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Feeling your neighbour: an experimental approach to the polysemy of *tundma* 'to feel' in Estonian[1]

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ABSTRACT

This paper offers an experimental approach to the polysemy of the Estonian perception verb *tundma* 'to feel' from the perspective of the *perception* → *cognition* metaphor. First, a sorting task is used to map how native speakers perceive the different senses of *tundma* 'to feel'. The results show that cognition-related senses of *tundma* form the most distinct and coherent group. This set was researched further by means of a second experiment, a conceptual feature rating task. The aim of this task was to assess if the cognition-related meanings of *tundma* differ from other cognition verbs of Estonian (*teadma* 'to know', *aru saama* 'to understand') in that they are metaphorically linked to physical perception. It was predicted that native speakers use characteristics tied to the physical perception in the conceptualisation of the type of knowledge expressed by *tundma*. However, native speakers did not rate sentences with *tundma* as more physical than sentences with abstract cognition verbs. This result is indicative of the nature of the semantics of *tundma* being more varied than was first thought. It is argued that the semantics of *tundma* refer to it being a verb of general proximal perception.

KEYWORDS: Estonian, perception verbs, polysemy, sorting task, conceptual feature rating task, tactile perception

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1. Introduction

Perception verbs and perception metaphors have been of interest to both linguists (Sweetser, 1990; Viberg, 1984) and anthropologists (Classen, 2005; Howes, 1991). Most of the research has focused on the senses of seeing and hearing (Alm-Arvius, 1993; de Vries, 2013; Evans & Wilkins, 2000; Johnson & Lenci, 2011; Proos, 2019; Sjöström, 1999; Usoniene, 2001; Vanhove, 2008), rendering the senses of touch, smell, and taste relatively under-studied. The reasons for this are manifold. Vision tends to be the sense which speakers talk about the most (San Roque et al., 2014), and its prominence has been established across different time periods (Winter, Perlman, & Majid, 2018). Verbs of vision are also the most likely to be used for expressing perception (Evans & Wilkins, 2000; Viberg, 1984), and it has been suggested that verbs of seeing and hearing have more meaning extensions than verbs of touching, smelling, and tasting (San Roque, Kendrick, Norcliffe, & Majid, 2018; Storch & Aikhenvald, 2013). However, evidence from linguistics (Majid & Burenhult, 2014; Majid et al., 2018; Storch & Aikhenvald, 2013; Wnuk & Majid, 2014), as well as anthropology (Classen, 2005; Howes, 1991), shows that the language of perception is much more versatile than is generally thought, usually due to most of these conclusions being based solely on Indo-European languages.

This study aims to address the gap in research on the language of touch by focusing on the tactile experience verb *tundma* 'to feel' in Estonian, and its polysemy. Tactile perception has been generally associated with metaphorical mapping into the field of emotions (Ibarretxe-Antuñano, 2006; Sweetser, 1990; Viberg, 1984). This extension is believed to have psychosomatic roots (Sweetser, 1990). Namely, feeling (at least) primary emotions, such as fear, results in a change in body chemistry, making the experience a physical one. Viberg (1984) has also observed that the tactile experience verb can encompass taste or both taste and smell (he found no languages where the verb was used for touch and smell and not taste). In what he sees as an areal phenomenon, Swedish, Finnish, Estonian, Hungarian, Russian, Polish, Serbo-Croat [*sic*], and Bulgarian use a compound verb composed of the verb 'to feel' and the noun 'smell' or 'taste' (e.g., *lõhna tundma*, 'to feel smell' in Estonian) to express smelling and tasting (Viberg, 1984, p. 143). In addition to emotions, smelling, and tasting, tactile perception verbs have also been attested to extend to expressing experiences, such as affecting (both physically and metaphorically), partaking in food/drink, and tackling an issue (Ibarretxe-Antuñano, 2006).

However, in Swedish, Finnish (Viberg, 2005), and Estonian, tactile perception verbs have an even more unusual meaning extension: the tactile experience verb can also mean 'to know something or someone'. As such, it is an example of the cross-linguistic metaphor *perception* → *cognition* (Ibarretxe-Antuñano, 2008; Storch & Aikhenvald, 2013; Viberg, 1984). Estonian makes for an interesting case study because, while in many languages tactile perception verbs are neither very frequent nor polysemous (San Roque et al., 2014), the three main tactile perception verbs in Estonian (*tundma* 'to feel', *katsuma* 'to

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touch', *tunduma* 'to feel) are rather frequent when compared to vision verbs (*nägema* 'to see', *vaatama* 'to look', *välja nägema* 'to look') and hearing verbs (*kuulma* 'to hear', *kuulama* 'to listen', *kõlama* 'to sound'), with the average normalized verb frequencies of 1,338, 2,407, and 638 per million words respectively in the Estonian Web Corpus (etTenTen). Furthermore, in a sample of 600 sentences containing the three tactile verbs, metaphoric use of the verb was found in 89% of the sentences, while the same figure was only 33% for vision verbs. Thus, Estonian tactile perception verbs are both frequent and polysemous in comparison to other Estonian perception verbs.

In this study we will focus on the polysemy of the Estonian perception verb *tundma* 'to feel'. *Tundma* is the Estonian verb for tactile experience. In comparison to the activity verb *katsuma* 'to touch' and the source-based *tunduma* 'to feel' (e.g., 'it feels scratchy'), it is the most varied in meaning. We report results from two different experiments. First, a sorting task was conducted to map native Estonian speakers' perception of the verb's polysemy. Next, a modified version of the conceptual feature rating task (Troche, Crutch, & Reilly, 2014, 2017) was used to take a closer look at one of the meaning categories that emerged in the first experiment, i.e., cognition-related senses, in the light of the *perception → cognition* metaphor. Following the theory of polysemy in cognitive semantics, all the senses of a verb share some characteristics. These underlying similarities make meaning extensions possible in the first place (Geeraerts, 2006; Gibbs, Jr, 2006; Johnson, 1987; Lakoff, 1987; Taylor, 1995). The second experiment looked into whether these underlying similarities play a role in the conceptualisation of the type of knowledge that is expressed by *tundma* 'to feel'. We first report the design, results, and analysis of the two experiments individually, and conclude with an overall discussion.

2. Sorting task

Since *tundma* 'to feel' is polysemous in Estonian, we first used a sorting task to obtain an overview of how language users perceive and categorise the senses of the verb. A pile sorting task allows the researcher to explore language users' opinions and intuitions about the categorisation of different language items. According to the cognitive semantics approach to polysemy, different senses of a word form various categories in the polysemy network, motivated by underlying, embodied similarities in meaning (Geeraerts, 2010; Taylor, 1995). Asking speakers to perform a pile sort and having them name the formed piles has proven to be a successful tool for exploring different meaning categories, as users base their sorting decisions on these underlying structural similarities (e.g., Beitel, Gibbs, Jr, & Sanders, 2001; Dingemanse & Majid, 2012; Raukko, 2003; Sandra & Rice, 1995). The goal of the sorting task was to explore if and which groups of senses emerge and to map the fields that the different senses of *tundma* extend to.

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2.1. STIMULI

To compile the list of the possible senses of *tundma*, 'to feel', a sample of 400 sentences was extracted from the Estonian Web Corpus (etTenTen). This was used in combination with the Explanatory Dictionary of Estonian (EKSS) (Langemets et al., 2009) that organises the meanings of *tundma* 'to feel' into 11 + 6 senses (11 senses + 6 compound/phrasal verbs). Some of these senses also include sub-senses that were analysed separately for the purpose of the pile sorting task. Additionally, where possible and reasonable, different constructions were also regarded as different senses (senses 13–17 in Table 1). The aim of compiling the list of senses in this way was to maximise their number, while taking into account that each should have at least some characteristics differentiating it from the other senses. As a result we distinguished 25 senses of *tundma* 'to feel' (Table 1).

2.2. DESIGN AND PARTICIPANTS

Two sentences per each sense (n = 50) were manually selected from a corpus sample (etTenTen) of 1,000 sentences with *tundma*, with the aim of including natural context for the senses. Some sentences had to be further shortened for clarity and readability (e.g., adverbs removed from the sentence, syntactic structure simplified). Experimental items were then divided into two lists so that each participant sorted only 25 items (one sentence per sense). The items in the lists were randomised for each participant. Altogether 66 participants completed the task (13 male, 53 female; average age 31, age range 21–65), with 32 participants sorting one list and 34 sorting the other list. The task was conducted on an Internet platform as an offline design.

The participants were instructed to sort the sentences into groups based on the meaning of *tundma* 'to feel' in a sentence. The task was a free sorting task, i.e., the participants were instructed to form as many groups with as many members as they wanted, as long as each item only belonged to only one group at a time. The task was designed as follows: participants saw a list of sentences on the left side of the screen. To form groups they had to drag and drop the sentences one by one to the right side of the screen. They then had to name each group. The interface and the instructions of the task were given to them in Estonian. After completing the task the participants had to provide demographic information about themselves.

2.3. RESULTS

The results of the sorting task were analysed using multidimensional scaling (MDS). The results were organised as a co-occurrence matrix showing how many times the participants sorted each item into the same group as each

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TABLE 1. *The 25 different senses of* tundma *with examples from the Estonian Web Corpus (etTenTen)*

Sense	Description	Example
01outside_stim	External tactile perception	*Tund-si-n, et keegi rabas mind* feel-PST-1SG that someone grab-PST.3SG I.PART *õla-st.* shoulder-ELA 'I felt that someone grabbed me by the shoulder.'
02internal	Internal perception (bodily states)	*Tund-si-n kõhu-s tugeva-t valu.* feel-PST-1SG stomach-INE strong-PART pain.PART 'I felt a strong pain in my stomach.'
03smelling	Smelling	*Tunnen kee-v-a lambaliha ja kilpkonna lõhna.* feel boil-APP-GEN mutton.GEN and turtle.GEN smell.PART 'I smell boiling mutton and turtle.'
04tasting	Tasting	*Veini maitse-t on tõesti tunda.* wine.GEN taste-PART be.3SG really feel.INF1 'You can really taste the wine.'
05reflex_bodystate	Internal perception (reflexive construction, not only in regards to physical stimuli)	*Nüüd tunnen end juba päris hästi.* now feel.1SG oneself.PART already quite well 'I feel quite well already.'
06impression	An unspecified experience (the nature of the stimulus is unclear)	*Neiu tund-is äkki tugeva-t Issanda puudutust.* girl feel-PST.3SG suddenly strong-PART Lord-GEN touch.PART 'The girl suddenly felt a strong touch from the Lord.'
07emotion	Feeling an emotion	*Artisti-na tunneb ta tantsusaate kogemuse üle* artist-ESS feel.3SG she dance.show.GEN experience.GEN over *vaid rõõmu.* only joy. 'As an artist, she is just happy about the experience of the dance show.'
08emotion_reflex	Feeling an emotion (reflexive construction)	*Oma laua taga tunne-n end turvaliselt.*

TABLE 1. *Continued*

Sense	Description	Example
		one's.own table.GEN behind feel-1SG oneself.PART safely 'Behind my own table, I feel safe.'
09interest_wish	Feeling an emotion accompanied by rational thought or need	*Sa* *tunned* *suurt* *huvi* *universumi* you feel.2SG big.PART interest.PART universe.GEN *sügavuste* *vastu*. depth.PL.GEN *against* 'You are very interested in the depths of the universe.'
10as_someone	Feeling oneself in the role of someone / being in a position of someone	*Tunneme* *ennast* *juba* *abielupaari-na* feel.1PL oneself.PART already married.couple-ESS 'We already feel like a married couple.'
11symp	To sympathize with (*tundma* + *kaasa*)	*Sõbranna-d* *tunnevad* *talle* *kaasa*. friend-PL feel-3PL (s)he.ALL with 'Friends feel for him/her.'
12unspec	Feeling something unspecified; apprehend via affective/sensory input	*Naise-d* *tunnevad*, *et* *neid* *on* *turu-l* woman-PL feel.3PL that they.PART be.3SG market-ADE *alahinnatud*. undervalue.PPP 'Women feel that they have been undervalued on the market.'
13get_feel	To experience, go through (*tundma* + *saama*)	*Töötasu* *vähenemist* *on* *tunda* *saa-nud* *ligi* wage. GEN decreasing. PART be.3SG feel. INF1 get- APP near *pool* *uuringu-s* *osalemu-i-st*. half study-INE participant-PL-ELA 'About half of the study participants have experienced a decrease in wage.'

TABLE 1. *Continued*

Sense	Description	Example
14give_feel_pat	To experience pathological phenomena (*tundma* + *andma*)	*Hammas ei valuta, aga annab tunda.* tooth NEG hurt.INF1 but give.3SG feel.INF1 'The tooth is not hurting, but it's sore.'
15give_feel_gen_state	To experience a general state of body/mind (*tundma* + *andma*)	*Magama-ta öö annab tunda.* sleep.INF2-ABE night give.3SG feel.INF1 '(One) can feel the sleepless night.'
16be_feel	To be experienced (*tundma* + *olema*)	*Töö-de-s on tunda efektse-t ja jõulist maalijakätt.* work-PL-INE be.3SG feel.INF1 compelling-PART and powerful.PART painter's.hand.PART 'You can sense a strong and powerful painter in the works.'
17give_feel_influence	To influence something (*tunda* + *andma*)	*Toetuse kadumine annab järgmise-l aasta-l tunda.* benefit.GEN losing give.3SG next-ADE year-ADE feel.INF1 'The loss of the financial help will be felt next year.'
18physics_literature	To know a field or subject thoroughly	*Maastikuehitaja tunneb põhjalikult lilli ja puid-põõsaid.* landscaper feel.3SG thoroughly flower.PL.PART and tree.PL-PART – bush.PL.PART 'A landscaper has thorough knowledge of trees and bushes.'
19clock	To know how to use or do something	*Kella lapse-d juba tund-sid.* clock.PART child-PL already feel-PST.PL 'The children already knew how to tell time.'

TABLE 1. *Continued*

Sense	Description	Example
20known_as	To know something as X or by the name X	*7.* *sajand* *on* *tuntud* *kui* *orientaalne* *periood* 7 century be.3SG feel.PPP as oriental period *kreeka* *kunsti-s.* greek.GEN art-INE 'The 7th century in Greek art is also known as the oriental period.'
21famous	To be famous (only in the passive past participle form)	*Koolimaja* *seina-l* *on* *tuntud* *vilistlaste* school.house.GEN wall-ADE be.3SG feel.PPP graduate.PL.GEN *portree-d.* portrait-PL 'There are portraits of well-known graduates on the school wall.'
22familiar	To be known, familiar	*Käsitletakse* *ikka* *vana* *ja* *tuntud* *temaatika-t,* handle.PASS still old.PART and feel.PPP subject-PART 'The subject matter being discussed is old and familiar.'
23acquainted	To be acquainted with someone (a closer resemblance to *teadma* 'to know')	*Ma* *tunnen* *seal* *maa-l* *vähese-id.* I feel.1SG there land-ADE few-PL.PART 'I know only a few people in that country.'
24know_thoroughlly	To know someone thoroughly (a specific, personal relationship with someone)	*Tunnen* *teda* *isiklikult* *koolipõlvest* *alates.* feel.1SG (s)he.PART personally school.time-ELA since 'I know him/her personally since we were in school.'
25recognise	To recognise someone or something	*Kase* *tunneb* *teiste* *puu-de* *seast* birch.GEN feel.3SG other.PL.GEN tree-PL.GEN among.ELA *kergesti* *ära.* easily away 'The birch is easily recognisable among other trees.'

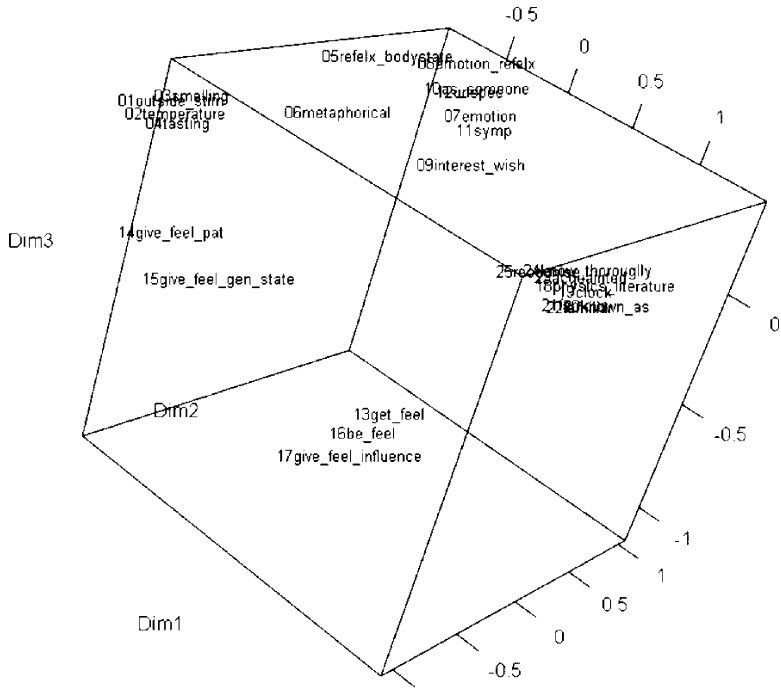

Fig. 1. MDS plot of sorting task results with *tundma* 'to feel'.

TABLE 2. *Goodness of fit and stress measures of the MDS analysis*

No. of dimensions	GOF (goodness-of-fit)	Stress
1	.474487	.34
2	.7475165	.17
3	**.8496266**	**.08**
4	.8902311	.05

other item. The co-occurrence matrix was then converted into a dissimilarity matrix, suitable for analyses in the statistical software R (R Core Team, 2016) using the wcmdscale function from the package vegan (Oksanen et al., 2018). A conversion to a distance matrix is required for the analysis – the Euclidean distance measure was selected for this. The resulting MDS plot is seen in Figure 1.

A three-dimensional solution was deemed the best fit for the data, following the two measures that describe how well the MDS analysis reflects the data: goodness of fit (GOF) and stress (see Table 2). The wcmdscale function offers an eigenvalue-based GOF measure which describes the percentage of variation

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described by the model. The stress value was obtained using the smacof package (de Leeuw & Mair, 2009). One dimension was deemed insufficient to describe the data as it rendered the GOF value too low and the stress value too high. A two-dimensional solution showed considerably better results, with a 27% increase of GOF and a 17% reduction of stress. A three-dimensional solution further increased GOF by 10% and decreased stress by 9%. Adding a fourth dimension did not result in significantly better fit (GOF +5%, stress –3%).

2.4. ANALYSIS

The results of the sorting task show that the senses of *tundma* 'to feel' are perceived to form (at least) three groups where senses are tightly bound to each other and at the same time dissimilar from the senses in the other groups:

1. Physical senses, including both internal and external perception as well as smelling and tasting;
2. Emotion-related senses;
3. Cognition-related senses.

In Figure 1, the physical senses, marked with numbers 01–04, are located in the upper left part. This cluster contains all the physical senses of *tundma*, including both internal and external perception as well as smelling and tasting. The second group, emotion-related senses, are situated in the top centre part, marked with numbers 07–11, entailing such senses as '09interest_wish' (*tunneb huvi* 'is interested', lit. 'feels interest') and '11symp' (*tunnen kaasa* 'I am sympathetic', lit. 'I feel with'). Two senses (05 and 06) hover between the clusters of physical and emotion-related senses. These are atypical members in that they have physical as well as emotional connotations. For example, one of the task sentences for the sense encoded as '06impression' included the phrase 'feel the Lord's touch' – it is not completely clear what kind of an experience is expressed with this kind of phrase. Most likely, it is not purely physical nor purely emotional, but a more general experience, possibly including elements from different kinds of experiences. Thus, it makes sense that it is not well-suited for either of the clusters. The same applies to sense '05reflex_bodystate'. When one is 'feeling well' it is not a purely physical sensation, it is more like a general description of the state of the body and the mind.

Slightly lower on the right side of the graph is the third group of senses, which includes all and only the cognition-related senses (19–25). It is notable that they are situated on the opposite side from both the physical as well as the emotion-related senses. This shows that there is more similarity between the latter two groups than between those groups and the cognition-related senses. In addition, the cognition-related senses form a rather uniform group, while the other two groups are somewhat more spread out. This suggests that the

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cognition-related senses are perceived as: (a) the most distinct from the other two sense groups; and (b) as consisting of members highly similar to each other. This means that cognition-related senses have a conceptually distinct place in the context of the polysemy structure.

Another cluster of senses, consisting of three elements (13, 16, 17), groups together in the lower central part of Figure 1. These senses are expressed by compound verbs and they all refer to an abstract type of influencing or experiencing action, referring to general processes that have an influence on something (e.g., *Töödes on tunda jõulist maalijakätt* 'One can feel a powerful painter in the artworks'). The analysis shows these senses were not a good fit to any of the other clusters, as participants were inconsistent in assigning them to the other groups. One way of analysing this result is to consider them as devoid of the original meaning of the tactile verb. Indeed, in these constructions the agent is an inanimate and often an abstract entity, making the senses atypical compared to the other groups. For this reason their meanings are not considered to form a meaning cluster in the framework of this task.

We now offer some interpretations to the dimensions demonstrated by the analysis. The first dimension (Dim1) spreads the senses on a continuum reflecting how physical they are, decreasing from left to right. This leaves the physical and emotion-related meanings to the left side of this axis. Although there is an intuitive difference in the physicality of tactile/haptic experiences and experiences of emotion, both are nevertheless more physical than the cognition-related senses. Deeming one group of senses abstract and the others concrete is a difficult task as the nature of tactile sensation is so manifold. For instance, Viberg (2015) acknowledges a continuum between bodily states and emotions, refraining from analysing the concept of feeling emotions as an extension of the abstract domain. A similar pattern unfolds in Figure 1.

We interpret the second dimension (Dim 2) as a scale between objectivity and subjectivity with higher values indicating a higher degree of subjectivity. Figure 1 shows that emotion-related senses express a more subjective experience, while physical senses express a more objective experience. Again, it is not reasonable to posit any extreme values along the dimension. For example, although feeling outside stimuli (sense 01) is objective in the sense that the stimulus is concrete and could be shared by the particular experiencers, their individual experiences still differ to an extent. This applies even more to feeling temperature or pain, although feeling emotions is clearly a far more subjective experience than feeling temperature or pain.

The third dimension (Dim 3) separates the three compound verbs in the bottom of the graph from the other senses. Analysis shows that these senses are the reason for two dimensions not being enough for a good fit and, as discussed earlier, reflects the random nature of assigning these senses to groups. Thus,

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the third dimension is just a necessity to accommodate the data. It is important to note that this interpretation of the dimensions does not imply that language users necessarily make conscious (or unconscious) decisions based on factors such as objectivity or subjectivity. Perceived similarity is a combination of many factors and the interpretation presented here is only one of several meaningful ways to describe the observed grouping of the senses.

The results of the sorting task show a diverse picture of the senses of *tundma* 'to feel'. While there are visible groupings of senses, there are also senses that do not seem to fit that well to any of the groups. Overall, however, there does seem to be a structure of the senses that native speakers agree upon. The most striking result is the coherence and independence of the group combining the cognition-related senses. This is especially interesting in the light of the well-known *perception* → *cognition* metaphor. Since we see such a clear distinction between these senses and the other senses, we might assume that, in the context of the polysemy system, these are the most entrenched extended meanings.

However, the design of the task does not allow us to investigate the particular characteristics that drive the extension. Following the theory of embodied meaning, extended meanings of a verb are motivated by the experiences lexicalised by the source verb (Gibbs, Jr, 2006). For example, the emotion-related meanings of *tundma* 'to feel' are likely based on the physical tactile experience due to its psychosomatic roots (e.g., Sweetser, 1990). Experiencing a strong emotion causes changes in body chemistry, resulting in perceived similarities between experiencing emotions and other internal processes, such as changes in temperature or feeling hunger. The theory of polysemy in cognitive semantics would predict that the cognition-related senses bear some resemblance to the physical meanings of the verb. Meanwhile, other cognition verbs, e.g., *teadma* 'to know' and *aru saama* 'to understand' remain more abstract, not constituting extended meanings of a physical verb. To test this hypothesis, a modified version of a conceptual feature rating task was conducted.

3. Conceptual feature rating task

The conceptual feature rating (CFR) approach was developed as a method for showing the abstractness or concreteness of words. Troche et al. (2014, 2017) argue that concreteness and abstractness are scalar concepts and should be portrayed that way. To this end, they used a multidimensional semantic space where all lexical items have a value on twelve different cognitive dimensions (e.g., polarity, emotion, quantity, etc.). We designed a modified version of this task to test our hypothesis that native Estonian speakers perceive *tundma*-knowledge as including characteristics closer to physical experiences than abstract cognition verbs.

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The CFR approach was chosen as it can be used to show the ways in which items vary along different cognitive dimensions, and hence effectively compare the different cognitive characteristics of *tundma*-knowledge to those of more abstract knowledge types. Although Troche et al. applied this method to nouns, the theory behind the method is concerned with concepts, not nouns specifically (Troche et al., 2014, pp. 1–2). Thus concepts that are represented by verbs should also be suitable test material. As such, applying the CFR approach to verbs could provide significant information about the method itself.

3.1. STIMULI

Six different cognition-related senses of *tundma* 'to feel' were included in the rating task. For the purpose of this task the senses 'famous' and 'familiar' were collapsed as 82% of the participants sorted them into the same group in the previous task. 'To be acquainted with someone' and 'to know someone thoroughly' (see Table 1) were also regarded as one, sorted into the same group by 85% of the participants in the sorting task. The final list of senses included in the rating task were the following:

1. To know something thoroughly, e.g., *füüsikat tundma* 'to know physics', *vene kirjandust tundma* 'to know Russian literature';
2. To know how to do something, to have a practical skill, e.g., *kella tundma* 'to know how to tell time', *kaarti tundma* 'to know how to read a map';
3. Being known as X, e.g., *tuntud hea ujujana* 'to be known as a good swimmer', *tuntud kui kogukonna kooshoidja* 'to be known as a pillar of the community';
4. Being famous or familiar, e.g., *tuntud näitleja* 'a well-known actor';
5. To know someone thoroughly, e.g., *naabreid tundma* 'to know one's neighbours', *kolleegi tundma* 'to know a colleague';
6. To recognise someone, e.g., *vana sõpra ära tundma* 'to recognise an old friend'.

We composed a list of stimuli where each of the six senses of *tundma* was represented by six sentences (n = 36). Each of the 36 experimental items was paired with a sentence where the same information is expressed by an abstract knowledge verb. This resulted in a list of 72 experimental items presented to each participant. Stimuli were designed so that only the verb would be manipulated, keeping the rest of the sentence identical between the abstract knowledge variant (see (1)) and the *tundma*-variant (see (2)).

(1) Jaan teab oma naabreid.
Jaan know.3SG his.own neighbour.PL.PART

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(2) Jaan tunneb oma naabreid.
Jaan feel.3SG his.own neighbour.PL.PART
'Jaan knows his neighbours.'

In (1), the verb implies that Jaan has factual knowledge about his neighbours, e.g., their names, maybe their occupations. In (2), however, Jaan has a more personal relationship with his neighbours, knowing not only the facts relating to them, but also how they act in certain situations, what they like and dislike, etc.

However, it was not possible to keep the two sentences identical in the case of two senses: 'to know how to do something' and 'to recognise someone'. There is no other cognitive verb in Estonian that could be used to form a pair of sentences identical in all other parts except for the verb. These pairs therefore differed more than just in the verb, as demonstrated for the sense 'to know how to do something' in (3) and 'to recognise something' in (4). The changes in the structure were the same for all the six sentence pairs for both the sense 'knowing how to do something' as well as the sense 'recognise'.

(3) (a) Kai tunneb tähestikku.
Kai feel.3SG alphabet.PART
'Kai knows the alphabet.'
(b) Kai oskab tähti lugeda ja kirjutada.
Kai be.able.3SG letter-PL.PART read and write-INF1
'Kai can read and write letters.'

(4) (a) Kai tunneb Jaani ära.
Kai feel.3SG John.GEN away
'Kai recognises Jaan.'
(b) Kai saab aru, et see on Jaan.
Kai get.3SG mind.PART that it be.3SG John
'Kai understands that it is Jaan.'

3.2. DESIGN AND PARTICIPANTS

For the purpose of this study we selected six dimensions from the total of 12 designed for the original CFR approach. They included emotion, social interaction, thought, time, sensation, and action. The rest were deemed as non-relevant for our purpose as the original list of dimensions was designed to compare a very wide range of nouns and determine their position on the abstractness–concreteness scale.

In the process of selection we considered the results of the study by Troche et al. (2014) and only included dimensions that expressed a significant distinction on the abstractness–concreteness scale. We also only included dimensions that were relevant to the concepts we were studying. For example, the 2014 study by Troche et al. included some dimensions that were specific to their design and would not be applicable for the design presented in this paper,

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e.g., the dimension *quantity*, which was chosen to tap into numerical vs. non-numerical semantics; or *space*, which was included with geographical concepts in mind. Other excluded dimensions were *polarity*, *morality*, *ease of modifying* (with adjectives), and *ease of teaching*. Ultimately, the dimensions chosen for the present study are the ones which are informative in regard to our research question, and that would likely still be comprehendible to our participants. However, this is not to claim a different list of dimensions would not be possible.

These six dimensions were split into two groups with each participant rating the 72 sentences on three dimensions. The dimensions were split up by including thought, time, and social interaction in one group, leaving emotion, action, and sensation in the other. The sentences were presented to the participants one by one in a fully randomised order. Participants had to rate each sentence on each of the three dimensions by using 7-point Likert scales (1 – not related, 7 – strongly related). The dimensions were represented by the following questions:

Thought: *Kui tugevalt on see lause seotud mõttelise tegevuse, ideede, arvamuste ja hinnangutega?* / How strongly is this sentence related to mental activity, ideas, opinions, and judgements?

Time: *Kui tugevalt on see lause seotud aja, järgnevuse või kestusega?* / How strongly is this sentence related to time, the order of events, or duration?

Social interaction: *Kui tugevalt on see lause seotud inimestevaheliste suhetega?* / How strongly is this sentence related to relationships between people?

Emotion: *Kui tugevalt on see lause seotud inimlike emotsioonidega?* / How strongly is this sentence related to human emotions?

Sensation: *Kui tugevalt on see lause seotud füüsiliste meeltega (nt nägemis- või kuulmismeelega)?* / How strongly is this sentence related to a physical feeling, such as vision or hearing?

Action: *Kui tugevalt on see lause seotud millegi tegemise, sooritamise või mõjutamisega?* / How strongly is this sentence related to conducting, performing, or influencing something?

Altogether 70 participants completed the task. The results of two participants had to be excluded as their use of the scales and task completion time indicated that they had not completed the task correctly. The remaining 68 participants included 7 males and 61 females with an average age of 29 (with a range of 18–57). The first group of dimensions was rated by 35 participants, and 33 participants rated the second group of dimensions. All participants reported Estonian as their native language. All participants were rewarded a 5-euro voucher upon completing the task. The average completion time was 28 minutes. The task was conducted online via the Qualtrics platform.

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Our hypotheses concerning the difference between the *tundma* cognition-related senses and the abstract knowledge verbs are presented below.

a. Time: *tundma*-knowledge is related to time, order of events, and duration more than abstract knowledge. Since *tundma* expresses a thorough knowledge of something or someone, which can be accumulated over time, time is a more important characteristic for the conceptualisation of *tundma*-knowledge than for abstract knowledge.
b. Thought: *tundma*-knowledge is related to mental activity, ideas, opinions, and judgements less than abstract knowledge. Since *tundma* expresses a personal, experiential knowledge of something or someone, we expected it to be perceived as less tied to abstract concepts like ideas and opinions than abstract knowledge.
c. Social interaction: *tundma*-knowledge is related to relationships between people more than abstract knowledge. Since *tundma* expresses a personal, experiential knowledge of something or someone, we expect personal communication to be a part of the conceptualisation of that knowledge. Thus, *tundma*-knowledge should be rated higher on the dimension of Social Interaction.
d. Emotion: *tundma*-knowledge is related to human emotions more than abstract knowledge. Similarly to the dimension of Social Interaction, we expect this to be the case because personal communication and experiences mostly also elicit emotions.
e. Sensation: *tundma*-knowledge is related to physical feeling like vision, hearing, and smell more than the other verbs. Since *tundma* is a perception verb, the cognition-related senses of the verb should be perceived as more related to physical feelings than abstract knowledge verbs.
f. Action: *tundma*-knowledge is related to actions, performing, and influencing more than abstract knowledge. Since *tundma*-knowledge should be grounded in physical sensation, then concrete, bodily actions should be perceived as being more tied to *tundma*-knowledge than abstract knowledge.

3.3. RESULTS

To test our hypotheses, we fitted a linear random effects model (Winter, 2013) for each dimension, testing the relationship between the rating and the choice of verb. The models were fitted using R (R Core Team, 2016) and the package *lme4* (Bates, Mächler, Bolker, & Walker, 2015, p. 4). Fixed effects included the verb (*tundma* 'to feel' vs. an abstract verb) and sense, as well as interaction effects. Random effects included the intercepts for subjects and items. P-values were obtained by executing a Likelihood ratio test, comparing the full model to

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the model without the fixed effect. The r-squared measure was obtained via the R package *MuMIn* (Bartoń, 2019). The Likelihood ratio test was also used to test the significance of the interaction effect by testing the interaction model against the model with no interaction. To pinpoint on which level of the fixed factors the significant interaction occurs, we ran post-hoc pairwise comparisons using estimated marginal means (package *emmeans* (Lenth, 2018)) in R, with the Tukey adjustment (full pairwise comparison tables are presented in the 'Appendix'). We report results for each dimension separately, followed by a discussion of all results.

3.3.1. Thought

The interaction between the fixed effects had a significant effect ($\chi 2$ (5, $N = 33$) = 23.647, p < .001, R^2 = .44). The *tundma*-knowledge sentences were rated lower than the abstract knowledge sentences for the sense 'recognising someone' (F(1,47) = 8,932, p = .00443), confirming our hypothesis. However, similarly to the dimension of Action, reasons for this result are more likely in the sentence structure. The verb used to paraphrase the *tundma*-sentence is *aru saama* 'to understand', which could be seen as inherently more tied to mental activity, ideas, and opinions, resulting in the sentences being rated higher on the dimension of Thought.

3.3.2. Time

We found no significant effect of neither the choice of verb ($\chi 2$ (1, $N = 33$) = 1.5701, p = .2102, R^2 = .57) nor the sense of *tundma* ($\chi 2$ (5, $N = 33$) = 5.0261, p = .4127, R^2 =.57) on the rating. Unlike the other dimensions, we did not find any significant variation for the dimension of Time. Analysing the distribution of the average ratings in this dimension we see that the ratings are low and very similar to each other, both for senses as well as the choice of verb. The dimension also has a very wide distribution of ratings with the average rating at about 3, i.e., close to the mean of the scale. This means that there were few strong opinions about the relatedness of the sentences to this dimension. The wide distribution can also mean that participants interpreted this dimension differently.

3.3.3. Social interaction

We found no significant effect of the choice of verb on the rating ($\chi 2$ (1, $N = 33$) = .0021, p = .9477, R^2 = .11). We found a significant effect of the sense of *tundma* on the rating ($\chi 2$ (5, $N = 33$) = 1311.4, p < .001, R^2 = .50). We predicted that the *tundma*-knowledge sentences would be rated higher on the dimension

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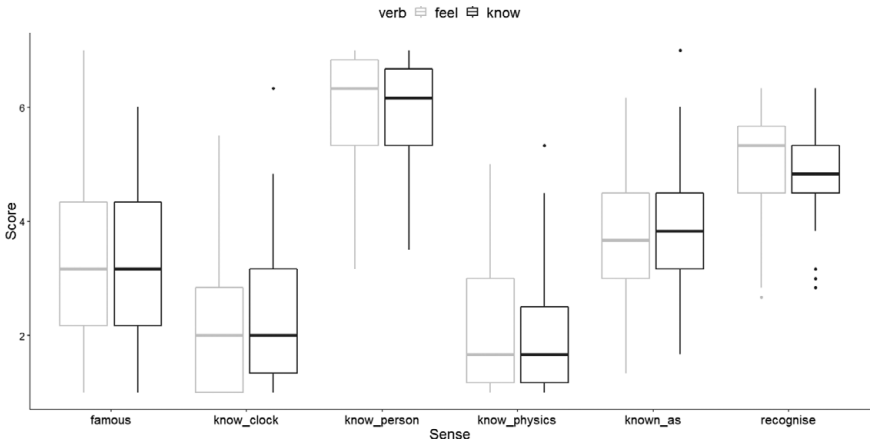

Fig. 2 A boxplot of mean ratings for each sense of *tundma* 'to feel' on the dimension of Social Interaction.

of Social Interaction; however, there was no significant difference in ratings for the two types of sentences. This suggests that the participants did not perceive the two types of sentences as being related to human interaction to differing extents. We did find an effect of sense, i.e., some senses of *tundma* were rated overall higher on the dimension than other senses. This is also noticeable when looking at the boxplot of mean ratings for the dimension (Figure 2). Senses that are related to human interaction, such as 'to know someone thoroughly', are rated as being more related to human interaction than more object-orientated senses such as 'to know something thoroughly'. This is easily comprehendible, since social interaction in essence is something tied to humans.

3.3.4. Emotion

We found no significant effect of the choice of verb on the rating ($\chi 2$ (1, $N = 35$) = 3e-04, p = .9852, $R^2 = .30$). There was, however, a significant effect of the sense of *tundma* on the rating ($\chi 2$ (5, $N = 35$) = 503.24, p < .001, $R^2 = .43$). The result is parallel to the result we got for the dimension Social Interaction. Again, we expected the *tundma*-knowledge sentences to be rated higher on the dimension than abstract knowledge sentences; however, no difference in the ratings surfaced. We did, however, find an effect for sense again. The ratings quite closely follow the pattern that was presented for the dimension Social Interaction. Likewise, the explanation for the result is similar: emotions are inherently tied to human event participants, and thus it is logical that senses related to human interaction receive a higher overall rating than other senses.

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3.3.5. Sensation

There was a significant effect of the interaction of the fixed effects ($\chi 2$ (5, N = 35) = 14.498, p = .012, R^2 = .49). The *tundma*-knowledge sentences were rated lower for the sense 'to know how to do something' (F(1,122) = 7.9, p = .0055). The reason for this could be rooted in the fact that, as mentioned in section 3.1, it was impossible in some cases to keep the non-verb segments of the sentence pairs identical as the meaning of the *tundma* 'to feel' sentence could not be conveyed by switching only the verb. A semantically close pattern is the one presented in example (3) (section 3.1), where the verb *oskama* 'knowing how to' forms compound verbs with *lugema* 'to read' and *kirjutama* 'to write'. Although *oskama* in itself is an abstract verb, in this context it only carries its meaning together with *lugema* and *kirjutama*. On the dimension of Sensation, the participants were asked how related a sentence is to physical sensations. The high score for example (3b) could be due to the verbs *lugema* and *kirjutama* being concrete verbs, lexicalising events closely tied to physical experiences. Hence, even if *tundma*-knowledge in example (3a) were physically motivated, the more concrete verbs in example (3b) would still be perceived as more linked to physical sensations and be therefore rated higher on the dimension of Sensation.

3.3.6. Action

The interaction between the fixed effects had a significant effect ($\chi 2$ (5, N = 35) = 40.916, p < .001, R^2 = .43). For the sense 'to know how to do something', the *tundma*-knowledge sentences were rated lower than the abstract knowledge sentences (F(1,61) = 20,383, p = .001), mirroring the result for the dimension of Sensation. As explained for the dimension of Sensation, reading and writing are also more linked with the dimension of Action (conducting and/or performing an action) than is the experience of knowing a concept. Conversely, for the sense 'to recognise someone', the *tundma*-knowledge sentences were rated higher than the abstract knowledge sentences (F(1,61) = 6,042, p = .016819), thereby confirming our hypothesis. Similarly to the sense 'to know how to do something', the sense 'to recognise someone' is also very difficult to paraphrase while maintaining the original meaning. While being lexically identical aside from the verb, the sentences in example (4) (section 3.1) are not semantically identical, albeit close in meaning. Furthermore, the particle *ära* 'away' carries an additional perfective meaning that is not present in the abstract knowledge sentences, and that possibly contributes to the higher rating in the dimension of Action.

The goal of this experiment was to find out whether the cognition-related senses of *tundma* 'to feel' exhibit more physical characteristics than other

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abstract cognition verbs such as *teadma* 'to know' or *aru saama* 'to understand'. We hypothesised that this is the case, because the cognition-related senses of *tundma* are the result of the metaphorical extension from perception to cognition. Following the theory of embodied meaning, the metaphor is based on some physical characteristics of tactile perception. Thus, the cognition-related senses of the verb should carry some of the same characteristics as the physical meanings of the verb. However, except for a few cases discussed above, this was not the case. Overall, the cognition-related senses of *tundma*, when compared to the other cognition verbs, did not elicit a rating different from the abstract knowledge verbs.

4. Discussion

This paper has described two experiments that set out to explore and explain the polysemy around the tactile perception verb *tundma* 'to feel' in Estonian. In the first task, we saw a polysemy structure emerge based on sorting decisions by native Estonian speakers. Participants distinguished between three groups of meanings: physical senses, emotion-related senses, and cognition-related senses. Mapping physical perception is subject to assessing its granularity and the choice of method. In some cases feeling emotions could also be considered physical perception, as primary emotions do elicit a chemical reaction that is physically felt in the body. In other cases, experiencing something internal, such as hunger, is assessed as different from feeling someone's touch, both of which in turn differ from feeling emotions.

Participants of the first experiment perceived the physical senses as including external stimuli as well as bodily sensations, such as pain and hunger. Emotion-related senses form a separate cluster, even though they are similar to feeling bodily sensations in the sense that the stimulus is internal to the experiencer. It seems that, contrary to Viberg's (2005, 2015) system of internal and external perception which categorises both emotions and bodily sensations as internal perception, rendering all haptic experiences with external stimuli in the category of external perception, the distinction between internal and external perception is not relevant in Estonian. This means that there is more perceived similarity between feeling someone's touch and feeling hunger, than between feeling hunger and feeling happiness.

Similarly, most of the participants did not sort the senses of smelling and tasting as separate, including them both in a group containing internal and external perception, the group of physical senses. Naturally, this does not mean that participants perceived the physical sensations of smelling and tasting as identical to tactile sensation, or feeling pain as identical to feeling someone's touch. It is merely likely that senses get sorted into a group if a participant "… finds any plausible rationale for relating it to prototypical members"

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(Langacker, 1987, p. 17). In this case, physicality as a shared characteristic in smelling, tasting, and external and internal perception takes precedence over the differences between the sensory experiences, establishing a contrast between feeling emotions and knowing someone.

The cognition-related senses formed a group that is separate from both the physical and the emotion-related senses, suggesting that these senses hold a well-defined space in the mind of native speakers. As Evans and Wilkins (2000) described the perception vocabulary of Australian languages, they noted that it is also possible to express knowledge with the visual perception verbs. However, they observed these as a case of a bridging context where an element of physicality or the possibility for a visual stimulus needs to remain in the object of knowledge. They argued that this is not the case for hearing verbs and that hearing can therefore be considered as a more productive source for the *perception → cognition* metaphor (Evans & Wilkins, 2000). The uniformity of the group of cognition-related senses seen in the results of the sorting task in this study suggests that the cognition-related senses are not contextual and they do not represent bridging contexts. As sorting elements into groups is a tool to mirror the categorisation of elements in a language user's mind, this result tells us that there is a conceptual space reserved for this type of *feeling knowledge* in the mind of native Estonian speakers.

Seeing that the *tactile perception → cognition* metaphor is a productive and entrenched one in Estonian, it is surprising that we did not find any consistent differences between ratings on cognitive dimensions for the cognition-related senses of *tundma* and abstract knowledge verbs (such as *teadma* 'to know') in our second task. In fact, our results show that the native speakers rate the two types of knowledge equally on a 7-point Likert scale.

This result reveals something intriguing about the verb *tundma* 'to feel' itself. We set off from the assumption that *tundma* 'to feel' is primarily a tactile perception verb, expressing experiencing something through the tactile sense. Indeed, looking at the Vibergian table of main perception verbs (Viberg, 1984, p. 125), *tundma* is the verb that occupies the slot of tactile experience verb, but it also extends to the experiences of smelling and tasting, as was shown in the first experiment in this study. Looking across languages, this is not uncommon behaviour. One verb can express different kinds of sensory experiences; for example, it is known that some languages have a verb that denotates 'non-visual perception'. This is true for *sentir(e)* in Romance languages (Enghels & Jansegers, 2013) and *nu* in Avatime, a Kwa (Niger-Congo) language spoken in Ghana (van Putten, 2019). *Sentir(e)* has the potential to extend to hearing, touching, smelling, tasting, and a variety of non-perceptual meaning fields like emotions and cognition (Enghels & Jansegers, 2013). *Nu* is described as a general perception verb denoting all sensory experiences except

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visual ones; however, it has a very limited number of non-perceptual meanings (van Putten, 2019).

In the light of this, it might be reasonable to consider *tundma* 'to feel' as a general perception verb as well, more specifically a verb of proximal perception. While *tundma* does not extend to fields of vision or audition, as *sentir(e)* does, it does extend to the fields of gustation and olfaction. The senses of tactition, gustation, and olfaction are categorised as proximal senses, as opposed to vision and audition, which are distal senses. As described in section 3.1, the type of knowledge *tundma* expresses is personal and experiential, requiring close contact with the object of knowledge. Thus, it is in line with the idea of proximity to the source of the experience being the key characteristic in deciphering the meaning of *tundma* 'to feel'. Moreover, *tundma* 'to feel' has some senses that do not fit well into the categories we saw emerging in the first task (section 2.4). The senses that the sorting task analysis showed to be 'in between' categories like '05reflex_bodystate' and '06impression' are great examples of 'general proximal perception' that includes elements from physical, as well as emotional and cognition-related experiences.

As mentioned in the 'Introduction', Swedish *känna* and Finnish *tuntea* follow a similar pattern – they are described as tactile experience verbs with semantic extensions to smelling and tasting as well as experiencing emotions and the same type of personal knowledge (Viberg, 2015) as Estonian. This would imply a general tendency of languages of this region to exhibit this behaviour; however, further research is needed in regard to whether this can indeed be considered to be an areal phenomenon.

If *tundma* 'to feel' is indeed a verb of proximal perception rather than tactile perception, this would explain why we did not see the expected results from the Conceptual Feature Rating task. Since *tundma* does not primarily express a physical tactile experience, the conceptualisation of the *tundma*-knowledge does not require elements of physical perception; instead, the notion of proximity to the source of experience is what is key to the conceptualisation. In this case, the fact that language users do not perceive *tundma* 'to feel' to be more connected to physical experiences than *teadma* 'to know' and *aru saama* 'to understand' is to be expected. However, an in-depth study into the question of whether *tundma* 'to feel' is a polysemous or general verb is needed to answer this question extensively.

As with every task, one should not ignore the fact that shortcomings in design could also be responsible for an unexpected result. The main concern with the present design would be that it is a metalinguistic task in nature, which can prove to be too unnatural and difficult for a language user. However, we believe our design was capable of answering the questions we set off to answer, and the nature of the meaning of *tundma* 'to feel' is the reason for the lack of effect we saw.

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This is because we did find a highly significant difference in ratings between the different senses on most dimensions. For example, the *tundma* sentences in the sense of 'to know someone thoroughly' should logically receive a higher rating on the dimension of Social Interaction than the sentences with other cognitive verbs. This was indeed the case, as discussed in section 3.3. We interpret these differences in ratings as proof that the participants understood the instructions correctly and were capable of performing the task.

In conclusion, the two experiments presented in this study paint a complex and varied picture of the meanings of *tundma* 'to feel'. The nature of the tactile perception verb and its meanings also informs us of the nature of the sense of touch itself, as language offers a unique insight into the senses (Majid & Levinson, 2011). The present study shows the versatility of touch and, more importantly, that it can hold the status of a prominent sense.

5. Conclusion

This paper focused on the polysemy of *tundma* 'to feel' in Estonian, with an emphasis on its cognition-related senses. In Estonian the tactile perception verb *tundma* 'to feel' is used to lexicalise a type of thorough knowledge about something or someone. Hence, in Estonian one can 'feel physics' or 'feel one's neighbour', meaning that one has a thorough knowledge about physics or knows one's neighbour well.

We conducted two experiments to outline this phenomenon. First, a sorting task showed that the verb lexicalises three different fields: senses expressing physical perception, emotion-related senses, and cognition-related senses. The analysis showed that the cognition-related senses form a group of senses that is most distinct from other senses and has a highly uniform structure. The second task, a conceptual feature rating task, was conducted to see if the cognition-related senses of *tundma* differ from other cognitive verbs in Estonian (e.g., *teadma* 'to know'), in that they are more closely linked to the original perception meaning of tundma. We expected the participants to perceive sentences with the cognition-related senses of *tundma* as reflecting the characteristics of the physical sense of touch, which would result in different ratings on cognitive dimensions for the *tundma*-knowledge and the abstract knowledge. However, we did not find any differences in the ratings for the two types of sentences.

We argue that the lack of effect is caused by the nature of meanings of *tundma* 'to feel' – although we set off assuming *tundma* is a polysemous verb, evidence points in the direction of *tundma* being a general proximal perception verb. If *tundma* is not a primarily tactile perception verb, we would not see the expected difference in ratings, i.e., there would be no reason to presume that the cognition-related meanings of *tundma* have an aspect of physicality to them.

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The notion of a general proximal perception verb would also coincide with other meanings *tundma* 'to feel' has. *Tundma* is also the verb used to express olfactory and gustatory experiences, which along with tactile perception constitute the proximal senses. Other meanings, e.g., the emotion-related ones, also hint to a close-up, personal experience. Moreover, some meanings of *tundma* are best described as 'unspecified proximal experience' that can encompass elements of physical, emotional, and cognition-related meanings, further proving that we might indeed be dealing with a general verb.

The case of the Estonian perception verb *tundma* 'to feel' and its semantics is a prime example of the multitude of meanings carried by perception verbs across the world's languages. The sense of touch and the language related to it has not previously been found to carry as many meanings as the language of vision and hearing. However, this is certainly the case for a number of languages. Mapping the particular aspects driving the creation of the meaning networks around the sense of touch is a fruitful topic for further research.

ABBREVIATIONS

1,2,3	person
ABE	abessive
ADE	adessive
APP	active past participle
ELA	elative
ESS	essive
GEN	genitive
INE	inessive
INF1	infinitive 1
INF2	infinitive 2
NEG	negation
PAP	present active participle
PART	partitive
PASS	impersonal passive
PPP	passive past participle
PST	past tense

Corpus

etTenTen = Estonian Web Corpus. Retrieved from <http://www.keeleveeb.ee/dict/corpus/ettenten/>

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Appendix

TABLE A1. *Pairwise comparison of estimated marginal means of the 'feel' vs. 'know' sentences with Tukey adjustment on the dimension of Sensation*

contrast	sense	estimate	SE	df1	df2	F.ratio	t.ratio	p.value
feel – know	famous	–0.0381	0.161835	1	122.08	0.055	–0.2354	0.814297
feel – know	know_clock	–0.45714	0.161835	1	122.08	7.979	–2.82474	0.005529*
feel – know	know_person	0.019048	0.161835	1	122.08	0.014	0.117698	0.906501
feel – know	know_physics	0.161905	0.161835	1	122.08	1.001	1.000429	0.319082
feel – know	known_as	0.052381	0.161835	1	122.08	0.105	0.323668	0.746743
feel – know	recognise	0.252381	0.161835	1	122.08	2.432	1.559492	0.121469

NOTE: * Significance level 0.05.

TABLE A2. *Pairwise comparison of estimated marginal means of the 'feel' vs. 'know' sentences with Tukey adjustment on the dimension of Action*

contrast	sense	estimate	SE	df1	df2	F.ratio	t.ratio	p.value
feel – know	famous	0.042857	0.189852	1	61.12	0.051	0.22574	0.822157
feel – know	know_clock	–0.85714	0.189852	1	61.12	20.383	–4.51479	2.95E-05*
feel – know	know_person	–0.04286	0.189852	1	61.12	0.051	–0.22574	0.822157
feel – know	know_physics	0.057143	0.189852	1	61.12	0.091	0.300986	0.764447
feel – know	known_as	–0.10476	0.189852	1	61.12	0.304	–0.55181	0.583092
feel – know	recognise	0.466667	0.189852	1	61.12	6.042	2.458054	0.016819*

NOTE: * Significance level 0.05.

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TABLE A3. *Pairwise comparison of estimated marginal means of the 'feel' vs. 'know' sentences with Tukey adjustment on the dimension of Thought*

contrast	sense	estimate	SE	df1	df2	F.ratio	t.ratio	p.value
feel – know	famous	0.058824	0.160737	1	47.4	0.134	0.365961	0.716022
feel – know	know_clock	0.073529	0.160737	1	47.4	0.209	0.457451	0.649436
feel – know	know_person	0.318627	0.160737	1	47.4	3.929	1.98229	0.05326
feel – know	know_physics	0.02451	0.160737	1	47.4	0.023	0.152484	0.879453
feel – know	known_as	0.02451	0.160737	1	47.4	0.023	0.152484	0.879453
feel – know	recognise	–0.48039	0.160737	1	47.4	8.932	–2.98868	0.00443*

NOTE: * Significance level 0.05.