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The internal structure of enthusiasm: a prototype analysis

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Abstract
The term enthusiasm is used frequently in both day-to-day language and professional settings. Scientifically, however, enthusiasm is not clearly defined. It is conceptualized and measured in different ways. In the present research, we examined the internal structure of enthusiasm. First, 28 features of enthusiasm were identified (Study 1.1) and rated on their centrality (Study 1.2). Results showed that features indicating joy and motivation were rated as central to the concept of enthusiasm, whereas features indicating restlessness and impatience were rated as less central. The validity of the central features was supported in three follow-up studies. More specifically, we found that the more central features were recalled better (Study 2.1), recognized faster (Study 2.2), and more often mentioned in autobiographical recalls of enthusiasm (Study 2.3). Taken together, the findings indicate that enthusiasm is prototypically structured, and that prototypical enthusiasm is a positive, energetic feeling that is associated with goal orientation and often involves interpersonal contact.

Keywords Enthusiasm · Positive emotion · Prototype analysis · Motivation

What is enthusiasm?

The word enthusiasm originates from the old Greek word "Entheos" and means possessed by a God. In his description of the performances of the rhapsode Lo, Plato first uses the word "enthousiasmós", when he recites Homerus (Verhoeven, 1972). In this context, enthousiasmós is described as "divine inspiration". In the 17th century, enthusiasm took on the meaning of "excessive and unbecoming religious". Nowadays, enthusiasm is generally described as an energetic feeling, related to excitement or eagerness, and aimed at a particular subject of interest or activity. However, a selection of several authoritative dictionaries reveals notable variations in their definitions of enthusiasm, especially in terms of detail and focus. Examples are: "A feeling of energetic interest in a particular subject or activity and an eagerness to be involved in it" (Cambridge Dictionary, 2023); and or "Enthusiasm is great eagerness to be involved in a particular activity which you like and enjoy or which you think is important" (Collins Dictionary, 2023). These definitions seem to agree on enthusiasm being an emotion of high arousal. Yet, the function or goal conduciveness of enthusiasm is not explicitly or uniformly articulated in these descriptions. Notably, social implications of enthusiasm are absent in these dictionary definitions.

Emotions are generally considered to be functional phenomena (Frijda, 1988). Most scholars agree that emotions have an adaptive function, in the sense that emotional responses helped our ancestors survive and reproduce (Lazarus, 1991; Russell, 2003; Scherer, 2009). Within these lines of research, the predominant emphasis has been placed on negative emotions (Roseman et al., 2020). However, since the beginning of the millennium, there has been a notable increase in the focus on positive emotions, coinciding with the emergence of positive psychology, a movement that has highlighted the importance of these emotions in human well-being (Fredrickson, 2013; Seligman, 2004). Although enthusiasm is not yet a major focus in research, recent work highlights the importance of positive emotions such as enthusiasm, shedding light on their role in goal pursuit and adaptive functioning (Milona et al., 2024).

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Enthusiasm is sometimes mentioned in scientific models that categorize emotions. To distinguish between the adaptive functions of different positive emotions Shiota et al. (2014) proposed a taxonomy of eight positive emotions[1]. In their view, goal conduciveness is central to the adaptive function of enthusiasm. So, enthusiasm helps to reach one's goals. These evolutionary psychologists describe enthusiasm as a response to material opportunities, like dogs wagging their tail when anticipating food. They propose that enthusiasm is experienced during anticipation of the reward and serves to motivate appetitive behavior (Griskevicius et al., 2010). This is consistent with research showing that affective stimuli high in motivational intensity (e.g., eliciting enthusiasm or disgust) evoke a narrowed focus of attention irrespective of their positive or negative valence (Domachowska et al., 2016; Gable & Harmon-Jones, 2008). It contradicts the general idea that positive affect is always associated with increased cognitive flexibility and a broadened focus of attention, whereas negative affect is associated with a narrowing of focus (Fredrickson, 2013). In addition, enthusiasm, evoked by recalling a personal experience, facilitated greater acceptance of weak persuasive messages and increased reliance on previously learned strategies and heuristics (Griskevicius et al., 2010). These studies indicate that the adaptive function of enthusiasm is to obtain a reward, so from this perspective goal conduciveness is a central element. This is also consistent with Poggi's view (2007) that enthusiasm is something you feel during or before attaining an important goal, one that is worth pursuing.

In the circumplex model (Russell, 1980), emotions are categorized along two dimensions: valence and arousal. Scherer (2005) added goal conduciveness and coping potential (power/control). In his model, he arranged several frequently used emotions. Enthusiasm was plotted in the positive and high arousal quadrant and in the high power/control and goal conduciveness quadrant. So, according to Scherer enthusiasm is not only positive and high in arousal, but also high in goal conduciveness and high on the power/control dimension. Positivity, high arousal, and goal conduciveness are elements that correspond with the definitions in the dictionaries and the views of other scholars. Power/control is a new element.

Predominantly, these definitions and scientific models used an intrapersonal perspective, concentrating on the beliefs and feelings of those experiencing enthusiasm. What seems missing, is the interpersonal aspect of enthusiasm. Some scholars, such as Poggi (2007), briefly acknowledge the social dimension of enthusiasm, noting that while it is an individual emotion, it is also one that often amplifies and spreads when shared with others. Furthermore, several empirical studies have also incorporated an interpersonal perspective of enthusiasm. Teaching effectiveness research addresses an interpersonal component of enthusiasm by examining the effect of teachers' enthusiasm on students. In this research, enthusiasm has been differentiated in being displayed or experienced (Keller et al., 2016). Experienced enthusiasm is defined as the degree of enjoyment that teachers experience in their professional activities, which may best be seen as an intrapersonal aspect of enthusiasm (Kunter et al., 2008). Displayed enthusiasm refers to nonverbal expressiveness (Collins, 1978) or, more generally, considers enthusiasm to be a component of instructional, and thus interpersonal behavior (Rosenshine, 1970). Studies show that displayed enthusiasm in particular enhances the effectiveness of teachers. One study showed that the dispositional enthusiasm of teachers positively predicted students' interest, but this was fully mediated by the enthusiasm students perceived in their teacher (Keller et al., 2014). In another study, where teacher enthusiasm and 12 other positive teacher behaviors were considered, enthusiasm was the most powerful unique predictor of student's intrinsic motivation and vitality (Patrick et al., 2000). In a business context, instructor enthusiasm in a sales training seminar improved student evaluations and evoked positive change intentions in sales employees (Arndt & Wang, 2014). These studies on teacher and instructor effectiveness highlight the interpersonal component of enthusiasm as a motivator. Whether this also makes the interpersonal element a defining characteristic of enthusiasm is, however, an empirical question.

Empirical research has conceptualized and measured enthusiasm in different ways. In some studies, enthusiasm is measured by observation of nonverbal behavioral indicators, like vocal animation, wide-opened eyes, and demonstrative gestures (Collins, 1978). Other studies included perceptions of humor, showing interest in the subject and pleasure (Frenzel et al., 2009; Murray, 1983), enjoyment (Kunter et al., 2008), contagious energy (Patrick et al., 2000), aggression and boldness (Wheeless et al., 2011). Marcus and MacKuen (1993), investigating the role of anxiety and enthusiasm during election campaigns, examined datasets of different election studies, and used pride, hope, and sympathy as markers of enthusiasm. On other occasions, enthusiasm is measured via self-reports of feeling enthusiastic (Stolwijk et al., 2017).

Thus, we can conclude that enthusiasm not only lacks a uniform definition across dictionaries. Within the scientific literature, enthusiasm has been conceptualized and measured in different ways. While there is a consensus

[1] They use the term "PANACEAS", based on the first letter of each of the eight emotion constructs in the taxonomy: Pride, Amusement, Nurturant Love, Attachment Love, Contentment, Enthusiasm, Awe, and Sexual Desire.

that enthusiasm typically embodies a positive, high-energy state, and most agree that enthusiasm has some level of goal orientation, additional factors are also mentioned, such as power or control (Scherer, 2005), humor (Murray, 1983), or hope (Marcus & MacKuen, 1993). The interpersonal element of enthusiasm is absent in most views, even though research on teacher and instructor effectiveness suggest that it might be important. So, what are the crucial features of enthusiasm? While the definitions and empirical studies have all incorporated general and more specific features, we believe the field is served by a bottom-up approach to assess which elements people see as central to the concept of enthusiasm. By stepping away from the factors typically highlighted in academic literature, this method opens up avenues for uncovering new, potentially important, associations that may have been unexplored in prior research. This strategy is particularly effective in revealing underrepresented aspects or "blind spots" in the field. To get a better understanding of the conceptualization of enthusiasm, we systematically grouped the spontaneous responses from our participants into coherent categories, employing a prototype analysis that has successfully been used in different research domains (e.g., Gregg et al., 2008; Hassebrauck, 1997; Hepper et al., 2012).

Prototype analysis

To study enthusiasm, it is useful to start with a clear concept. Ideally, a concept can be defined with a limited number of necessary and sufficient elements. However, many concepts, like enthusiasm, have fuzzy boundaries. Some examples may describe enthusiasm better than others and some features are more central than others. The goal of prototype analysis is to gain insight into the cognitive representation of a concept. Prototype analysis assumes that "knowledge about any given category is structured around, and represented in long-term memory as, a *protype* which captures the meaning of the category" (Cantor et al., 1982, p. 46), with the heart of the analysis being a "list of features or attributes generated by naive subjects as typical of that class of situations" (p. 50). Its reliance on the free generation of features by laypeople is considered to be one of the major strengths of this approach, as it allows to identify features that have not (yet) been identified in the literature. Furthermore, the method distinguishes between features that are more strongly related (i.e., more central) to a prototype and features that are less strongly related (i.e., more peripheral). While central features form the core of a concept, peripheral features reflect the broader and more flexible boundaries of the construct. Although peripheral features are less defining, they help capture the full complexity and variability of the concept.

We reasoned that - with these methodological advantages - prototype analysis could provide valuable insights for studying an under-researched emotion like enthusiasm. This decision was also inspired by previous studies that documented its value in gaining a better understanding of the concepts of emotion (Fehr & Russell, 1984), love (Fehr & Russell, 1991; Regan et al., 1998), modesty (Gregg et al., 2008), commitment (Fehr, 1988), forgiveness (Kearns & Fincham, 2004), gratitude (Lambert et al., 2009), hope (Luo et al., 2022), nostalgia (Hepper et al., 2012), vengeance (Elshout et al., 2015), and greed (Seuntjens et al., 2015).

For a concept to have a prototype structure, two conditions have to be met (Rosch, 1975). First, it should be possible to identify different features of the concept and to determine the centrality of each feature. Second, the prototype structure should influence information processing. To test these requirements for the concept of enthusiasm, we conducted five studies following the prototype analysis procedure (Elshout et al., 2015; Gregg et al., 2008; Hassebrauck, 1997; Hepper et al., 2012; Luo et al., 2022; Seuntjens et al., 2015). To identify the different features of the concept, we asked participants to generate different features of enthusiasm (Study 1.1) and to rate the centrality of these features (Study 1.2). In Studies 2.1 and 2.2 we followed the approach that is commonly used in prototype analyses to validate the centrality structure by studying its impact on information processing via recall, recognition, classification speed, and reaction time measures. Furthermore, Study 2.3 provided ecological validity, by examining autobiographical recall of central versus peripheral features. All studies were approved by the Leiden University ethical committee[2].

Section 1: identifying the central features of enthusiasm

In this first section, we identified the different features of enthusiasm and determined their centrality. In Study 1.1, participants were asked to list features of enthusiasm. To generate a wide array of features we approached two distinct groups: a representative sample of the general public and a group of professionals. These features were then compiled into categories (from then on referred to as 'features'). Following the commonly used procedure in prototype analysis (Elshout, 2015; Gregg et al., 2008; Hassebrauck, 1997; Hepper et al., 2012; Seuntjens, 2015), the centrality of these features was rated in a subsequent study (Study 1.2).

[2] Approval numbers: Study 1: CEP18-1204/468, Study 2: CEP19-0705/380, Study 3: CEP19-1124/556, Study 4: CEP19-1011/499, Study 5: CEP19-0708/386.

Study 1.1: generating features of enthusiasm

Method

Participants and procedure

Participants were 151 Dutch members of an online research panel[3] (M_{age} = 43.14 years, SD=14.63, 62.9% female, 37.1% male)[4]. Additionally, the first author presented the studied material to his professional network via social media, resulting in another 100 Dutch people participating. No background questions were posed to these additional participants. The sample size of 251 participants (151 from Prolific, and 100 from the professional network) and the relative overrepresentation of female participants (62.9%) aligned with sample sizes and gender distributions of previous prototype analyses (e.g., Elshout et al., 2015; Gregg et al., 2008; Hepper et al., 2012; Hassebrauck, 1997; Seuntjens et al., 2015). All participants were asked to list in five minutes, all features of enthusiasm that came to mind with a maximum of 25 features. Thereafter, all mentioned features were compiled into categories of features by independent coders.

Results and discussion

Data from 23 online panel participants were excluded. These participants did not mention any features or provided nonsense answers. The 128 remaining participants described 608 features (M=4.75, SD=3.02, range 1–22). The 100 social media participants generated 1179 features (M=11.79, SD=5.42, range 3–25). Participants generated a large range of features and none of the features was mentioned by all participants. Following the procedure of Hepper et al. (2012), descriptions that contained more than one related statement were divided into separate "units of meaning". An item like "You are happy and motivated to do something" was divided into "Being happy" and "Motivated to do something". This resulted in 5 extra features for the online panel (N=613, M=4.79, SD=3.07) and 13 extra features for the professionals (N=1192, M=11.92, SD=5.41). Next, we removed 6 features that were mentioned twice by the same participant in the panel. This resulted in a set of 607 features (N=607, M=4.74, SD=3.02). In the professionals' data, we removed 9 features that were mentioned twice, resulting in 1183 features (N=1183, M=11.83, SD=5.36). The observed variation in the number of features identified may be attributable to the differing backgrounds of the respondents and their level of interest in the subject. The initial group predominantly consisted of highly educated Dutch professionals with a professional interest in enthusiasm. The second group consisted of participants in an online research panel, representative for the Dutch population. This could also explain why the number of features mentioned by the last group was lower than some other prototype analyses; 7.55 (Hepper et al., 2012), 8.52 (Hassebrauck, 1997), 8.51 (Seuntjens et al., 2015), 12.28 (Luo et al., 2022). Typically, these earlier studies involved psychology students, a demographic that is not only highly educated but also presumably more engaged and interested in such topics.

Next, two independent coders grouped identical features (e.g., excitement and excitement), features that are semantically similar (e.g., excitement and exciting), synonyms (e.g., exciting and rousing), or have a similar meaning (e.g., excitement and arousal). Together with the first author, they solved discrepancies by discussion. They then established a set of 28 categories, plus a separate category for synonyms of enthusiasm[5], and a category for features that did not fit any of the other categories, with the intention to exclude these last two categories afterward.

From this point forward, we decided to use the results obtained from the panel respondents for further analyses, owing to their greater representativeness of the broader population. We explored whether individuals with a professional interest would generate different features. A Spearman's rank-order correlation indicated a positive relationship between the rankings of the two groups, suggesting substantial agreement ($\rho(28)=0.40$, $p=.034$). Additionally, a Wilcoxon Signed Ranks Test revealed no significant differences in the relative ranking of features between panelists and professionals ($Z=-0.036$, $p=.971$). This supports the conclusion that the prototype structure of enthusiasm is similarly recognized by both groups. Having established a set of categories that effectively grouped the data from both the panelists and the professionals, the next phase involved proceeding with data from a group of respondents representative of the general population.

A new pair of independent raters were then asked to assign the original 607 features, generated by the online panel, to this set of 28 categories[6]. We de-duplicated identical words

[3] We invited participants via research panel DYNATA. This panel consists of 360,000 Dutch panelists, who are recruited via different sources. Panelists receive panel points for their participation. Depending on the source, panel points can be worth money, discount coupons, or donations to self-selected charities. Participation is voluntary and anonymous. For more information: www.dynata.com.

[4] For all our experiments we followed the guidelines for sample size to recruit at least 50 participants per condition (Simmons et al., 2011, 2013). In all our studies we recruited at least 75 participants.

[5] Dutch synonyms for enthusiasm are *geestdrift* or *begeesterd*. These Dutch terms are derived from the German word Begeisterung, which shares the same root meaning as enthusiasm.

[6] In our study, we used categories defined by both professionals and an online panel. However, the final categorization of features was

Table 1 Prototype features of enthusiasm, exemplars, centrality ratings (Study 2), frequencies (Study 1)

Feature	Exemplars	Study 2		Study 1
		Centrality rating		Frequencies
		M	*SD*	*N*
Joy	Cheerful, Joy, Upbeat, Good mood	5.52	1.27	136
Motivation	Motivated, Driven, Keen, Going for it	5.52	1.23	52
Good feeling	Fine feeling, Enjoy, Good atmosphere	5.44	1.19	15
Eager	Keen on, Looking forward, Feeling like it	5.43	1.19	20
Positive	Positivity, Optimism	5.42	1.30	21
Laughing	Smiling, Jovial, Beaming, Radiant	5.41	1.22	28
Passion	Mad about, Love	5.40	1.36	13
Pleasurable	Nice, Fun	5.37	1.21	15
Honest	Sincere, Authentic, Real, Fair	5.36	1.41	4
Bursting with	Talking about it, sharing, telling, brimming with	5.33	1.36	14
Kind	Friendly, Empathetic, Sociable, Warm	5.28	1.35	15
Curious	Interested, Eager to learn, Wanting to know everything	5.26	1.09	11
Freedom	Free, Uninhibited, Broad-minded	5.26	1.39	3
Energy	Energetic, Energy level, Strength, Power	5.25	1.29	20
Happiness	Moment of happiness, Contented, Satisfied.	5.22	1.43	11
Active	Lively, Enterprising, Taking action, Pressing ahead	5.14	1.28	23
Spontaneous	Spontaneity, Without thinking	5.09	1.32	10
Anticipation	Hopeful, Dream, Wish, Hope	5.08	1.28	6
Affecting others	Convincing, Motivating others, Taking along, Winning over	5.07	1.37	17
Inspiration	Inspired, Inspiring	5.07	1.31	4
Presence	Radiating, Charisma	5.00	1.43	3
Together	Collaboration, Cooperation, Team, Connection	4.92	1.37	1
Creative	Ideas, New	4.90	1.45	4
Exuberant	Exhilarated, Ecstatic, Excited, Fervent	4.77	1.50	31
Result	Winning, Progress, Achievement	4.76	1.44	6
Restless	Talking loudly, Fidgety, Nervous, Tension	4.11	1.63	41
Impatient	Unable to wait	4.09	1.68	6
Unaware	Youthful, Naive, Unrestrained, Beginner	3.61	1.59	4

from the original set. This resulted in a set of 202 different features. The inter-rater reliability between the coders was substantial ($\kappa = 0.72$). This suggests that this set of categories was suited to further investigate the prototype structure.

To summarize, participants in this study were able to generate a range of different features of enthusiasm. Thereby one of the conditions for a prototype structure has been met. The generated features were compiled into 28 categories. From here on, these categories are referred to as features, whereas features that are part of this feature-category are referred to as exemplars (see Table 1). In the next study, we assessed how a new sample of participants rated these features in terms of centrality, that is the extent to which they considered these features related to enthusiasm[7].

Study 1.2: centrality ratings

Method

Participants and procedure

Participants were a new sample of 204 Dutch people recruited via the same online research panel as Study 1.1 (M_{age} = 46.39 years, $SD = 16.79$, 51% female, 49% male).[8] The 28 different features obtained in Study 1.1 were presented in random order, each accompanied by up to four exemplars. Participants rated the centrality of each feature to enthusiasm on a 7-point scale (1 = *not at all related*, 7 = *extremely related*).

Results and discussion

The mean centrality ratings and standard deviations per feature are listed in Table 1. Following Hassebrauck (1997) and Hepper (2012), we examined the intraclass correlation (ICC) across participants' ratings of centrality. We first transposed the data to compute this measure of reliability, whereby the 28 features were used as cases and the respondents as items.

exclusively based on the input from the online panel. This methodology resulted in certain categories being infrequently mentioned, as detailed in Table 1. Notably, the category 'Together' was considered relevant due to its mention 13 times by professionals, despite its minimal mention (only once) by the online panel participants.

[7] The features were translated by a professional translator. The original Dutch features, the examples and their English translations are listed in Appendix A.

[8] Again, the first author invited people from his own online social network to participate. This time 326 people participated (M_{age} = 44.85 years, $SD = 9.99$, 42.6% female, 57.4% male). There was a strong correlation between the centrality ratings of the online panel participants and this group, $r(27) = 0.733$, $p < .001$. Providing an indication of the robustness of the results.

This analysis showed that participants' responses were very coherent, (ICC = 0.97, $p < .001$, 95% CI = [0.95, 0.98].

We expected the centrality ratings to correlate positively with the frequencies of the features in Study 1.1, as these are both indicators of the prototype structure. We indeed found a positive relation between centrality and frequency, $r_s(27) = 0.46$, $p = .013$.

Following prior prototype research, we used the centrality ratings to categorize features in two distinct categories: "central" and "peripheral" features. The participants considered the 14 central features to be more closely related to enthusiasm, whereas the 14 peripheral features were considered less related to enthusiasm (see Table 1)[9].

The obtained features are congruent with the views that enthusiasm is a positive (joy, good feeling, positive), goal oriented (motivation, eager, curious), and high arousal state (energy, passion, bursting with). The interpersonal element of enthusiasm, which was absent in most views, is also represented by different central features (honest, kind), and several exemplars of the central feature 'bursting with', such as talking about it, sharing, and telling, as well as some of the peripheral features (affecting others, together). The different features and their congruence with other views will further be discussed in the general discussion.

Section 2: validating the enthusiasm prototype

In this second section, we validated the prototype structure by measuring recall and recognition of the central and peripheral features of enthusiasm. When a concept has a prototype structure, central features are more accessible in memory than peripheral features (Cantor & Mischel, 1977), although sometimes peripheral words might be remembered better because they deviate from what is expected (Stangor & McMillan, 1992). We hypothesized that central features, due to their cognitive accessibility, would be better remembered and more often falsely recognized than peripheral features. Prior research (e.g., Hassebrauck, 1997; Hepper et al., 2012; Luo et al., 2022; Seuntjens et al., 2015) has demonstrated that the activation of a prototype results in heightened accessibility of central features, leading to both greater recall accuracy and an increased likelihood of false recognition.

Furthermore, people are faster at classifying features that are central to a prototype (Hassebrauck, 1997; Hepper et al., 2012). Also, people mention central features more often than peripheral features when they describe a real-life experience involving the concept (Hepper et al., 2012). These elements of a prototype analysis were tested in three subsequent studies. First, we tested if central features of enthusiasm were recalled and recognized better than peripheral features (Study 2.1). Then we measured differences in reaction time and tested if central features were recognized faster than peripheral features (Study 2.2). Finally, we examined if central features were more present in autobiographical recalls of enthusiasm (Study 2.3).

Study 2.1: recall test

Method

Participants and procedure

Participants were 152 Dutch people of 18 years and older (M_{age} = 49.78 years, $SD = 15.91$, 51% female, 49% male); a new sample of the same online research panel was used in Studies 1.1 and 1.2. The included features were selected based on the ratings of Study 1.2. The obtained 28 features were divided into two sets of 14 features, whereby each set contained 7 central and 7 peripheral features. The mean centrality ratings of the two sets did not differ for the central features (Set 1: $M = 5.37$, $SD = 0.09$; Set 2: $M = 5.38$, $SD = 0.09$; $t[12] = 0.03$, $p = .978$) or peripheral features (Set 1: $M = 4.77$, $SD = 0.47$; Set 2: $M = 4.78$, $SD = 0.54$; $t[12] = 0.03$, $p = .979$).

To activate the enthusiasm prototype, participants were randomly assigned to one set and exposed for four seconds to a sentence containing one of the features and the word enthusiasm (e.g., "Enthusiasm is related to joy"). The order of the 14 statements was randomized. Next, participants were presented with a short, unrelated questionnaire as a filler task. Subsequently, they were asked to write down all the presented features they could remember (free recall for three minutes). The purpose of this last part was to test whether central features were more often freely recalled and more often falsely recalled than peripheral features. Next, for the recognition task, participants were presented with all 28 features, including the 14 non-presented features of the other set. Participants were asked to indicate whether a feature had been included in the presented set. These responses were used to compute indices for correct and false recognition of central features and correct and false recognition of peripheral features.

[9] It is important to acknowledge that the terms "central" and "peripheral," as used in this context, may imply a dichotomy. However, in reality, they represent relative differences in the extent of relatedness to enthusiasm. For the purposes of this study, we use these terms in alignment with the methodology established in previous prototype analysis research (e.g., Hepper et al., 2012).

Results and discussion

Free recall

We compared central and peripheral features on free recall. Because the data were not normally distributed, we conducted a Wilcoxon signed rank test. Participants did not correctly recall more central (M=1.80, SD=1.55) than peripheral features (M=1.61, SD=1.50), $Z(151) = -1.50$, p=.134. Central features, however, were more often falsely recalled (M=0.30, SD=0.64) than peripheral features (M=0.13, SD=0.58), $Z(151) = -3.54$, p<.001.

Recognition data

The recognition data were also not normally distributed, so again, we conducted a Wilcoxon signed rank test. Participants correctly recognized more central (M=5.36, SD=1.64) than peripheral features (M=4.82, SD=1.59), $Z(151) = -4.33$, p<.001. They also falsely recognized more central (M=3.43, SD=2.02) than peripheral features (M=2.41, SD=1.89), $Z(151) = -6.28$, p<.001.

To further assess participants' ability to discriminate between central and peripheral features and to control for response bias, we applied Signal Detection Theory (SDT; Pollack, 1970). SDT provides a framework for distinguishing between participants' ability to differentiate signal (e.g., previously presented features) from noise (e.g., new, non-presented features) and their tendency to respond affirmatively regardless of accuracy. Especially relevant for the current purposes are the parameters that assess Criterion C (response bias) and A' (discrimination ability) [10]. The Criterion C assess whether participants show a general tendency towards saying that they recognized a feature; in the current analyses a negative value would indicate that they would tend to say that they recognized a feature. Prototype analyses would assume that features that are part of the prototype are more often correctly and incorrectly recognized, which would imply a negative C value. Prototype analyses do not explicitly state that people are less able to recognize whether they had or had not seen a central feature. But because analyses do assume that false recognition is higher for central than for peripheral features, it is interesting to test whether that also leads to a higher A' value for central features.

The results on Criterion C (M = −0.33, SD=0.38) showed that participants overall– i.e., for central and peripheral features - more often stated that they recognized the features. This accords with the notion that features that belong to the prototype are more often– truly and falsely– recognized. The results for A' showed that discriminatory value was lower for central features (M=0.65, SD=0.11) than for peripheral features (M=0.70, SD=0.11, Z = −3.33, p<.001. Participants thus discriminated less between central features they had versus had not seen. This accords with the assumption of prototype analyses that especially central features are not only correctly but also incorrectly recognized.

In summary, while no significant difference was observed in the correct free recall of central and peripheral features, the higher rate of false recall and recognition for central features aligns with the expected prototype structure of enthusiasm. These findings suggest that central features occupy a more prominent role in the cognitive representation of enthusiasm, leading to both greater recognition and a higher susceptibility to errors in recall and recognition.

Study 2.2: classification and verification speed

Method

Participants and procedure

Participants were 160 Dutch Leiden University students (M_{age} = 21.80 years, SD=3.04, 82% female, 18% male). Participants received €1,- compensation for their participation. Participants were informed that they took part in a reaction time study, and they were asked to respond as quickly as possible. Before the actual experiment started, they were presented with 10 practice trials in which they had to respond whether a word (e.g., cheese, guitar) was or was not related to food by typing an 'F' for Yes, and a 'J' for No. After this, participants proceeded to the actual study. Participants were presented with 28 features of enthusiasm (14 central, 14 peripheral) plus 28 control features (tree, dog, clock, and the like). All features were presented in a random order. After each feature, participants were asked to indicate whether this could be considered a feature of enthusiasm or not, by typing an 'F' for Yes, and a 'J' for No. We counted the number of times the features were identified as enthusiasm and recorded the speed of the Yes responses, as we were only interested in the classification speed of features that were classified as enthusiasm. The verification speed of control features was not considered since these features

[10] A' was calculated based on hit rate (H) and false alarm rate (FA) using the following formulas: If H>FA, $A' = 0.5 + ((H - FA) \times (1+H - FA) / (4 \times H \times (1 - FA)$. If H=FA, $A' = 0.5$. If H<FA, $A' = 0.5 + ((FA - H) \times (1+FA - H) / (4 \times FA \times (1 - H)$. Chance performance yields an A' of 0.5, while perfect discrimination yields an A' of 1.0. Criterion C was calculated using the formula C = - ((H - FA) / (H+FA −2 × H × FA), where negative values indicate a tendency to respond "yes" more frequently, and positive values reflect a more conservative response tendency. See for similar applications e.g., Baumann and Kuhl (2002) and Bolte et al. (2003).

are not related to enthusiasm and therefore were hardly ever classified as enthusiasm.

Results and discussion

Data from one participant were removed from the analysis. This participant indicated enthusiasm every time a control word was shown and indicated not-enthusiasm when one of the enthusiasm features were shown. Most likely, this participant misunderstood the instructions. Analyses were thus conducted with data from 159 participants.

Classification

In the analyses, we first compared the percentages of central, peripheral, and control stimuli, indicated by participants as features of enthusiasm. As the data were skewed, we used non-parametric tests. Results showed a main effect of feature type, Friedman $X^2(2, N=159)=311.79$, $p<.001$. Central features ($M=87.06\%$, $SD=11.95$) were more often classified as enthusiasm than peripheral features ($M=62.85\%$, $SD=14.79$), Wilcoxon's $Z(158)=-10.65$, $p<.001$, and control features ($M=7.86\%$, $SD=9.36$), Wilcoxon's $Z(158)=-10.95$, $p<.001$. Moreover, peripheral features were more often classified as enthusiasm than control features, Wilcoxon's $Z(158)=-10.95$, $p<.001$.

Response time

In the subsequent analysis, we concentrated on comparing the response times. Our interest was specifically in the response times of features identified as enthusiasm. Consequently, we limited our focus to the s response times of affirmative responses (verification speed), as negative responses do not reflect the prototypical characteristics of enthusiasm. Following prior research (Elshout, 2015; Hepper et al., 2012; Seuntjens et al., 2015), we recoded extremely fast (<300ms) responses to 300ms, and extremely slow (>3000ms) responses to 3000ms. Of the total of 8,960 responses, 11 responses (0.1%) were extremely fast and recoded to 300ms, and 63 responses (0.7%) were extremely slow and recoded to 3000ms. The data were skewed, so we used non-parametric tests. Of the features that were classified as enthusiasm, central features ($M=788.77$ms, $SD=207.98$) were faster classified than peripheral features ($M=917.07$ms, $SD=299.45$), Wilcoxon's $Z(158)=-8.58$, $p<.001$.

To summarize, participants classified more central features as related to enthusiasm than peripheral features. Moreover, they were faster in classifying central features than peripheral ones. Participants also classified more peripheral features to enthusiasm than control features. This suggests that peripheral features are also part of the prototype, even though they are less prototypical than central features.

Study 2.3: autobiographical recall

Method

Participants and procedure

Participants were 153 Dutch people of 18 years and older, a new sample of the same online research panel as studies 1.1, 1.2, and 2.1, ($M_{age}=44.35$ years, $SD=15.13$, 47% female, 53% male). Participants were randomly assigned to the enthusiasm condition ($n=78$) or control condition ($n=75$). In the former, they were asked to describe an autobiographical situation in which they experienced enthusiasm, whereas in the latter they were asked to describe a normal weekday. In doing so, we followed the standard approach for prototype analyses (e.g., Elshout et al., 2015; Hepper et al., Luo et al., 2022; Seuntjens et al., 2015). Participants were instructed to provide detailed descriptions, including what they felt, where they were, who they were with, the nature of the situation, and when it occurred. Subsequently, participants in both conditions rated the extent to which each of the 28 features was present in that situation on a 10-point scale, ranging from 1; 'not at all' to 10; 'very much'.

Results and discussion

Fourteen participants (ten in the enthusiasm condition, and four in the control condition) gave nonsense responses (e.g., "eiidjd"). Ten participants (six in the enthusiasm condition, and four in the control condition) gave non-relevant answers for the purposes of this research (e.g., "I am sick and therefore never enthusiastic", "I don't know", "That's private"). Data from these 24 participants were not included in this analysis. Reported analyses were conducted with data from 128 participants (62 in the enthusiasm condition, and 66 in the control condition; $M_{age}=45.32$ years, $SD=15.34$, 48% female, 52% male). The responses provided by these participants were reviewed and considered appropriate for further analysis as they consisted of descriptions of situations.

Autobiographical recall

A 2 (Condition: enthusiasm versus control) × 2 (Feature: central versus peripheral) mixed ANOVA, revealed a main effect of Condition, $F(1, 126]=12.59$, $p=.001$, $\eta_p^2=0.09$) (Table 2).

Table 2 Ratings of central and peripheral features in enthusiasm and control condition

	Enthusiasm condition		Control condition		Condition total	
	M	SD	M	SD	M	SD
Central features	8.03	1.46	7.03	1.78	7.51	1.70
Peripheral features	6.92	1.43	6.00	1.69	6.45	1.63
Features total	7.47	1.37	6.52	1.65	6.98	1.59

Table 3 Correlations (Spearman's Rho) among measures of internal structure

		Study	1	2	3	4	5	6	7
1	Frequencies	1.1	1	0.46*	−0.01	0.285	−0.40*	0.52**	0.12
2	Centrality rating	1.2		1	0.41*	0.61**	−0.77**	0.72**	0.70**
3	Correct recognition	2.1			1	0.57**	−0.57**	0.43*	0.46*
4	False recognition	2.1				1	−0.75**	0.80**	0.52**
5	Reaction time	2.2					1	−0.86**	−0.59**
6	Classification	2.2						1	0.40*
7	Autobiographical recall	2.3							1

* Correlation is significant at the 0.05 level (2-tailed)

** Correlation is significant at the 0.01 level (2-tailed)

Participants indicated that enthusiasm features were more present in the enthusiasm condition than in the control condition. We also found a main effect of feature type indicating that central features were indicated to be more present than peripheral features, $F(1, 126) = 143.88$, $p < .001$, $\eta_p^2 = 0.533$. The interaction effect was not significant[11], $F(1, 126) = 0.21$, $p = .645$, $\eta_p^2 = 0.002$. Both central features, $t[123.88] = 3.47$, $p = .001$, $d = 0.29$) and peripheral features, $t[126] = 3.29$, $p = .001$, $d = 0.28$) were rated more present in the enthusiasm condition than in the control condition. In the enthusiasm condition, central features were mentioned more often than peripheral features, $t(61) = 9.42$, $p < .001$, $d = 0.12$. While this further supports our reasoning, it should be noted that the interaction is not significant, as in the control condition, central features were also rated as more present than peripheral features, $t(65) = 7.75$, $p < .001$, $d = 0.13$. A post hoc explanation could be that the recall of a normal weekday may generate similar patterns (although to a lesser extent) as the recall of enthusiastic events, a finding that could emerge if– when recalling events people to some extent include events that sparked their enthusiasm. In this respect, it may be interesting to note that a recent prototype analysis on hope (Luo et al., 2022) found a similar pattern in their study on the autobiographical recall of hope versus an ordinary weekday. Follow-up research could be used to assess whether this explanation holds.

To summarize, compared to the control condition, both central features and peripheral features were indicated to be more present in situations in which enthusiasm was recalled. Moreover, central features were indicated to be more present than peripheral ones. This study therefore suggests that both central and peripheral features are part of the prototype structure of enthusiasm and that central features are more essential. By asking participants to recall and describe personal experiences, this study highlights that the cognitive representation of enthusiasm closely aligns with how the emotion is naturally felt and expressed.

Relationship between different measures

In the present research, we obtained several different measures related to the internal structure of enthusiasm; for each of the 28 features, we obtained frequencies (Study 1.1), centrality ratings (Study 1.2), correct recognition (Study 2.1), false recognition (Study 2.1), reaction time (Study 2.2), classification (Study 2.2), and presence in the autobiographical recall (Study 2.3). If the enthusiasm prototype has a consistent internal structure, one would expect that these different measures are related. To test this, we analyzed the correlations between the scores of the 28 features in the current five studies (Table 3).

Results largely confirmed the internal structure. We found significant correlations between almost all of the measures. These consistencies provide further support for the prototype structure of enthusiasm. Only the frequencies of features did not correlate significantly with correct recognition and false positive recognition, and the features indicated as being present in the autobiographical recall. This is partly consistent with the results in a prototype analysis of vengeance (Elshout, 2015), where the correlation between frequencies and correct recognition was also low. A possible explanation is that particular (less prototypical) words stand out because they are used less often in relation to enthusiasm. Such words might not be mentioned frequently

[11] The absence of a significant interaction effect could stem from the control group's tendency to describe a normal weekday in positive terms, thereby lessening the contrast with the enthusiasm condition.

when thinking of enthusiasm while being recalled because they are notable, and memory researchers have shown that words are better memorized when they deviate from what is expected (Stangor & McMillan, 1992).

General discussion

We examined the prototype structure of enthusiasm in five studies. Results of the first two studies showed that features like joy, motivation, and a good feeling were rated as central to the concept enthusiasm, whereas features as restless, impatient, and unaware were rated as less central (e.g., peripheral). The validity of the central features was supported in three follow-up studies. More specific, we found that central features were more often recalled, and as the signal detection analyses corroborated, more often– both correctly and incorrectly– recognized (Study 2.1). They were more often and faster classified as a feature of enthusiasm, (Study 2.2), and more often mentioned in autobiographical recalls of enthusiasm (Study 2.3). We also found that the internal structure of the prototype was consistent throughout the different studies. Based on our current findings, we can conclude that enthusiasm is prototypically structured, and that prototypical enthusiasm is a positive, energetic feeling that is associated with goal orientation and often involves interpersonal interactions. Our research both aligns with established knowledge and contributes new insights, particularly regarding the social aspect of enthusiasm and the nuances of its association with power and control. These novel insights are plausibly attributable to the bottom-up approach implemented in the prototype analysis methodology.

The enthusiasm prototype

A first core element of the prototype of enthusiasm is a positive valence. Almost all obtained features have positive connotations. Only three of the peripheral features might be considered as negative (restless, impatient, and unaware), although some exemplars of the feature ‘unaware’ could be considered as positive in valence (youthful, unrestrained). Although positive valence is not an integral part of the definition of enthusiasm in dictionaries, our findings show that it is a central part of the prototype structure of enthusiasm. Most scientific views agree that positive valence is an important element of enthusiasm (Scherer, 2005) or generally categorize enthusiasm as a positive emotion (Griskevicius et al., 2010; Poggi, 2007).

A second core element of the enthusiasm prototype is high arousal. Our results indicate that the feature ‘energy’ is a central element of enthusiasm. Moreover, many of the other obtained central features (eager, passion, bursting with), and several of the peripheral features (active, spontaneous, exuberant, restless, impatient) concern high arousal elements. These findings are consistent with definitions of enthusiasm in dictionaries and the view of other scholars (Griskevicius et al., 2010; Scherer, 2005).

A third core element in the enthusiasm prototype is goal conduciveness. Our results indicate that both central features of enthusiasm (motivation, eager, curious) and peripheral ones (anticipation, result) imply goal orientation. These findings are consistent with definitions of enthusiasm in dictionaries and scientific views on enthusiasm (Griskevicius et al., 2010; Poggi, 2007).

A fourth core element of the prototype structure of enthusiasm concerns an interpersonal orientation, as our findings indicate that enthusiasm is also defined by a social element. In this sense, our findings concur with the more general notion that emotions serve an important social function, and the advancements that have been made in studies on the interpersonal effects of emotions (e.g., Parkinson, 1996; Van Kleef & Côté, 2022). However, the fact that the literature on emotions acknowledges the interpersonal effects of emotion expressions does not necessarily imply that people consider the social element as a defining characteristic of an emotion. Results of our studies suggest that it may an important defining feature for enthusiasm, as it emerged in central features (‘honest’, ‘kind’, and ‘bursting with’) and its exemplars, as well as in some of the peripheral features (‘affecting others’, ‘together’). This is an important insight, as none of the dictionary definitions and only a few of the scientific approaches have identified the social aspect as a defining characteristic of enthusiasm (Keller et al., 2014).

The four core elements of enthusiasm cover most of the features that our participants generated. Freedom is the only central feature that does not sort nicely within the four above-mentioned core elements (positive valence, high arousal, goal conduciveness and interpersonal orientation). Perhaps a certain degree of freedom is rather a prerequisite to experiencing enthusiasm than a core element itself. In this way, freedom is related to the peripheral features ‘spontaneous’ and ‘unaware’, in the sense of being unrestrained.

Our findings are generally consistent with views of other scholars, but we also found some differences. In his interpretation of the circumplex model, Scherer (2005) added goal conduciveness and coping potential (power/control) to the existing dimensions: valence and arousal. He plotted enthusiasm as being positive and high in arousal, which is consistent with our findings. Additionally, he positioned enthusiasm as being high in power and control and goal conducive. As discussed, goal conduciveness is consistent with our findings. Power could relate to the central feature of energy. We cannot confirm that enthusiasm is strongly

associated with a control, however, as it was not directly referenced in the central features.

Measurements used in empirical research on enthusiasm typically cover some of the core elements; positive valence items like pleasure and enjoyment (Frenzel et al., 2009; Kunter et al., 2008), high arousal items like energy and excitement (Kunter et al., 2008, 2011). Goal conduciveness and interpersonal interaction times are sometimes present (Collins, 1978) but are used less often. Some measurements contain items that are related to the core elements, like 'humor' (related to positivity and laughing; Frenzel et al., 2009; Murray, 1983), 'hope' and 'pride' (related to positivity in the sense of optimism; Marcus & MacKuen, 1993), or 'sympathy' and 'empathy' (related to kind; Marcus & MacKuen, 1993; Wheeless et al., 2011). Sometimes measurements contain items that, according to our findings, are less central to the enthusiasm prototype. Wheeless et al. (2011) used items like 'bold' and 'aggressive', which might be related to the peripheral features of 'restless' and 'impatient', but not to core elements or central features.

Limitations and future directions

As in the current studies only Dutch respondents participated, it might be worthwhile to examine the enthusiasm prototype with participants with a different cultural background or a different native language. As emotions may vary across cultures (Mesquita et al., 1997), we encourage studies on the prototype of enthusiasm in other countries, also to obtain insights in generalizability of our current findings. Exploring these variations could reveal whether the features identified in the Dutch sample reflect broader patterns or are shaped by culturally specific factors.

While the present study focuses on the cognitive representation of enthusiasm, it does not directly address the events or processes that generate the emotion. For that purpose, alternative methods have been developed that concentrate on how people's emotions relate to how they evaluate events. Such studies generally concentrate on how people appraise events on a limited number of dimensions (e.g., novelty, intrinsic pleasantness, goal conduciveness, coping potential, and compatibility withs standards; see Scherer, 2019). They focus on how the type of appraisals people make generate the emotion they feel. Such an approach is notably different from the prototype analysis approach, that concentrates on obtaining people's associations without imposing a priori restrictions. We would like to stress that we see merit in both approaches and feel they may be complementary. Whereas prototype analyses reveal what (lay)people consider are the main defining features of an emotion, appraisal studies may indicate which events generate the emotion. Viewed this way, we see added value in further research on how people appraise events that generate enthusiasm.

Future research could also benefit from comparing features of enthusiasm to those of other emotions. In our studies, we concentrated on determining and validating the prototypical structure of enthusiasm. Similar studies could also be designed for emotions that might share some of these features, e.g., awe or joy. Network analyses (Lange & Zickfeld, 2021) could then be employed to identify features that are unique to each of these emotions, and features that are shared by the emotions. We could, for example envisage that freedom (with exemplars free and broad-minded), could also emerge as a central feature in a prototype analysis of awe, while energy (with exemplars strength, power) might be less central to awe. Studies like these could further advance the understanding of the unique properties of enthusiasm (versus other emotions).

In most approaches, enthusiasm is considered a state variable. Other views, however, consider enthusiasm as a personality trait (Seligman, 2004). Results of our current research provided support for both views. Our studies showed that most features in the prototype structure of enthusiasm are generally used to describe states (e.g., good feeling, laughing). Some features, however, are more commonly used as a personality trait (e.g., honest, kind). Additionally, other features can be used to describe both state and trait (e.g., energy, energetic). Further research could focus on the difference between dispositional and situational enthusiasm. Some individuals exhibit higher dispositional enthusiasm than others. On the other hand, certain people, or events, may evoke enthusiasm. Research on dispositional and situational enthusiasm, and the interaction between the two, could provide more insight in the dynamics of enthusiasm. It would be useful to develop an enthusiasm scale that measures the dispositional tendencies to experience enthusiasm. Additionally, it would be worthwhile to investigate which situations trigger enthusiasm. If certain situations can trigger enthusiasm this would be useful information for educational purposes and other professional situations.

In addition to identifying enthusiasm's core elements, it may be interesting to discuss the motivational basis of enthusiasm. Our findings suggest that enthusiasm likely has a strong agentic orientation, as evidenced by features such as motivation and eagerness. However, other features (e.g., kindness, honesty) hint at connections to communal motives, such as affiliation. Future research could explore whether enthusiasm connects to specific motives, or whether it represents a broader mode of motivational striving.

In summary, the present research substantiates the prototypical structure of enthusiasm, identifying four fundamental elements: positive valence, high arousal, goal conduciveness, and interpersonal orientation. Notably, the

latter aspect, interpersonal orientation, is largely absent in dictionary definitions and seldom acknowledged in existing scientific discourse. This not only underscores the benefit of using a bottom-up approach that is provided by prototype analyses. It also contributes to a better understanding of the emotion of enthusiasm. As we also discussed, however, future research could benefit from comparing enthusiasm to other emotions. The features we identified in the current manuscript could serve as input for such comparative studies. We hope that the current research will encourage future studies to further elucidate the unique properties and characteristics of enthusiasm.

Appendix A: Features and exemplars in English and Dutch (original)

Features	Exemplars	Features in Dutch	Exemplars in Dutch
Joy	Cheerful, Joy, Upbeat, Good mood	Blij	Vrolijk, Vreugde, Opgewekt, Goed humeur
Motivation	Motivated, Driven, Keen, Going for it	Motivatie	Gemotiveerd, Gedreven, Graag willen, Er voor gaan
Good feeling	Fine feeling, Enjoy, Good atmosphere	Fijn gevoel	Goed gevoel, Genieten, Genot, goede sfeer
Eager	Keen on, Looking forward, Feeling like it	Zin in	Verheugen, Er zin in hebben
Positive	Positivity, Optimism	Positief	Positiviteit, Optimisme
Laughing	Smiling, Jovial, Beaming, Radiant	Lachen	Glimlachen, Goedlachs, Glunderen, Stralen
Passion	Mad about, Love	Passie	Gek zijn op, Liefde
Pleasurable	Nice, Fun	Plezier	Plezierig, Leuk
Honest	Sincere, Authentic, Real, Fair	Eerlijk	Oprecht, Authentiek, Echt, Rechtvaardig
Bursting with	Talking about it, sharing, telling, brimming with	Ergens vol van zijn	Erover praten, delen, vertellen, mededeelzaam
Kind	Friendly, Empathetic, Sociable, Warm	Aardig	Vriendelijk, Empathisch, Sociaal, Warm
Curious	Interested, Eager to learn, Wanting to know everything	Nieuwsgierig	Interesse, Leergierig, Alles willen weten
Freedom	Free, Uninhibited, Broad-minded	Vrijheid	Vrij, Ongeremd, Ruimdenkend
Energy	Energetic, Energy level, Strength, Power	Energie	Energiek, Energieniveau, Kracht, Power
Happiness	Moment of happiness, Contented, Satisfied.	Geluk	Gelukkig, Geluksmoment, Happy, Tevreden
Active	Lively, Enterprising, Taking action, Pressing ahead	Actief	Levendig, Ondernemend, Doen, Doorpakken
Spontaneous	Spontaneity, Without thinking	Spontaan	Spontaniteit, Ondoordacht
Anticipation	Hopeful, Dream, Wish, Hope	Verwachting	Verwachtingsvol, Droom, Wens, Hoop
Affecting others	Convincing, Motivating others, Taking along, Winning over	Anderen aansteken	Overtuigen, Anderen aanzetten, Meenemen, Meeslepen
Inspiration	Inspired, Inspiring	Inspiratie	Geïnspireerd, Inspirerend
Presence	Radiating, Charisma	Uitstraling	Uitstralen, Charisma
Together	Collaboration, Cooperation, Team, Connection	Samen	Samenwerking, Team, Connectie
Creative	Ideas, New	Creatief	Ideeën, Nieuw
Exuberant	Exhilarated, Ecstatic, Excited, Fervent	Uitbundig	Uitgelaten, Extase, Opgewonden, Vurig
Result	Winning, Progress, Achievement	Resultaat	Winnen, Voortgang, Prestatie
Restless	Talking loudly, Fidgety, Nervous, Tension	Druk	Hard praten, Bewegelijk, Zenuwachtig, Spanning
Impatient	Unable to wait	Ongeduldig	Niet kunnen wachten
Unaware	Youthful, Naive, Unrestrained, Beginner	Onwetend	Jeugdig, Naïef, Onbevangen, Beginneling

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Declarations

Conflict of interest The authors have no financial or non-financial interests to disclose.

Ethics approval All procedures performed were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. Als studies were approved by the Ethics Committee of the University.

Consent to participate Informed consent was obtained from all individual participants included in the study.

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