1. Introduction

On hearing that someone is warm, you will understand that we are talking about a friendly person, someone who shows affection and enthusiasm, and is in general fairly nice. But why warm? Is it pure chance that we use the same adjective, warm, for describing people and for talking about concrete temperature perception, as in warm water or it is warm here? Or is there a deeper connection between these uses and experiences underlying them? These questions have attracted considerable attention from both psychologists and linguists. Starting with social psychology, there has been much experimental research on the connection between warmth and affection. In a seminal experiment by Williams and Bargh (2008), the participants who had held a warm versus cold beverage later appreciated other people as more versus less generous and caring (i.e., having a warmer or colder personality), therefore providing evidence for a deeper association between prosociality and physical warmth. Similar results were obtained in conceptually related experiments, for example, the participants holding warm beverages in IJzerman and Semin (2009) judged themselves as emotionally closer to their friends and relatives (see also Fay & Maner, 2012; Schilder et al., 2014 for other examples), but have not been replicated in others (e.g., Lynott et al., 2014). As noted in IJzerman, Neyroud, et al. (2018), the period between 2008 and 2018 saw more than 80 published and unpublished reports on the relation between social thermoregulation (i.e., interpersonal relationships as crucially linked or even organized by processes of body temperature regulation) and various other domains. To give a few examples, there are studies showing that daily perceptions of physical warmth co-fluctuate with feeling social (Fetterman et al., 2017), that diversity in social networks helps to protect core body temperature against the cold (IJzerman, Lindenberg, et al., 2018), and that coldness makes people think about loved ones (IJzerman, Neyroud, et al., 2018).

The bulk of the relevant research has involved and has been carried out by speakers of major European – often Germanic – languages, in most cases English, in which words like warm and cold are frequently used both in a physical temperature sense (to feel warm/cold) and in reference to interpersonal relationships (a cold/warm person, warm feelings, etc.). Note that it is very hard to find any information on the language involved in the experiments, not to mention the native languages of the experimenters or of the participants in the experiments. The tacit
assumption seems to be that the words like warm and cold in both uses are self-evident and easily translatable between languages.

Turning to the more linguistically oriented research, the frequently used English expressions like cold/warm people underlie one of the most widely quoted conceptual metaphors affection is warmth, first introduced in Lakoff and Johnson (1980) and subsequently characterized by Grady (1997) as a ‘primary’ metaphor. Grady suggests that primary metaphors in general originate in recurring correlations in experience and hypotheses that affection is warmth is based on our experience of being held affectionately by our loving parents and feeling warmth (the idea evoking much older literature on attachment and early work on the links between physical contact and attachment formation such as Bowlby [1969] and Harlow [1958]). Multiple experiences of this kind lead to natural cognitive associations between bodily warmth and the subjective experience of affection. Metaphor researchers also assume that primary metaphors are often universal, since they are grounded in universal bodily experiences (cf. Grady, 1997; Kövecses, 2005: 2–3; Grady & Ascoli, 2017).

If an association is taken to be universal on the basis of commonly used English expressions, it means that it should also find multiple parallels in other languages. However, is this really true? Are linguistic manifestations of the affection is warmth association really widely spread across the languages of the world or are they biased toward particular language families or geographic areas? This is the question that the current study seeks to answer. Given the influence of Lakoff and Johnson’s work on research in social psychology (cf. Landau et al., 2010 for an overview and Fetterman et al., 2017 for social warmth), the answer to this question should be of interest for social psychologists, including those who suggest or subscribe to other theories of grounded cognition.

Note that universality of the association between warmth and affection was originally a tenet of the conceptual metaphor theory, and it is not altogether clear to us when and on what grounds this claim was first made in the literature. Most of the examples for the suggested metaphors in both Lakoff and Johnson (1980) and Grady (1997) come from English, with occasional mentions of expressions from a few major West European languages. Similar examples do occur in other languages, cf. examples (1) – (4) from four different languages – Ukrainian (Indo-European: Slavic), Palula (Indo-European: Indo-Aryan), Indonesian (Austronesian: Malayo-Sumbawan), and Cantonese (Sino-Tibetan: Sinitic).¹

(1) Ukrainian (Indo-European: Slavic) (Kryvenko, 2015: 324)

tepl-á
warm-F.NOM.SG
'warm'

(2) Palula (Indo-European: Indo-Aryan) (Liljegren & Haider, 2015: 463)

ma ta táat-u tu ba
ISG.NOM[M] PARTICLE hot/warm-M.SG 2SG.NOM PARTICLE
sidáá-š
cold-M.SG
'I am merciful but you aren’t.’ (lit. ‘I am hot/warm but you are cold.’)

(3) Indonesian (Austronesian: Malayo-Sumbawan) (Siahaan, 2015: 694)

-senyum yang meng-hangat-kan dada-ku...
smile that ACT-warm-CAUS chest-my
‘...the smile which made me feel warm inside’

(4) Cantonese (Sino-Tibetan: Sinitic) (Hilário de Sousa, personal communication)

sam1 gok3dak1 hou2 nyun5
heart feel very warm
‘feeling warm in heart’

However, given the enormous diversity of the world’s languages, occasional examples from a score of languages are not sufficient for generalizations about any linguistic feature. And while research on metaphors has been extended to more languages from different parts of the world, there are on the whole relatively few systematic cross-linguistic studies on most metaphors, including affection is warmth. Vejdemo and Vandewinkel (2016) restrict themselves to temperature metaphors involving terms for body parts in a few languages. Several chapters in Koptjevskaja-Tamm (2015) have sections on temperature-based metaphors in the relevant languages, but the volume does not offer any systematic overview of those.

This paper, based on a sample of 94 languages coming from all over the world, is therefore the first systematic cross-linguistic study on expressions that can be interpreted as manifestations of the affection is warmth metaphor. The paper is organised as follows. Section 2 explains the basics of systematic cross-linguistic research, among other things, its ambitions to tease apart the different reasons for why languages can share certain similarities with each other. Section 3 defines the object of the study, affectionate warm expressions, that is, linguistic expressions comparable to the English phrases such as warm words/people/smiles and the like, elaborates on which kinds of expressions are included among them and on what is meant by warm in a cross-linguistic perspective, and breaks down the overarching research question into three more specific ones. Section 4 is devoted to the methodology used in the study – the methods used for the data collection (Section 4.1), the language sample (Section 4.2), the categories employed for coding the data (Section 4.3), and the statistical methods (Section 4.4). Section 5 presents the results, the distribution of affectionate warm expressions across different languages, language families, and geographic areas. Section 6 discusses how this distribution can be accounted for and how these findings can
be interpreted in the light of different approaches to universals – linguistic and non-linguistic. Section 7 concludes and reflects on the potential implications of this study for psychological research.

To briefly summarize the results, the relevant expressions turn out to show a remarkably skewed distribution and seem to be absent in most language families and linguistic macro-areas. In this way the study contributes to the growing awareness of the ways in which some of the central concepts and conclusions in linguistics, psychology, and cognitive research in general can be influenced by the Anglocentric, Standard Average European, and WEIRD perspectives on the relevant phenomena.

2. Approaching Linguistic Diversity
According to the generally accepted estimation, there are currently between 6,000 and 8,000 languages, at least half of which are endangered and may be lost in the not too distant future. Languages are amazingly diverse, and the more we learn about them the more diversity we uncover (cf. Evans & Levinson, 2009 for a captivating overview). However, cross-linguistic variation is not completely unrestrained, and languages share numerous similarities with each other. There are several reasons for this.

First of all, there are historical relations among languages, whereby a certain property is shared by genetically related languages or by languages that have been spoken in the same area or have had other contacts with each other (‘language contact’ is a broad term covering any use of more than one language at the same time and place). Genetically related languages (i.e., languages stemming from the same ancestor language) can obviously be similar to each other in various respects, for example, in their basic words – cf. three and brother in English and their correspondences in two other Indo-European languages, tri and brat in Russian and tre and frater in Latin. Languages can also “borrow” various properties from each other in the course of language contact. Borrowed words are ubiquitous, but not only words spread from language to language. Word order, various grammatical constructions and patterns, sounds, intonation – languages can basically converge on any linguistic property when used in multilingual situations. Particularly interesting in the present context are similarities in semantic patterns shown by languages that have been in contact with each other. Thus, no one will find it odd that both the Swedish word mus and the Russian word myska can refer to both a little rodent and to a small handheld device. This combination of meanings in one and the same word is far from self-evident, but the semantic pattern shared by Swedish and Russian is simply a calque, or a loan translation, from English. Or take a less obvious example, the familiar farewell expressions au revoir (French), auf Wiedersehen (German), pä återseende (Swedish), do svidanja (Russian), näkemiin (Finnish), that follow the same model across a number of European languages – simply because it has spread across them due to language contact. Speakers of languages that have been in contact with each other are often not aware of the origin of these semantic parallels but take them as very natural and self-evident linguistic patterns (Koptjevskaja-Tamm & Liljegren, 2017; Gast & Koptjevskaja-Tamm, 2018; Thompson et al., 2020).

Finally, there are recurrent linguistic patterns that are less dependent on historical relations among languages. Some of them even appear to be universal. For instance, all languages can systematically distinguish between simple statements (declaratives) and questions or between affirmative and negative utterances, even though they do this differently. All languages have different words for ‘sleep’ and ‘die’. Opinions vary as to whether there are innate universal properties of language as an autonomous cognitive system (the influential hypothesis launched by Noam Chomsky and embraced within the generative linguistics, cf. Dąbrowska, 2015 for a recent critical overview), or whether the observed cross-linguistically recurrent patterns are rooted in general human biological, perceptual, and cognitive preconditions and predispositions, functions of language, typical human activities, socio-cultural praxis, and other environmental factors.

A central issue in all cross-linguistic comparison is to what extent observed similarities among languages may be explained as due to chance, inheritance, contacts, universal tendencies, or a combination of these factors. This is a challenging enterprise embracing different approaches and different ideologies. The view adopted in this study is that generalizations over linguistic properties should be based on careful systematic cross-linguistic studies, preferably involving many languages from different parts of the world. This is what linguistic typology is about. It is the study of linguistic patterns that are found cross-linguistically, in particular, patterns that can be discovered solely by cross-linguistic comparison’ (Croft, 2003: 1). Typological research takes linguistic diversity as its point of departure, assumes that the variation across languages is restricted, and aims at discovering the systematicity behind it and suggesting potential explanations for both the linguistic patterns themselves and for their distribution across languages.

In general, modern typological research is very cautious about declaring ‘universals’, or properties that are believed to be present in all or most languages. Most universals suggested by earlier cross-linguistic comparison have been shown to have too many counter-examples (cf. The Universals Archive in Konstanz, http://typo.uni-konstanz.de/archive/intro/index.php). Recent decades have seen an explosive growth and diversification of sophisticated quantitative methods for uncovering statistically robust cross-linguistic tendencies in various phenomena (i.e., statistical rather than absolute universals) and identifying the underlying biases that drive the synchronic patterns that we find. Among other things, it has become evident that historical contingencies are an extremely powerful factor behind cross-linguistic similarities: linguistic patterns tend to be distributed very unevenly across the languages of the world, which can be explained by historical relations among languages, in particular by language contact (Bickel, 2015; Bickel, 2017; Bickel & Nichols, 2006; Cysouw, 2010; Cysouw, 2013; Dunn et al., 2011; Dryer, 1989; Jaeger et al., 2011; Maslova, 2000; Nikolaev 2019). There is also a growing body of research
on the role of environmental factors influencing or shaping linguistic systems. Environment can be understood in terms of geography and climate, as in Everett et al. (2016) and Everett (2017) on language tones and vowel systems, and in Regier et al. (2016) on semantic categorization within the domain of ice and snow, all these properties argued to be correlated with the climate. Environment can also be understood in more social terms, as in Sinnemäki and Di Garbo (2018) on possible correlations between linguistic complexity and the sociolinguistic characteristics of the relevant linguistic community, and in Blasi et al. (2019) on the association between human sound systems and the subsistence type of the relevant population groups. This cautiousness in declaring universality of properties displayed by languages is in stark contrast to the position taken both in the generative linguistics and in the metaphor theories, for which observations on English and a few other European languages have often been interpreted as direct reflections of universal properties and relations.

3. Defining the Object and the Main Questions of the Study

As stated in the Introduction, the current paper aims to investigate to what extent linguistic manifestations of the Affection is Warmth metaphor are widely spread across the world’s languages. A cross-linguistic endeavour of this kind is crucially dependent on comparable data coming from different languages. In general, the issues of cross-linguistic identification of phenomena and methods of data collection are central in typology, where the researchers often deal with various languages in which they lack competence, which have been studied within very different research traditions, or are merely understudied (as the case is for the majority of the world’s languages). Cross-linguistic identification of phenomena presupposes a procedure that ensures that we compare like with like. However, another key concern for cross-linguistic research is to find a reasonable level of abstraction, at which the language-specific details can be reduced to manageable patterns. The two concerns interact in various ways, and what counts as ‘like and like’ is often dependent on the research object and goal.

There are, however, serious methodological complications inherent in systematic cross-linguistic research on metaphor. Conceptual Metaphor Theory emphasizes conceptual association that does not boil down to individual metaphorical uses or to linguistic convention. But to quote Gibbs (2015:183), cognitive linguists, and others, should articulate criteria for identifying metaphoric patterns in language and inferring specific conceptual metaphors from discourse. These procedures should be specified with sufficient detail so that other researchers can possibly replicate the analysis and emerge with similar conclusions. Translated into the methodology of systematic cross-linguistic research, this means that we can only test the extent to which some concrete manifestations of suggested metaphors hold across languages rather than whether the conceptual metaphors as a whole are universal.

In other words, metaphor hunting has to be broken down into doable tasks that ensure or at least facilitate comparability and cross-linguistic identification of the studied phenomena. The approach taken here is to restrict ourselves to temperature terms, such as hot, warm, cold, and the like, and to check to what extent these have uses that may be related to the Affection is Warmth metaphor, that is, expressions such as warm words, warm people, and so on. Such expressions will be called ‘Affectionate Warm’ expressions. Here we elaborate on which kinds of expressions are included among ‘Affectionate Warm’ and on what is meant by ‘warm’.

Below is a list with typical contexts for ‘Affectionate Warm’ linguistic expressions pulled out from various sources where the metaphor has been discussed (e.g., Juvonen & Nikunläsi, 2015 for Finnish; Stathi, 2015 for Modern Greek; Rasulic, 2015 for English and Serbian; Siahaan, 2015 for Indonesian):

**People (disposition) and emotional attitudes:**

Showing (Friendly) Emotions is Warm, Not Showing (Friendly) Emotions is Cold

- people
- bodily entities metonymically related to emotions:
  - heart, face, eyes
- manifestations of emotions: look, smile, voice

**Interpersonal relations and social interaction:**

Friendly/Intimate/Close is Warm, Unfriendly/Distant is Cold

- relations between people, institutions, governments, nations, etc.: relations, ties, cooperation, collaboration
- social interaction, in particular communication:
  - reception, reaction, feedback, support, words, speech
- general mood or feeling: atmosphere
- a group of people related by friendly relations

**Intrinsically positive emotions:**

- affection, friendship, love
- happiness, joy

Let’s now turn to the temperature terms themselves. English has numerous words and expressions for talking about temperature, among which the adjectives hot, warm, and cold have a central place. They are more frequent than any of the others and can apply to any entities and any situations with the relevant temperature properties. They can be used for talking about tactile temperatures: The stones are hot/warm/cold, about personal feeling temperature: I am/feel hot/warm/cold, and about ambient temperature: It is hot/warm/cold here; The wind was hot/warm/cold.

English speakers seem to largely agree on the meanings and uses of hot, warm, and cold, in particular, on how to choose between the two warming adjectives (Lehrer, 1970; Prator, 1963, in addition to the standard definitions in numerous dictionaries). Warm is primarily about pleasantly, comfortably warming temperatures, whereas unpleasantly, uncomfortably, or dangerously warming temperatures are within the responsibilities of hot. To
be sure, temperature perception in humans is subject to individual variation; in addition, most linguistic categories have fuzzy boundaries, meaning that there is no fixed and exact demarcation line between warm and hot with situations that can be described by both. Thus, hot occasionally denotes high temperatures that do not have to be unpleasant, uncomfortable, or dangerous, like hot tea or a hot sauna. Nevertheless, you will hardly warn someone to watch out for the warm stove — it is the hot weather that can be dangerous for people’s health and life, and a statement like ‘I feel hot in here’ can be interpreted as an indirect request to open a window.

But a quick glance at another major European language, French, suffices to show that languages can differ even in these simple matters. First, French lacks the lexical contrast corresponding to the one between warm and hot: all warming temperatures are covered by the same word chaud, occasionally provided with intensifying or modifying expressions such as ‘very’, ‘extremely’, ‘a bit’, and the like. The basic contrast in French is therefore between chaud ‘warm/hot’ and froid ‘cold’. The meaning of the third relatively frequent temperature word tiède is close to that of lukewarm or warmish in English; these temperatures feel neither warm nor cold. Now, of course French has words for denoting very high or nice cooling temperature in specific situations, like brûlant ‘burning hot’ or frais ‘fresh, cool’, but these have a much more marginal status than chaud or froid, comparable to scorching in English.

In addition, French uses three different syntactic constructions with three different verbs to distinguish between tactile, personal-feeling, and ambient temperatures: while the stones ARE hot (Les pierres SONT chaudes), I HAVE hot (J’AI chaud), and it MAKES hot (IL FAIT chaud). This is very different from English, where It is cold can be used both for ambient and for tactile temperature (it can stand for all kinds of things like tea or a stone) and They are cold can apply to both people who experience personal-feeling temperature and to, say, both people and stones that feel cold when you touch them. No such uncertainty is possible in French.

What French expresses using different constructions other languages can express using different words. For instance, Russian has two different ‘hot’ words — горячий for tactile contexts, like горячий чай ‘hot tea’, and зяблый for ambient and personal-feeling temperatures, like зяблый климат ‘hot climate’ and мне зяблый ‘I feel hot’.

Even very closely related languages can show interesting differences in their temperature systems. For instance, while English warm and hot have direct correspondences in most of the Germanic languages, their meaning can be different. The Swedish varm and the German warm are, in a way, comparable to the French chaud in covering all warming temperatures, both pleasant and unpleasant. Therefore, when speaking Swedish, you can warn people to watch up for the warm stove and discuss why the warm weather can be dangerous for people’s health and life. However, the Swedish hot and the German heiss are so frequent and generally applicable to all kinds of situations, that the Swedish warm and the German warm are often associated with the more comfortable and pleasant experiences.

The main lesson here is that languages differ in how they categorize the temperature domain by means of lexical expressions — which is amply demonstrated by the systematic descriptions of the numerous temperature systems in Koptjevskaja-Tamm (2015). Summarizing the main differences illustrated above,

- ‘warm’ for pleasantly comfortable warming temperatures is not necessarily distinguished by a special word in languages
- languages can have different expressions (words and constructions) for different kinds of temperature evaluation, for example, for tactile temperature sensation versus thermoregulation.

Given that even simple words like warm, hot, and cold in English are far from being self-evident and easily translatable to other languages, the current study tests to what extent any frequent words that are systematically used for any warming temperatures can have ‘affectionate’ uses. More specifically, we seek to provide answers to the following questions:

a. How widely are ‘affectionate warm’ expressions spread across the languages of the world? Is their distribution influenced by areal and/or genetic affiliation of languages?
b. Is there a connection between the presence of ‘affectionate warm’ expressions in a language and the existence of the opposition between ‘warm’ and ‘hot’ in the same language?
c. And finally, is there any connection between the presence of ‘affectionate warm’ expressions in a language and the climatic conditions under which the language is spoken?

4. Methodology
4.1. Data collection
The data underlying this study has been collected during a period stretching over at least 13 years. The study itself constitutes a part of an overarching program devoted to the cross-linguistic study of the temperature domain from several angles and headed by the first author (Koptjevskaja-Tamm, 2015). Working out a reasonable methodology for this research has been far from trivial, partly because temperature expressions do not easily lend themselves to simple elicitation by means of extra-linguistic stimuli, as opposed to, for instance, colour or odour terms, which have been widely studied cross-linguistically (Berlin & Kay, 1969; Majid & Kuspe, 2018). There are, of course, diverse thermal stimuli that have been successfully used in studies on temperature perception in various groups of people and on its relation to various pathological states (cf. Bakkers et al., 2013; Castellote & Valls-Solé, 2019; Green & Akirav, 2007 for some examples). For linguistic purposes, however, their applicability is severely restricted for various reasons.
The main instruments for data collection and analysis for most of the languages in the database are various versions of the standard temperature guidelines (https://osf.io/gcbh2/files/). Importantly these are intended for linguists working on particular languages who can use them for data collection and/or for organization of the data in the languages of their expertise rather than for ‘naive’ language users. Initially written in English and Russian, they have been translated, at least partially, into several other languages of broader communication (French, Spanish, Portuguese, Pashto, etc.) by researchers working with native speakers of various less described languages. The temperature guidelines have been elaborated in several steps involving trial and error with different formats and first tested on a few languages. The majority of the contributors to (Koptjevskaja-Tamm, 2015) used the first ‘approved’ version of the guidelines (https://osf.io/g2kq7/) for the collection and organization of the data in their languages of expertise, which were later abridged and made more focused (https://osf.io/ywg2j/).

The data underlying the present study comes from multiple sources:

- the descriptions of 25 languages in (Koptjevskaja-Tamm, 2015) based on the long version of the standard temperature guidelines
- other studies on temperature terms and temperature-related metaphors in single languages, many of which have been inspired by Koptjevskaja-Tamm (2015) and follow its methodology (e.g., Ladygina, 2013; Lehtila, 2014; Sharifian & Jamarani, 2015; Treis & Doyiso, 2019)
- replies to various versions of temperature guidelines (https://osf.io/gcbh2/files/) filled in by experts in and native speakers of different languages
- replies to queries posted at LingTyp – the mailing list of the Association for Linguistic Typology

On the whole, around 90 linguists, many of whom are also native speakers of the relevant languages, have contributed to the data collection (cf. Appendix 2 for the details). These researchers are currently working in or originate from about 40 countries, half of them being in Europe, but also ten Asian countries (China, India, Indonesia, Iran, Israel, Japan, Lebanon, Pakistan, Thailand, and Turkey), five African countries (Algeria, Ethiopia, Gabon, Ghana, South Africa), Australia, Chile, Mexico, and USA. In the majority of cases, the data collection and data analysis have been monitored by the first author or have been carried out in a close dialogue with her.

The longest version of the temperature guidelines (https://osf.io/g2kq7/) consists of a checklist/questionnaire, a background, and an appendix. The background provides a general description of the linguistic temperature domain, while the appendix gives further definitions for various terms and criteria for identifying relevant phenomena. The main part of the guidelines is an analytical checklist/questionnaire. In the longest version, it starts with a listing task where the participants (language experts and native speakers) are asked to list all the temperature terms in the language that they can come up with and provide their approximate translations into English, Russian, or another ‘meta-language’ used in the data collection. The next steps consist in checking their various specific and general properties (such as meaning, grammatical properties, constructions in which they can be used, etc.) and providing examples of their uses and meanings – both concrete (i.e., in reference to physical temperature) and extended (such as warm words, hot music, or in cold blood). At the final step, the participants are invited to make generalizations on the meanings and grammatical properties of the whole temperature system in the language, based on the answers to the earlier sections. Building on the results obtained at the first stages of the programme, the subsequent versions of the guidelines were made much shorter and more focused on eliciting data that can be used for testing particular generalizations and finding specific phenomena, among others, particularly extended uses of temperature terms (https://osf.io/ywg2j/).

The questionnaire itself, while being detailed and sufficiently strict, is still quite open and can be used in various ways – both while collecting data (often by a combination of direct elicitation with group discussions, observations of language use, and corpus searches) or organising the data that come from various corpora, occasionally complemented with some elicited information. This relative freedom in the data collection methodology is well justified given the huge variation in the status of the different languages involved in the study, the general level of their documentation, and the availability of resources. To illustrate, the descriptions of the temperature systems in relatively well studied national languages, such as Modern Greek (Stathi, 2015), Finnish (Juvonen & Nikunlaisi, 2015), East Armenian (Daniel & Khurshudian, 2015), Indonesian (Siahaan, 2015), or Japanese (Shindo, 2015), are based on the data coming from large language corpora (often complemented with dictionary information). Here the researchers, who are native speakers of these languages, have pulled out all the occurrences of temperature words in corpora containing texts of different genres and covering millions of words and have used the temperature guidelines as a checklist for the organization and analysis of their data.

Data collection for less described languages is trickier and involves a good portion of creativity from the researcher, who is usually deeply anchored in the relevant language and culture. For instance, the description of the temperature system in Palula, a minor language in Pakistan (Liljegren & Haider, 2015), is primarily based on direct elicitation of examples, searches in the earlier collected texts, and group discussions with native speakers. This work was jointly carried out by two researchers – a native speaker of Palula and a Swedish field worker who has spent many years in the community and has produced multiple linguistic resources for the language. Similarly, the data on Akan and Kasem (both spoken in Ghana) were collected by the first author’s students at the University of Ghana-Legon as part of their course task. The students, who are native speakers of the languages, used their own
linguistic competence to produce examples and analyse their meanings but also checked the data with other members of the community, and, finally, produced reports with an overview of their data and results organized in accordance with the chapters in (Koptjevskaja-Tamm, 2015). In still other cases native speakers have mainly been involved in producing and evaluating data, elicited and analysed by the field worker (e.g., Roulon-Doko, 2015 on Gbaya, Central African Republic; Žúňiga, 2015 on Mapudungun, Chile; Epps, 2015 on Hup, Brazil; Schapper, 2015 on Kamang and Abui, Indonesia; and Brykina & Gusev, 2015 on Nganasan, Russia). In these cases, the field workers are native speakers of other, often major languages (here French, Spanish, English, Russian) but have all spent many years in the communities and have produced multiple linguistic resources for the languages, such as grammars, dictionaries, text collections, school books, and the like. This deep knowledge of the relevant languages and cultures helps the researchers to direct their questions towards situations and contexts where temperature expressions are likely to be used, both with concrete and extended meanings. For instance, many cultures in South East Asia, Indonesia, and sub-Saharan Africa primarily associate human emotions, traits, and inner states with particular body parts, which can be described as having a particular colour, weight, size, texture — or temperature. With this background knowledge, the researcher systematically checks to what extent different body part terms combine with different temperature terms and what the resulting combinations mean.

The cases presented so far speak of published and unpublished studies and reports on temperature systems in particular languages. In many cases, the data has been primarily collected as a contribution to the cross-linguistic comparison effort without the aim of resulting in an independent publishable report. In those cases, the temperature guidelines have been filled in by an expert on a language (almost always themselves a native speaker) and delivered to the first author, who has gone through the data and gone back to the expert with additional questions, comments, hypotheses, and so on. In some cases, most of the discussion has been carried out via email, in others, the expert and the first author have been sitting together (e.g., at LLACAN in Paris, at the University of Ghana-Legon in Accra, or at the Tartu University). Finally, some data comes from relatively short queries aimed at specifically eliciting information on the possibility of using temperature words with extended meanings, among others, in affection as warmth contexts. These were posted at the mailing list Typling, gathering many typologists and field linguists working on languages in various parts of the world, and generated a number of responses on a few less accessible languages.

To summarize, information on the different languages included in the project has been collected and organized in various ways. Generally speaking, the data for the current cross-linguistic comparison covers both primary data, that is, expressions that native speakers of different languages understand and use for speaking about temperature in various contexts and concrete examples of such uses (utterances and sentences), but also more general ‘meta-linguistic’ descriptions provided by experts and native speakers.

4.2. Sample

The resulting sample contains data from 94 languages from 24 language families, as well as four isolates (i.e., languages not genetically related to any existing languages), two creole languages, and one artificial language (cf. Table 1, also Appendix 1 and 2, https://osf.io/gcbh2/files/). The sample is thus restricted to spoken languages, even though we have sporadic data on a few sign languages.

In the database (see Appendix 1 for details, https://osf.io/f9yeh/), all the languages are provided with ‘glottocodes’ referring to records in the currently most comprehensive on-line catalogue of languages and language families Glottolog 4.1 (Hammarström et al., 2015). Glottocodes are unique and persistent language identifiers consisting of four alphanumeric characters (i.e., lowercase letters or decimal digits) and four decimal digits, for example, ‘stan1249’ for Swedish. These can be used to retrieve the information on the genealogical affiliation of languages and on the location where they are spoken (defined as latitude and longitude). The coordinates may represent the geographical centre-point of the area where the speakers live, but may also indicate a historical location, the demographic centre-point or some other representative point (https://glottolog.org/glottolog/glottologinformation accessed on 2020-02-08).

The languages in the sample represent all the six macro-areas of the world, that is, ‘an area of the globe of roughly continent size’, as defined in Glottolog 4.1. – Eurasia, Africa, North America, South America, Australia, and Papuasia (a cover term for Micronesia, Melanesia, and Polynesia including New Zealand) (https://glottolog.org/meta/glossary#macroarea accessed on 2020-02-04). However, this is still a convenience sample, since the languages have not been selected according to any strict selection method to ensure a fair representativeness of the world’s languages and to avoid obvious biases in the sampled data (cf. Bakker, 2011; Miestamo et al., 2016). Most of the language families in the sample are represented by one language, with a few exceptions. Genetically, the Indo-European family (numbering 589 languages in Hammarström et al., 2015) is overrepresented, with as many as 30 languages in the sample. Niger-Congo languages (numbering 1432 languages in Hammarström et al., 2015) have 14 representatives in the sample. Areally and genetically, languages from the Americas, Australia, and Papuasia are underrepresented (significantly, Austronesian languages, numbering 1275 languages in Hammarström et al., 2015, have only six representatives in the sample).

Nevertheless, in the context of cross-linguistic research on lexical semantics and/or on metaphors, the current sample is extraordinary in the sheer number of the represented languages and their genetic and areal diversity. In general, a large portion of systematic cross-linguistic research is based on convenience samples, which is well justified given the ‘practical circumstances which force a
### Table 1: The languages in the sample.

| Affiliation | Language | Macro-area/Area |
|-------------|----------|-----------------|
| Artificial (1) | Esperanto | Eurasia/Europe |
| Indo-European (30) | Armenian | Eurasia/West Asia |
| | East Armenian | Eurasia/Europe |
| Baltic (2) | Latvian, Lithuanian | Eurasia/Europe |
| Celtic | Irish | Eurasia/Europe |
| Germanic (9) | Afrikaans | Africa/Subsaharan |
| | Danish, Dutch, English, German, Icelandic, Norwegian, Swedish, Yiddish | Eurasia/Europe |
| Greek | Modern Greek | Eurasia/Europe |
| Indo-Aryan (3) | Marathi, Palula | Eurasia/South Asia |
| | Kelderari Romani | Eurasia/Europe |
| Iranian | Persian (Western Farsi) | Eurasia/West Asia |
| Romance (4) | French, Italian, Portuguese, Spanish | Eurasia/Europe |
| Slavic (8) | Bulgarian, Czech, Macedonian, Polish, Russian, Serbian, Slovak, Ukrainian | Eurasia/Europe |
| Creoles (2) | Indo-European/Germanic-based/Pacific Creole English | Papunesia |
| Creoles | Bislama, Tok Pisin | Papunesia |
| Uralic (6) | Finnic (2) | Estonian, Finnish | Eurasia/Europe |
| | Hungarian | Hungarian | Eurasia/Europe |
| | Khanty | Khanty | Eurasia/North Asia |
| | Permic | Komi-Permian | Eurasia/North Asia |
| | Samoyedic | Nganasan | Eurasia/North Asia |
| Turkic (1) | Turkish | Eurasia/Europe, West Asia |
| Afro-Asiatic (7) | Cushitic | Kambaata | Africa/North Africa |
| | Egyptian | Ancient Egyptian | Africa/North Africa |
| Semitic (5) | Algerian Arabic, Amharic, Lebanese Arabic, Maltese, Modern Israeli Hebrew | Africa/North Africa, Eurasia/West Asia, Eurasia/Europe |
| Dravidian (1) | Tamil | Eurasia/South Asia |
| Japonic (1) | Japanese | Eurasia/East Asia |
| Mongolic (1) | Mongolian | Eurasia/Central Asia |
| Sino-Tibetan (4) | Burmo-Qiangic | Burmese | Eurasia/SE Asia |
| | Qiangic | Japhug | Eurasia/East Asia |
| | Sinitic (2) | Cantonese, Mandarin | Eurasia/SE Asia |
| Tai-Kadai (1) | Thai | Eurasia/SE Asia |
| Austroasiatic (1) | Aslian | Jahai | Eurasia/SE Asia |
| Austronesian (6) | Malayo-Sumbawan | Indonesian | Eurasia/SE Asia |
| | Northwest Sumatra Barrier Islands | Nias | Eurasia/SE Asia |
| | Oceanic (4) | Mota, Wotlap, Vurës, Xârâçûû | Papunesia |
| Angan (1) | Menya | Papunesia |
| Timor-Alor-Pantar (2) | Abui, Kamang | Papunesia |
| Gunwinyguan (1) | Dalabon | Australia |

(Contd.)
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The researcher to just grab the data which happen to be available and sufficiently reliable' (Bakker, 2011: 106).

The size of the sample and its genetic and areal diversity should be sufficient to get an estimate of the cross-linguistic distribution of 'affectionate warm' expressions and provide at least tentative answers to the questions stated at the end of Section 3.

4.3. Coding categories

The linguistic data underlying the study is used to classify the languages according to three variables:

1. whether they have linguistic expressions in which words for warming temperatures are used to refer to experiences that can be connected to interpersonal warmth, affection, communal sharing, etc. \((\text{warm} \Rightarrow \text{aff})\),

2. whether they make a consistent distinction between terms for 'pleasantly/comfortably warming' and 'unpleasantly/uncomfortably/dangerously warming' temperatures \((\text{warm} \neq \text{hot})\),

3. whether they have any extended (metaphorical, etc.) uses of their temperature terms at all, that is, whether the words like 'warm' or 'cold' can be used to refer to experiences outside of the concrete temperature domain \((\text{ext temp})\).

The basic distinction here is between languages like English, Swedish, or Russian, which have multiple examples of 'affectionate warm' uses, and languages like the Austroasiatic language Jahai (Malaysia) or the Mande language Bamana (Mali, Guinea, Burkina Faso, and Senegal), which lack any linguistic expressions of this kind. The former get value 1 and the latter 0 for the variable \(\text{warm} \Rightarrow \text{aff}\).

Importantly, languages like English, Swedish, or Russian show systematic links between expressions for physical and interpersonal warmth and also often project the opposition between physical 'warm' and 'cold' onto interpersonal warmth (where 'cold' denotes the absence of affection), for example, \(\text{warm} / \text{cold eyes, a warm/cold person}\), etc. In addition, there are two other groups of languages with marginal 'affectionate warm' expressions. For instance, Nganasan (Uralic), the northernmost language of Eurasia spoken on the Taimyr peninsula in Siberia, has an expression 'warm words'. This is most probably a calque from Russian, given that Nganasan is severely endangered, with the last full speakers in their 60s and 70s, and dominated by Russian in most spheres. Notably, the only sentence with this expression in (Brykina & Gusev, 2015: 561) also contains the Russian loan word for 'thank you'. 'Warm words' in Nganasan are therefore comparable to the expressions \(\text{cold war or hot line}\) that have been calqued into many languages without any further systematic semantic consequences for these languages. In other words, even though Nganasan does have (at least) one 'affectionate warm' expression.

| Affiliation    | Language       | Macro-area/Area |
|----------------|----------------|-----------------|
| Nyulnylan (1)  | Bardi          | Australia       |
| Algonquian (1) | Eastern Ojibwe | North America   |
| Na-Dene (1)    | Athapascan     | North America   |
| Mayan (1)      | Yucatec Maya   | North America/Mesoamerica |
| Otomangean (1) | Zapoteco      | North America/Mesoamerica |
| Nadahup (1)    | Hup            | South America   |
| Quechuan (1)   | Upper Napo Kichwa | South America  |
| Boran (1)      | Bora           | South America   |
| Isolate (4)    | Basque         | Eurasia/Europe  |
| (Araucanian)   | Mapudungun     | South America   |
| Niger-Congo (14)| Ubangi         | Africa/Subsaharan |
| Bantu (2)      | Orungu, Zulu   |                |
| Gur (4)        | Buli, Dagaare, |                |
|                | Gurene, Kasem |                |
| Atlantic       | Wolof          |                |
| Kwa (6)        | Akan, Dangme, Ewe, Ga, Sele, Tafi | |
| Mande (1)      | Bambara        | Africa/Subsaharan |
| Khoekwadi (Khoisan) (1) | Gui | Africa/Subsaharan |
WARM’ expression, this is an isolated and most probably calqued example that hardly testifies to any systematicity in this connection. Such languages get value 2 for the variable WARM => AFF.

Finally, there are languages in which there is a clear ’AFFECTIONATE WARM’ connection, but it is not directly linked to the adjectives that are currently used to mean ‘warm’ in reference to concrete temperatures. For instance, French distinguishes between chaud ‘warm’ in reference to temperature (e.g., l’air chaud ‘the warm or hot air’, l’eau chaude ‘the warm or hot water’) and chaleureux ‘warm, cordial’ in reference to social warmth (des amis chaleureux ‘warm friends’). The adjective chaleureux is transparently derived from the word chaleur ‘warmth’ and was used to refer to physical warmth until the end of 15th century in examples like temps chaleureux ‘warm or hot weather’ (https://www.cnrtl.fr/etymologie/chaleureux accessed on 2020-02-08). However, it cannot be used in this way in modern French, even though its connection to physical warmth is still clear to the speakers. Interestingly, in the opposite domain of coldness, the same word froid is used in both senses: l’air froid ‘the cold air’ and il a été très froid avec nous ‘He has been very cold with us’. The same contrast is found in Portuguese, whereas their relatives Italian and Spanish can use the same ‘warm’ for both physical and social temperatures. Another interesting case is presented by Czech, Slovak, and Hungarian, in which ‘warm’ as applied to people has acquired the sense ‘homosexual’ and has more or less ousted the majority of the ‘AFFECTIONATE WARM’ expressions, which can still be given in dictionaries and are recognized by speakers (e.g., teplé přítivání ‘warm welcome’ in Czech). Languages like French or Czech are ascribed value 3 for the variable WARM => AFF.

The second variable in the classification of the languages concerns whether they make a consistent distinction between terms for ‘warm’, that is, pleasantly/comfortably warming temperatures, and for ‘hot’, that is, unpleasantly/uncomfortably/dangerously warming temperatures, WARM ≠ HOT. Languages like English (warm vs. hot) or Lithuanian (šiltas vs. karštas) are ascribed value 1, while French (chaud) or Maltese (šun), in which one and the same term can cover the whole warming zone, get value 0 for this variable. What is meant by a ‘consistent’ distinction is in some cases open to negotiation. For instance, as mentioned earlier, the Swedish words varm and het differ from their English correspondences in that varm can in principle cover all warming temperatures. However, it is still often associated with pleasantly warming temperatures, given the relatively high frequency and general applicability of het, Swedish is classified as a language with a consistent ‘warm’ – ‘hot’ distinction, that is, as having value 1.

Finally, the languages in the sample are classified in accordance to whether they have any extended (metaphorical, cross-perceptual, etc.) uses of their temperature terms at all, that is, whether the words like ‘warm’ or ‘cold’ can be used to refer to experiences outside of the concrete temperature domain, cf. hot pepper, cold rage, hot news in English. The values for this variable, EXT TEMP (extended temperature), partly follow the pattern adopted for WARM => AFF: languages with multiple examples of such uses get value 1, those with no attested uses get value 0, while value 2 is ascribed to languages showing isolated, occasional examples.

Most of the coding for this particular study was carried out by the first author and was fairly straightforward given the information provided by the sources. The decision to have four values for the first variable rather than having a binary opposition was not there from the start but was taken in view of special cases presented by some of the languages and agreed upon by both authors.

Appendix 1 lists the languages with their coding categories, while Appendix 2, in addition, contains the relevant warming terms, representative examples of ‘AFFECTIONATE WARM’ expressions, and the sources of information for each of the languages in the sample. The examples have been chosen to be as comparable to each other as possible, which explains the frequency of expressions like warm person/heart/relationship, admittedly having a western flavour. The underlying data is, however, much more varied.

4.4. Statistical methods
We used mixed effects logistic regression for testing whether the distribution of ‘AFFECTIONATE WARM’ expressions across languages is influenced by various factors suggested at the end of Section 3. In order to test if there is a connection between the presence of ‘AFFECTIONATE WARM’ expressions and macro-areas, on one hand, and on the other hand, the connection between the presence of these expressions and the existence of the opposition WARM ≠ HOT in a given language, a hierarchical Bayesian logistic model was fit with intercepts and slopes (for the binary warm-vs.-hot predictor) pooled across macro-areas. To further check if there is a connection between the presence of ‘AFFECTIONATE WARM’ expressions and climate data, an expanded model was fit with the standard deviation of average monthly temperatures in the region where a language is spoken as an additional predictor. The formal specification of the models, datasets, and scripts can be found in the Supplementary Materials (https://osf.io/f9yeh/).

5. Results
The sample includes 46 languages where ‘AFFECTIONATE WARM’ expressions are attested and 48 reported as lacking any. Tables 2 and 3 show the distribution of the sample languages with and without ‘AFFECTIONATE WARM’ expressions across different families and areas. Given the uneven representation of the different macro-areas in the sample, in Table 3 Europe and Asia are considered separately, while the two Americas have been merged, as well as Australia and Papuasia.

Indo-European languages represent the lion’s share of the languages with ‘AFFECTIONATE WARM’ expressions in the sample, as indicated in Table 2 and summarized in Table 4. There are on the whole only nine language families and one artificial language with such expressions (with the isolate Basque and the Aligic language Eastern Ojibwe only having a few occasional examples), as opposed to fifteen language families, three language isolates, and two creole languages lacking them. In other
words, ‘affectionate warm’ expressions are found in only about 26% of the non-Indo-European languages coming from about one third of the non-Indo-European families in the sample, including Basque, Uralic languages, and Esperanto, all of which are known to be substantially influenced by the Indo-European languages. Significantly, the only Afro-Asiatic language with ‘affectionate warm’ expressions is Modern Hebrew, which is well known for its “European semantics” due to the active participation of European Jewish settlers in Palestine in the revival and normalization of the emerging Hebrew (cf. Zeldes Amir, 2013 for an overview).

Furthermore, as is clear from Table 2, ‘affectionate warm’ expressions are basically restricted to Eurasia, with Europe being particularly rich in languages with such expressions. The only language with ‘affectionate warm’ expressions in Africa is Afrikaans, which is a very close relative of Dutch, a Germanic European language.

A strong areal bias in the distribution of the ‘affectionate warm’ expressions is supported by regression modelling. In the fitted Bayesian logistic-regression model with intercepts and slopes pooled across macro-areas with the opposition warm ≠ hot as a predictor, Europe is the only area with a statistically robust tendency to have

Table 2: Genetic affiliation of the languages in the sample with/without ‘affectionate warm’ expressions and with/without a systematic distinction between terms for pleasantly and unpleasantly warming temperatures.

| Language family | Languages with warm => aff expressions | Languages with no evidence for warm => aff expressions | Languages with warm ≠ hot | Languages without warm ≠ hot | Totals |
|-----------------|----------------------------------------|------------------------------------------------------|--------------------------|-------------------------------|--------|
| Afro-Asiatic    | 1                                      | 6                                                    | 2                        | 5                             | 7      |
| Austronesian    | 1                                      | 5                                                    | 1                        | 5                             | 6      |
| Indo-European   | 29 (22/1/6)*                           | 1                                                    | 18                       | 12                            | 30     |
| Japonic         | 1                                      | 0                                                    | 1                        | 0                             | 1      |
| Mongolic        | 1                                      | 0                                                    | 1                        | 0                             | 1      |
| Sino-Tibetan    | 2                                      | 2                                                    | 3                        | 1                             | 4      |
| Turkic          | 1                                      | 0                                                    | 0                        | 1                             | 1      |
| Uralic          | 6 (2/3/1)*                             | 0                                                    | 5                        | 1                             | 6      |
| Artificial      | 1                                      | 0                                                    | 0                        | 1                             | 1      |
| Algic           | 1 (0/1/0)*                             | 0                                                    | 1                        | 0                             | 1      |
| Angan           | 0                                      | 1                                                    | 0                        | 1                             | 1      |
| Austroasiatic   | 0                                      | 1                                                    | 0                        | 1                             | 1      |
| Boran           | 0                                      | 1                                                    | 0                        | 1                             | 1      |
| Dravidian       | 0                                      | 1                                                    | 0                        | 1                             | 1      |
| Gunwinyguan     | 0                                      | 1                                                    | 0                        | 1                             | 1      |
| Creole          | 0                                      | 2                                                    | 0                        | 2                             | 2      |
| Khoi-Kwadi (Khoisan) | 0                              | 1                                                    | 1                        | 0                             | 1      |
| Mande           | 0                                      | 1                                                    | 0                        | 1                             | 1      |
| Mayan           | 0                                      | 1                                                    | 1                        | 0                             | 1      |
| Na-Dene         | 0                                      | 1                                                    | 0                        | 1                             | 1      |
| Nadahup         | 0                                      | 1                                                    | 0                        | 1                             | 1      |
| Niger-Congo     | 0                                      | 14                                                   | 0                        | 14                            | 14     |
| Nyulnylan       | 0                                      | 1                                                    | 0                        | 1                             | 1      |
| Otomanguean     | 0                                      | 1                                                    | 1                        | 0                             | 1      |
| Quechuan        | 0                                      | 1                                                    | 0                        | 1                             | 1      |
| Tai-Kadai       | 1                                      | 0                                                    | 1                        | 0                             | 1      |
| Timor-Alor-Pantar | 0                              | 2                                                    | 0                        | 2                             | 2      |
| Isolate         | 1 (0/1/0)*                             | 3                                                    | 2                        | 2                             | 4      |
| Totals          | 46 (33/6/7)*                           | 48                                                   | 38                       | 56                            | 94     |

Notes: * x/y/z refers to the number of languages with the values 1/2/3.
Table 3: The distribution of the languages with/without ‘AFFECTIONATE WARM’ expressions across the macro-areas in the sample (bold marks the dominant type in the area; 0 = not attested, 1 = multiple and systematic attestations, 2 = isolated examples, probably borrowed, 3 = ‘AFFECTIONATE WARM’ expressions not based on the adjectives currently used to refer to physical warmth).

| Values                  | Europe | Asia | Africa | Americas | Australia+Papunesia | Total |
|-------------------------|--------|------|--------|----------|---------------------|-------|
| Languages with value 0  | 2      | 6    | 20     | 8        | 12                  | 48    |
| Languages with value 1  | 22     | 10   | 1      | 0        | 0                   | 33    |
| Languages with value 2  | 2      | 3    | 0      | 1        | 0                   | 6     |
| Languages with value 3  | 5      | 2    | 0      | 0        | 0                   | 7     |
| Languages with values 1/2/3 | 29 | 15   | 1      | 1        | 0                   | 46    |
| Totals                  | 31     | 21   | 21     | 9        | 12                  | 94    |

Table 4: The relative contribution of Indo-European and non-Indo-European languages to the data on the ‘AFFECTIONATE WARM’ expressions in the sample.

| Languages with ‘WARM’ expressions: ⇒ aff expressions | Indo-European | Non-Indo-European | Languages with no evidence for ‘WARM’ expressions: ⇒ aff expressions | Total for the sample |
|-----------------------------------------------------|---------------|-------------------|-------------------------------------------------------------------|---------------------|
| Number of families*                                  | 1             | 9*                | 19*                                                              | 29*                 |
| Relative share of families                           | 3,5%          | 31%               | 65,5%                                                            | 100%                |
| Number of languages                                  | 29            | 17                | 48                                                               | 94                  |
| Relative share of languages                          | 31%           | 18%               | 51%                                                              | 100%                |

Notes: * For simplicity, we count the two English-based Creole languages as belonging to the same family and Esperanto as belonging to a family of its own. The four isolates count as four different language families.

‘AFFECTIONATE WARM’ expressions: the posterior 89% interval for its intercept does not include zero. From among other areas, Central, North, South, and West Asia are by default equally relatively likely to have or lack such expressions (mean posterior intercepts are close to zero), while other areas show a tendency to lack them with the repugnance being most pronounced in Mesoamerica, Papunesia, South America, and Subsaharan Africa, whose posterior 89% intervals are strictly negative. The 89% posterior interval for the intercept is also strictly negative.

All this indicates that the tendency to have ‘AFFECTIONATE WARM’ expressions is not universal for the world’s languages. If languages from all macro-areas were equally likely to have them, the pooled intercept – the basic probability for a language to have such expressions averaged across macro-areas – would be robustly positive and by-macro-area intercepts be close to zero because the fact that a language is spoken in a particular region would not tell us much about the probability of encountering ‘AFFECTIONATE WARM’ expressions in it. The results are the opposite of that: the pooled intercept is robustly estimated as being negative, which means that a randomly chosen language is not likely to have ‘AFFECTIONATE WARM’ expressions. By-macro-area intercepts indicate the basic probability of encountering such expressions in a language from a particular macro-area, compared to the worldwide baseline. Only in Europe we are more likely than not to encounter such expressions, and other areas are either close to the (negative) baseline or have even lower basic probabilities.

It must be noted that language families are statistically indistinguishable from macro-areas because they are mostly embedded in them (each family has all or the vast majority of its languages in a single area), and there is not enough variation inside macro-areas to warrant including languages families as predictors in the model. On the whole, our data and the model demonstrate that, when contact history is taken into account, the lack of ‘AFFECTIONATE WARM’ expressions is in fact the preferred option in the sample.

Table 5 compares the cross-linguistic distribution of ‘AFFECTIONATE WARM’ expressions with the existence of a systematic distinction between the terms for pleasantry/comfortably warming temperatures (‘warm’) and those for unpleasantly/uncomfortably/dangerously warming temperatures (‘hot’). Prima facie, the table suggests a possible connection between the availability of a lexical distinction between ‘warm’ and ‘hot’ and the existence of ‘AFFECTIONATE WARM’ expressions. This conclusion is supported by the hierarchical logistic-regression model with macro-areas as random effects: the predictive 89% interval for the pooled slope of the ‘warm’ versus ‘hot’ predictor does not include zero (see the Supplementary Materials for additional details).

It should be noted that the connection is obviously restricted to European and Asian languages. The lexical distinction is, however, not limited to these languages.
Table 5: The number of the languages with/without ‘AFFECTIONATE WARM’ expressions across languages having/lacking a systematic distinction between terms for pleasantly and unpleasantly warming temperatures (‘warm’ vs. ‘hot’).

| ‘warm’ vs. ‘hot’ | Languages with ‘WARM’ => ‘AFF’ expressions (values 1/2/3)* | Languages with no evidence for ‘WARM’ => ‘AFF’ expressions (value 0) | Totals |
|------------------|-----------------------------------------------------------|---------------------------------------------------------------|--------|
| TEMPERATURE TERMS| 23 / 4 / 3                                                | 6                                                             | 36     |
| WARM ≠ HOT       | 8 / 2 / 5                                                  | 42                                                            | 58     |
| Totals           | 31 / 6 / 8                                                 | 48                                                            | 94     |

Note: * x/y/z refers to the number of languages with the values 1/2/3.

even though it is much more frequent there than otherwise. And, as evident from Table 5, there are quite a few examples of languages with ‘AFFECTIONATE WARM’ expressions involving a general warming term, which covers the whole spectrum of warming temperatures, both pleasant and unpleasant (among others, Italian, Greek, and Esperanto[11]).

Alternatively, the existence of both a lexical distinction between ‘warm’ and ‘hot’ and of ‘AFFECTIONATE WARM’ expressions in a language may be connected to other factors, for instance, climatic conditions under which the language is spoken (cf. Brown, 2013; Witkowski & Brown, 1985 on the lexical differentiation between ‘hand’ and ‘arm’ and Regier et al., 2016 on the lexical differentiation between ‘snow’ and ‘ice’ as correlated with average annual temperatures). It is not difficult to come up with different plausible reasons for a possible connection here. On the one hand, there is the general principle that the lexicon of languages reflects local communicative needs, which may very well be shaped by the local environment (cf. Regier et al., 2016 for a clear argumentation) so that a greater variation in daily or seasonal temperatures might imply a more elaborated temperature lexicon. On the other hand, it is intuitively easy to imagine that warming ambient temperatures in the tropics will primarily have negative associations (cf. the discussion at the end of Section 6). However, the current data is not sufficient for drawing any conclusions since the inclusion of the climate variable does not lead to any increase in its predictive power: the WAIC indicator rose from 54.6 to 61.3 (with the standard deviation of the difference in WAIC equal to 3.15) and the BayesFactor for the new model with the basic model taken as the null hypothesis is ≈1.

The map in Figure 1 shows the distribution of the languages with ‘AFFECTIONATE WARM’ expressions or lacking evidence for any.

Finally, it could be suggested that the observed patterns can be explained by the fact that some languages simply lack any extended uses for their temperature terms. The data, however, strongly contradicts this: only eight of the sampled languages are reported as lacking any extended uses of their temperature terms – which is in stark contrast to the lack of ‘AFFECTIONATE WARM’ expressions in as many as 48 languages.

The map in Figure 2 shows the distribution of the languages having or lacking any extended uses of their temperature terms, including ‘AFFECTIONATE WARM’ expressions.

6. Discussion

As outlined in Section 1, the main question asked in this study is whether the frequently used English expressions like warm/cold people, words, eyes, and the like have multiple parallels across the languages of the world. The fact that the English expressions have been interpreted as bearing witness to the metaphor ‘AFFECTION IS WARMTH’ or to the association between physical and social warmth that is taken to be universal, leads to the reasonable assumption that similar expressions should be omnipresent, or at least quite frequent, in the world’s languages.

However, the data coming from the 94 genetically and areally diverse languages in our sample demonstrates a more complicated picture. The relevant expressions show a remarkably skewed distribution and seem to be absent from most of the language families and from most of the linguistic (macro-)areas. As mentioned in Section 2, this is not unheard of: linguistic patterns tend to be distributed very unevenly across the languages of the world, mainly due to the various historical relations among them, where contact plays a major role (cf. Dryer & Haspelmath, 2013 for multiple examples). However, even more striking fact is that ‘AFFECTIONATE WARM’ examples in our sample are basically restricted to Eurasia and are particularly ubiquitous in the languages of Europe. Again, this does not come as a surprise for typologists. There is a rich and constantly growing evidence that European languages share numerous properties with each other, with quite a few of those being fairly unusual in other parts of the world. Europe has been a large convergence zone on many levels, with multiple economic, cultural, and linguistic connections criss-crossing the area and being superimposed on each other. The term ‘Standard Average European’ language is now widely used as a (not very strictly defined) term for lumping the European, and particularly the West-European, languages, especially when bringing to the fore those features that make them stick out in the context of the world’s languages (van der Auwera, 2011). In the present context, it is worthwhile to mention the collaborative project documented in (Pirainen, 2012), which identified 380 widespread European idioms – that is, set expressions like night and day or to play with fire, that are shared by many of the European languages but are hardly found in any languages outside of Europe, or at least, outside of the European cultural sphere. In other words, the languages of Europe share many parallels in their semantic organization, including numerous metaphorical expressions.
In Section 4.3, we mentioned the highly endangered Uralic language Nganasan, which has a single ‘AFFECTIONATE WARM’ expression ‘warm words’, most probably calqued from the dominant Russian language. This case shows the first step in how a language can acquire a linguistic metaphor by calquing a single expression. We can hypothesize that such a process can be the incipient stage in the diffusion and further consolidation of metaphorical expressions, especially if it is supported by calquing a few other similar expressions. After a while the calqued expressions are no longer perceived as ‘foreign’ and start being used as a model for further expressions building on the same association.

Czech, Slovak, and Hungarian, mentioned in the same section, show the opposite process, whereby a language can lose a linguistic metaphor. In this case the association between warmth and affection is being ousted by the association between warmth and homosexuality, which, in turn, seems to be shared by several languages as a result of language contact.

What about the non-European languages like Persian, Palula, Khalkha Mongolian, Japanese, Thai, Mandarin, and Cantonese? Conspicuously, all of them, apart from Palula, are big standard languages, used for wider communication – “LOL languages” (Literate, Official, Lots of Users), to use Östen Dahl’s (2015) apt label. It is fully possible that ‘AFFECTIONATE WARM’ expressions in at least some of them are of native origin, but it is also fully possible (and even probable) that language contacts has been instrumental here as well.

Summarizing, the reply to the question whether expressions similar to the English phrases warm/cold people, words, eyes, and so on, are widely spread across the languages of the world is ‘not really’. From the linguistic point of view, the association between warmth and affection, at least as manifested in such expressions, is primarily found in the European languages, complemented by several Asian literate official languages with lots of users, that are known to be quite special among the world’s languages.

So far we have been talking about the linguistic metaphor. A further question is whether these findings have any bearing on the issue of the hypothesized primary metaphor affection is warmth or on the universally embodied model for thinking about social relations in general.
There is a lively debate in research on metaphor on the relation between linguistic metaphors and the more general cognitive associations. For instance, there are numerous experiments demonstrating cross-linguistic, cross-cultural, and cross-individual variation in how spatial relations are mapped onto other basic domains of experience (e.g., *musical pitch of time*), which challenge the assumption that they are grounded in universals of experience and are fixed (cf. Casasanto, 2017 and the references there). There is also a growing number of psychological studies showing bi-directional associations between domains (e.g., IJzerman & Koole, 2017; IJzerman & Semin, 2009; Lee & Schwarz, 2012; Zhong & Leonardelli, 2008), for overviews see Landau et al. (2010) and Winter et al. (2015), and suggesting other theories of grounded cognition, such as those focused on scaffolding (Williams et al., 2009), perceptual symbols (Barsalou, 1999), or thermoregulatory processes (H. IJzerman et al., 2015). There is also a growing number of counter examples to conceptual metaphor explanations. For example, people have assumed that a ‘Good is UP’ primary metaphor (e.g., Meier & Robinson, 2004) can impact people’s linguistic and evaluative judgements, but other empirical work shows that these behavioural patterns are better accounted for by relationship between stimulus and response dimensions (Lakens, 2012; Lynott & Coventry, 2014) and do not require any assumptions about conceptual metaphors at all.\(^\text{11}\)

Within the metaphor theories, there is an increasing awareness that the relation between cross-linguistic universality versus variation in the use of metaphors is complicated and needs to be taken seriously. Kövecses (2005: 4), who has done extensive work on this issue, suggests that a cognitive linguistic view of metaphors needs to integrate several important additional claims, such as, among others, the following ones:

- universal experiences do not necessarily lead to universal metaphors;
- bodily experience may be selectively used in the creation of metaphors;
- bodily experience may be overridden by both culture and cognitive processes; and
- primary metaphors are not necessarily universal.

There are several solutions to the challenges mentioned above. One example of such a solution is offered in Hierarchical Mental Metaphors Theory (Casasanto, 2017), which distinguishes between ‘mental’ metaphors, designating mappings between non-linguistic representations, and ‘linguistic’ metaphors, representing mappings between linguistic representations. Mental metaphors are constructed on the basis of different kinds of experience over multiple timescales (and can also be innate) and therefore build superordinate families of mappings. In other words, for a given target domain children acquire a superordinate family of source-domain mappings, which, in turn, should be universal when the corresponding source-target relationships are found universally in the world. However, only some of them are conventionalised in a particular language and culture, and it is prolonged exposure to relevant conventions (say, to particular linguistic expressions or particular cultural practices) that activates and strengthens the corresponding source-target association and weakens the competing associations in the same superfamily. The weakened association is, however, not completely extinguished but can be activated, as has been demonstrated in several experiments (cf. Casasanto, 2017 for examples and references).

The same insistence on distinguishing between different kinds of associations and metaphors is present in the current version of Primary Metaphor Theory (Grady & Ascoli, 2017). The idea is that recurrent co-experiences lead to natural cognitive associations (‘pre-metaphors’), some of which may become conventionalized patterns of conceptual and linguistic association when reinforced by the linguistic and cultural environment. The stance of Primary Metaphor Theory on the role of linguistic evidence in the discovery of universal conceptual associations is, however, somewhat confusing. On the one hand, Grady and Ascoli (2017: 35) allude to the occurrence of similar expressions across languages ‘widely distributed in space and time’ as evidence for primary-metaphor patterns – illustrating this by a list of sixteen languages that would not be accepted as a serious sample by any researcher versed in cross-linguistic comparison. On the other hand, they note ‘that the universality of a set of motivations for primary metaphors does not imply that lexical patterns themselves must be universal. There are a number of intervening factors between experience, for instance, and linguistic conventionalization, including cultural mediation, so that even a conceptual association that is well motivated may not end up leading to a productive pattern of semantic extension’.

So, to repeat the question stated above: do our findings on the distribution of the linguistic *affectionate warm* expressions have any bearing on the issue of the universality of the hypothesized primary metaphor *affection is warmth* or of the association between the two domains?

It seems that there are at least two possible reactions to these findings. First, it is possible to discount linguistic facts as evidence against the universality of cognitive associations. This seems to be a logical interpretation of the recent views on the distinction between cognitive metaphors (or associations) and linguistic metaphors, as briefly accounted above. From this perspective, the highly limited attestation of *affectionate warm* expressions across the languages of the world does not say anything about the universality or non-universality of the cognitive association between warmth and affection. The association can still be universal, without having linguistic manifestations in every language. Or there may be linguistic manifestations of such an association not expressed by the temperature words themselves. In other words, it is in principle always possible to discount the linguistic data as not good enough.

However, it is also possible to interpret the linguistic findings as casting serious doubts on the universality of the association between *affection and warmth* and pointing towards other explanations. It is true that our sample does not contain examples of languages where ‘cold’ is associated with the presence of affection rather than with its
absence. However, conspicuously, our sample shows that in a number of African languages it is ‘cold’ that has other pleasant associations— with peace, serenity, comfort, contentedness, absence of calamities, etc.14 To illustrate, the literal translation of ‘Dona Nobis Pacem’, or ‘Grant us peace’, in the Agnus Dei section of a Christian Mass into the Kwa language Ewe (spoken in Ghana, Togo, and Burkina Faso) is ‘give skin coldness to us’. It does not feel far-fetched to suspect that climatic conditions may play an important role in the establishment of enduring and prevalent cognitive associations, even though the inclusion of a climate variable into the regression model for this particular study has not led to any increase in its predictive power (see Section 5 and the Supplementary Materials). For instance, it may be suggested that temperature metaphors reflect how people deal with the metabolic demands of the environment. Different linguistic metaphors are reflective of different metabolic needs across cultures, which are implemented according to different cultural practices and rely on different needs depending on the environment (e.g., different climates).

7. Conclusions

The main question asked in this study is whether the frequently used English expressions like warm/cold people, words, eyes, and so on, often assumed to constitute obvious evidence for the primary and universal metaphor affection is warmth, or for the universal cognitive association between physical warmth and sociality, have multiple parallels across the languages of the world. More specifically, we seek to provide answers to the following questions:

a. How widely are affectionate warmth expressions spread across the languages of the world? Is their distribution influenced by the areal and/or genetic affiliation of the languages?

b. Is there any connection between the presence of affectionate warmth expressions in a language and the existence of the opposition between ‘warm’ and ‘hot’ in the same language?

c. And finally, is there any connection between the presence of affectionate warmth expressions in a language and the climatic conditions under which the language is spoken?

In our sample, coming from 94 genetically and areally diverse languages, affectionate warmth expressions are basically restricted to Eurasia, with the hotspot among the Indo-European languages spoken in Europe. Outside of these languages, affectionate warmth expressions are attested in the languages and language families that have had intensive contacts with them, as well as in several national languages spoken in Asia. We have also found a statistical correlation between the availability of a lexical distinction between ‘warm’ and ‘hot’ and the existence of affectionate warmth expressions in a language, suggesting that the presence of this distinction can contribute to licensing the metaphor cross-linguistically. However, this connection is obviously restricted to the languages spoken in Eurasia. Finally, our data is not sufficient for drawing any statistically robust conclusions on possible connections between the presence of affectionate warmth expressions in a language and the climatic conditions under which the language is spoken.

We interpret the data as not giving support to the universal association between affection and warmth— not even a statistical universal. However, we hasten to acknowledge the obvious limitations of this study in providing cross-linguistic evidence for the linguistic metaphor affection is warmth. First of all, the study has only focused on what we have called affectionate warmth expressions involving temperature terms like the adjectives warm and cold, whereas the same association can have various other manifestations, as for example, Your words warmed my heart. Secondly, there is always a real possibility that researchers may miss relevant examples, especially in the underdescribed ‘non-Western’ languages, for which they lack native-like competence. We hope therefore that the diverse and often sophisticated methods of data collection for this project, in most cases based on active involvement of native speakers (cf. Section 4.1), minimize this risk.

These limitations notwithstanding, we feel that the burden of proof lies with those researchers who insist on the universality of the cognitive association between affection and warmth, given the genetically and areally restricted occurrences of affectionate warmth expressions across languages. If linguistic evidence is not good enough for falsifying the assumption, is it falsifiable at all? Or how can it be verified?

At this point it is appropriate to reflect on the ways in which these findings can influence how psychologists build their future studies.

Language is considered by psychologists as an important way to assess human cognition. For instance, the immense majority of social psychology studies use self-reports as indirect measures of underlying cognitive phenomena, a feature that has been criticized for at least a decade (Baumeister et al., 2007; Cialdini, 2009; Dolinski, 2018). These studies often lack extensive description and observation of the phenomena of interest (Rai & Fiske, 2010) and generalize from these self-reports and questionnaires to the whole of humanity, often without describing relevant demographics or taking into account the limitations of the sample (Simons et al., 2017). Thus, evidence of differences in how humans express themselves through metaphors can have a significant impact on how psychologists interpret verbal reports from their participants and generalize their answers to other humans in different societies or even other social groups in the same society.

Henrich et al. (2010) showed that psychological findings published in international high profile journals are heavily skewed towards certain samples, usually American undergraduates. The domains in which this bias manifests range from basic visual perception processes to social representations. The authors proposed a useful and catchy, albeit imperfect, label to name these kinds of samples: Western, Educated, Industrialized, Rich, and Democratic (WEIRD). As Majid and Levinson (2010: 103) put it, WEIRD
languages have also misled (many) linguists who have ‘projected assumptions based on English and familiar languages onto the rest’. However, even this label can bring potential misunderstandings regarding the nature of differences between human groups (Clancy & Davis, 2019; Dahl, 2015). For instance, Dahl (2015) shows that language studies exhibit a particular bias towards LOL languages: Literate, Official, and with Lots of Users. However, these languages would not necessarily be considered WEIRD by any standards (e.g., Afrikaans or Vietnamese). Thus, one of the contributions that a typological approach to the study of language brings to the study of psychology of language in general, and to the study of metaphors and social thermoregulation in particular, is its being descriptive, fine-grained, and sensible to local particularities, which is much in line with certain approaches in cultural psychology (Kline et al., 2018).

This study begets the question of which factors lead to such language differences in temperature metaphors. An attractive explanation is to attempt to map such differences to ‘cultural’ differences, on superficial assumptions about human culture. An explanation of this kind may, for example, seek to determine whether differences in the use of temperature metaphors in the context of social relationships will differ in people who live in more individualistic versus more collectivistic societies. However, this approach has been criticized by cultural psychologists because it tends to arbitrarily group people with different socio-historical origins and cultural practices. Language development may be universal but constrained by local environmental influences that lead to significant cognitive and behavioral differences in the long run (Heyes, 2018; Kline et al., 2018). Thus, social psychologists must consider the complex interaction between physiological, developmental, social, and evolutionary processes to understand how social thermoregulation occurs in unique ways across diverse communities.

So how does this study impact future social thermoregulation studies?

First of all, similarities in social relationships will perhaps reflect similarities in language metaphors. In the case of affection is warm, members of societies that share common linguistic features may show similar patterns of social thermoregulation. However, an indirect conclusion at which we can arrive from these findings is that, first, if thermoregulation studies remain restricted to populations that are historically related, they will mistakenly assume that similarities are universal. Second, by also ignoring other historical relationships (e.g., phylogeny of languages and recent history of colonization and influence of Indo-European languages), these studies may fail to recognize an important factor that might explain striking similarities in seemingly distant populations. Finally, given the variation in how people use language, at the very least, psychologists interested in thermoregulation should extend their studies to many more countries to better understand this phenomenon (e.g., following the example of IJzerman et al., 2018). Interdisciplinary teams of typological linguists and social psychologists can work together to investigate similarities and differences in languages and social thermoregulation, thus generating better hypotheses to be tested and seeking to obtain more robust findings.

Data Accessibility Statement
The data used in this project has been made available at https://osf.io/gcbh2/.

Notes
1 Following the current praxis in cross-linguistic research, the examples are both translated and provided with a glossing that makes their structure explicit in accordance with The Leipzig Glossing Rules www.eva.mpg.de/lingua/resources/glossing-rules.php.

2 The preparation of Koptjevskaja-Tamm (2015) took several years, which explains the apparent contradiction in the claim that the studies dating from 2012 were inspired by the 2015 publication.

3 A creole language originates in a situation of prolonged contact between speakers of different languages, e.g., in colonial settlements, and becomes the native language of the whole community. It is customary to classify creoles in accordance with their ‘lexifier’, i.e., the language that provides the basis for the bulk of their lexicon and in most cases was spoken by the socially dominant group (e.g., the colonizers). According to the predominant (but not the only) opinion, reflected in Table 1, creole languages are not genetically related to their lexifiers in the same way as, say, French and Portuguese relate to Latin, whose descendants they are.

4 The inclusion of Esperanto can be contested on the grounds that it is constructed, as opposed to the other languages in the sample. We will take up this issue in fn. 11 below.

5 Our deaf colleagues speaking Swedish and Finnish sign languages have provided us with ‘affectionate warm’ examples in both languages, commenting that these can be calqued from Swedish and Finnish, at least to some extent. The general impression we get from discussing the issue with a few other sign language experts is that such expressions can easily be transferred to sign languages from the surrounding majority languages, at least when it comes to urban (deaf-community) sign languages. We leave this issue for future research.

6 The practice of systematically grouping languages in accordance with the large linguistic area, or macro-area, they belong to goes back to Dryer (1989) and Nichols (1992), who laid the foundation for research in areal typology. However, the precise definition of these notions, their number and size vary across studies and researchers. For the purposes of this study it is reasonable to split Eurasia and Africa in several more coherent and traditionally recognized areas – Europe, North, East, West, Central, South and Southeast Asia, North Africa and Subsaharan Africa.

7 Glottolog 4.1. uses ‘Atlantic-Congo’ rather than the established label ‘Niger-Congo’ and excludes some of the languages and language groups whose genetic relationship with the rest of the family is disputed,
among others, Mande languages. We have chosen to keep the more traditional and more widely used label ‘Niger-Congo’ but treat Mande as a separate top-level family.

Language families are too fine-grained to be included in the model.

The information on average temperatures was extracted using the R package GSODR based on the publicly available data in the GSODR database added to manually for regions not covered for it. See get_temp_data.R in the Supplementary Materials for details on the automatic extraction.

The model was specified directly in the Stan language, but a corresponding R formula could look as follows: affectionate.warm ~ warm.hot + (1 + warm.hot|macroarea). See the Supplementary Materials for the details about the priors for the coefficients.

Esperanto is interesting here as an extreme case for studying how conscious and less conscious forces interact in shaping a language. Its basic lexical stock was constructed by its creator Ludwik Zamenhof, whose intention was to make it as systematic and regular as possible. In accordance with this, in antonymic pairs (i.e., pairs of words with opposite meanings) one of the words is systematically derived from the other by the prefix mal- ‘un’, e.g., granda ‘big’ vs. malgranda ‘little’ or varma ‘warm/hot’ vs. varmahvarma ‘cold’, which is fairly bizarre and artificial as compared to natural languages (Koptjevskaja-Tamm et al., 2017). However, meanings and uses of words are usually much more fluid, largely shaped in interaction and influenced by the speakers and their background, in this case, their first language. It is therefore not surprising that the association between ‘cold’ and peace, serenity, etc., which is fairly bizarre and artificial as compared to natural languages, has been carried over to Esperanto, together with many other typically European semantic patterns, given that the majority of Esperanto speakers have their background in the European languages.

The new model can be described as affectionate.warm ~ warm.hot + (1 + warm.hot|macroarea) + stddev.monthly.temp; see Supplementary Materials for the details about the priors for the coefficients.

As pointed out to us by Dermot Lynott (p.c.), in much of the above mentioned psychological work there is an implicit assumption that conceptual metaphors are universal since they are based on universal embodied experiences, but the available evidence does not provide strong support for their existence even in samples involving speakers of English or other West European languages.

Our data on African languages is in fact considerably more extensive than what has been presented here since it also includes the information on the uses of temperature words in several hundred languages sourced from the lexical database Reflex https://sites.google.com/site/referencelexicon/home/presentation-en. The association between ‘cold’ and peace, serenity, etc., is confirmed for many of those languages, whereas the association between ‘warm’ and ‘affectionate’ is not explicitly documented for any. However, given the heterogeneity of the data and the quality of many of the sources, we have decided that we cannot rely on the absence of attestation in the database as truly reflective of the linguistic situation in the languages documented there. The association of positive serenity with ‘cool’ is of course present even in such West European languages as English, cf. ‘cool, calm and collected’, as reminded to us by Dermot Lynott. However, such examples most often involve the ‘pleasant cold’ term, opposed to the more general or the ‘unpleasant cold’ term, and are on the whole much more marginal than those found in African languages.

Additional Files

The additional files for this article can be found as follows:

• Appendix 1: The languages in the sample provided with their genetic affiliation, macroarea, geographic coordinates, mean temperatures and classified according to the main parameters used in the study (‘Appendix_1_Languages_warmth_w_coords_temp_norm.csv’, cf. also https://osf.io/f9yeh/)
• Appendix 2: ‘Affectionate warm’ examples in the sample with their sources (‘Appendix_2_Affectionate_warm_expressions_in_the_sample.docx’, cf. also https://osf.io/ndqge/)
• Questionnaires and guidelines for data collection (https://osf.io/gcbh2/, Supplementary materials)
• Supplementary materials.pdf: Inferential statistics used in the study (https://osf.io/4r7wh/)
• Scripts and data (https://osf.io/gcbh2/, Supplementary materials): get_temp_data.R (https://osf.io/s5h3b/), random_slope_non_centered.stan (https://osf.io/pcen4/), random_slope_non_centered_w_temp.stan (https://osf.io/2t8k9/), warm_hot_models.R (https://osf.io/e8bmr/)

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**Competing Interests**
The authors have no competing interests to declare.

**Author Contributions**
The first author designed the study, collected the data, and performed qualitative analyses. The authors jointly annotated the data for quantitative and spatial analysis and formulated the framework for statistical modelling which the second author implemented. The second author interpreted the results of the statistical analyses and drew the maps. The authors jointly wrote the text of the paper.

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