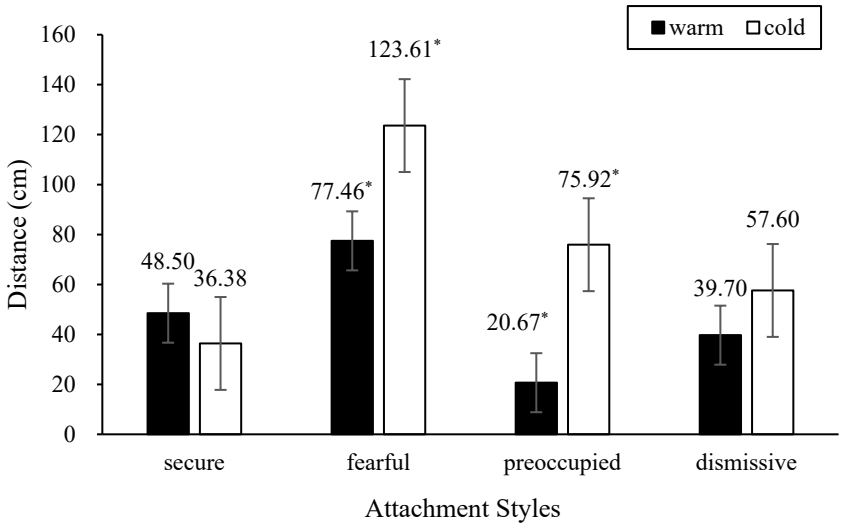
The Average Interpersonal Distance Maintained in the Secure and Insecure Groups



** $p < .01$

Figure 10

The Average Interpersonal Distance Maintained in the Four Categories



* $p < .05$

Figure 11

The Discriminant Analysis of the Original Data

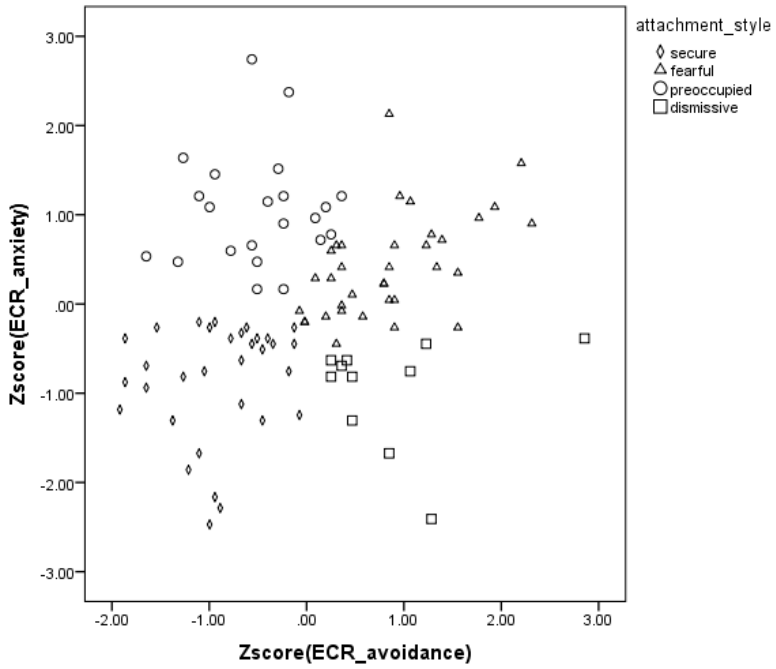


Figure 12

The Discriminant Analysis without the Disordered Groups