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Emotional grammar

Is there a relationship between emotions and grammatical creativity?

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Abstract

The purpose of this study was to explore whether there is a relationship between emotional state and the degree of creative use of grammatical constructions. Based on previous literature on the relationship between mood (used interchangeably with emotional state) and creativity a hypothesis was formulated: *Speakers in a more positive mood will be more creative in their use of grammatical constructions*. Sixteen native Danish speakers participated in an experiment consisting of a general mood assessment (PANAS), two mood inventories (MI) evaluating current mood, two language production tasks (LPT), two tasks where eye blink rates (EBR) were tracked, and a mood induction task. In working with the experiment and the data the pheno-methodological triangulation (P-MT) was employed. This consists of three levels: 1st person methods (subjective perspective); 2nd person methods (intersubjective perspective); and 3rd person methods (objective perspective). Examples of use in the study: use of native speaker intuition for coding the data (1st person); discussions with co-researchers (2nd person); and correlation analyses (3rd person).

The analyses showed that positive mood was associated with less creative (i.e. less divergent) use of word constructions and morpheme constructions, contrary to the prediction. That is, the lemmas and their morphological changes used by participants in a more positive mood were less divergent in relation to the -KORPUS-DK corpus of Danish language. Possible explanations for these results are discussed in terms of research design, population, and analyses. The thesis has identified a research gap, and further exploration of the relationship between emotions and grammatical creativity, and maybe even grammar in general, is recommended.

Keywords: emotions, mood, grammatical structures, mind and body, Danish language, linguistics, construction grammar, cognitive semiotics

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Abbreviations

ASC	Argument structure construction
AUT	Alternate uses task
CoREST	Corpus retrieval system & tools
EBR	Eye blink rate
ED	Equally divergent
EES	Evaluated emotional states
EGD	Evaluated grammatical divergence
END	Equally non-divergent
GGC	General grammatical construction
L1	First language
L2	Second language
LD	Less divergent
LPT	Language production task
MD	More divergent
MI	Mood inventory
PANAS	Positive and negative affect schedule
P-MT	Pheno-methodological triangulation
SD	Standard deviation

1 Introduction

> *When the sensorium is strongly excited nerve-force is generated in excess, and is transmitted in certain directions, dependent on the connection of the nerve-cells, and, as far as the muscular system is concerned, on the nature of the movements which have been habitually practised*
>
> Charles Darwin, *The Expression of the Emotions in Man and Animals* (1872, p. 66)

Seven years ago, inspired by personal experience with emotions and their effect on mind and body and fuelled by intense work with language both as a student, a copywriter, and a poet, I came to ask myself, whether emotions might influence linguistic expression at a structural level. Reading Darwin, the personal experience manifested itself as a long-recognized scientific subject, and the above quote was especially inspirational in the following process. Supporting the idea of the effects of emotions on mind and body is a literature linking mood and the neurotransmitters dopamine and serotonin (Akbari Chermahini & Hommel, 2012; Ashby, Isen & Turken, 1999; Dayan & Huys, 2008; Cools, Roberts & Robbins, 2008), while a connection between mood, dopamine, and creativity has also been suggested (Akbari Chermahini & Hommel, 2012).

> [P]hasic changes in dopamine levels might provide the common currency underlying the relationship between mood and creativity (Akbari Chermahini & Hommel, 2012, p. 6)

Thus, the literature supports a connection between mood and creativity (Akbari Chermahini & Hommel, 2010; Akbari Chermahini & Hommel, 2012; Baas, De Dreu & Nijstad, 2008; Estrada, Isen & Young, 1994; Mumford, 2003; Vosburg, 1998).

> [M]ood stands out as one of the most widely studied and least disputed predictors of creativity (Baas et al., 2008, p. 779)

However, previous research has focused on creativity in a general sense, but not considered linguistic creativity. Therefore, the research question of the present study is:

Is there a relationship between emotional state and the degree of creative use of grammatical constructions?

With this question the present study fills a gap in the research, as little is known (to the best of my knowledge) about the effects of emotions on creative use of grammar. Furthermore, as the present study is based in cognitive semiotics, the study shows that the research area of creativity and the effects of emotions on language can benefit from a cognitive semiotics approach. To investigate the issue at hand the study partially replicates an experiment (Akbari Chermahini & Hommel, 2012) and adds a language production part. To analyse the data from the experiment a construction grammar approach is deployed for syntactic analysis.

Several studies have pointed to an interacting relation between emotional state and creativity (Akbari Chermahini & Hommel, 2012; Baas et al., 2008; Isen, 2002; Isen, Daubman & Gorgoglione, 1987; Isen, Daubman & Nowicki, 1987; Isen, Johnson, Mertz & Robinson, 1985), where especially positive mood plays an active role in *enhancing* creativity (Isen, 2002). Based on this knowledge the following hypothesis is formulated:

Speakers in a more positive mood will be more creative in their use of grammatical constructions.

In the following chapters cognitive semiotics and construction grammar and some of their basic principles and methods are explained as well as the theoretical backdrop of the investigation such as *emotional states* and *linguistic creativity* (chapter 2, Theoretical background). Then, the present study and the experiment is outlined (chapter 3, The present study). The materials, procedure, and data treatment and coding in the experiment are presented, and the corpus investigation and analysis and the comparative analysis of the experiment and corpus data explained (chapter 4, Methods). After this, the results of the analyses of the experiment and corpus data are explained (chapter 5, Results). Then, the results and what they mean in a greater perspective of research of the effects of emotions on language are discussed (chapter 6, Discussion). Finally, the results and the discussion are concluded on, and suggestions for future replications and similar research are provided (chapter 7, Conclusion).

2 Theoretical background

In this chapter I define and explain cognitive semiotics, construction grammar, and the backdrop of the investigation, i.e., emotional states, linguistic creativity, the role of the neurotransmitter dopamine, and the interrelations between emotional states and creativity.

2.1 Cognitive semiotics

> [T]he creation of cognitive semiotics means that we can now also set up our own experiments, taking into account features and dimensions which are ignored or downplayed in, notably, psychological and sociological experiments (Sonesson, 2019, p. 15)

Cognitive semiotics is a *transdisciplinary* field of study (Zlatev, 2015) built on the philosophical direction of *phenomenology* that methodologically and thoroughly studies *experience* (Stampoulidis & Bolognesi, 2019), with some scholars paying special attention to the philosopher Edmund Husserl. Cognitive semiotics is not just another name for cognitive science.

> The approximately equal indebtedness of cognitive semiotics to linguistics, semiotics, and cognitive science; it can be seen as both integrating and transcending these (Zlatev, 2015, p. 1044)

Cognitive semiotics uses the methodology from these fields as well as their models and theories (Stampoulidis & Bolognesi, 2019). At the same time, cognitive semiotics is connected to fields such as gesture studies, evolution studies, and studies of the embodied mind (Zlatev, 2015). This, as the Sonesson quote above exemplifies, enables cognitive semiotics to do research that might otherwise be impeded by its respective fields and the rigid norms and practices that are sometimes characteristic of them.

Cognitive semiotics is an encompassing and explorative field of study that works with and develops upon such concepts as the *sign* (Sonesson, 2019), *meaning making* (Sonesson, 2019; Zlatev, 2015; Zlatev, 2018; Zlatev, Steffensen, Harvey & Kimmel, 2018), *intentionality* (Zlatev, 2018), and *embodied mind* (Zlatev, 2015) and *embodiment* (Pielli & Zlatev, 2020). Several

characteristics can be connected to cognitive semiotics, but these do not equal cognitive semiotics in a strict sense.

> [The characteristics] should be seen as characterizing a prototype-based definition and not every Cogsem researcher should be seen as committed to all five features (Zlatev, 2015, p. 1057)

Of these characteristics the present study works with: *pheno-methodological triangulation* (Pielli & Zlatev, 2020), *the conceptual-empirical loop*, *phenomenology*, and *transdisciplinarity* (Zlatev, 2015), which is described further below.

2.1.1 Phenomenology

Cognitive semiotics takes its philosophical outset in phenomenology, especially the phenomenology of the philosopher Edmund Husserl. For some cognitive semioticians (Parthemore, 2016; Zlatev et al., 2018; Zlatev, 2018) the work by the existential phenomenologist Maurice Merleau-Ponty is a natural extension of the phenomenology of Husserl, where the body is at the centre of experience, and meaning created in the space between the body and Lebenswelt as held by Merleau-Ponty's understanding of the concept *intentionality* (Zlatev, 2018). In this view, intentionality is understood as an *openness to the world*, being a base of *meaning making* (Zlatev, 2018) deeply rooted in *experience*, one of the most fundamental ideas of phenomenology. Experience is a key term.

> [T]he basic idea [of phenomenology] is to *depart from experience itself*, and to provide descriptions of the phenomena of the world, including ourselves and others, as true to experience as possible (Zlatev, 2015, p. 1060, original italics)

My own experience with emotional states testifies to the impact they can have. It is not an experience specifically with the impact of emotional states on creativity in grammatical constructions, but experience with other types of effects of emotional states on body, mind, and language, which are then used to explore the terrain of the significance of emotional states. Besides this, I bring about my personal experience reading fictional literature, and writing it – such as poems and short stories – and thus with intimate knowledge about the techniques for conveying

emotions, themes and more through language at several levels, inter alia, structural, formal, grammatical, and verbal expressions. Writing it is feeling it; it is living it in the Lebenswelt.

The present study aims to investigate the communicated emotive experience of Danish speakers. The study aims to traverse phenomenological conceptual investigations combining it with semiotic investigation. Göran Sonesson explains the role of phenomenology, its naturalization, and experimental research in cognitive semiotics:

> If […] we elaborate the notion of schema, which has antecedents not only in cognitive science, but, well before that, in phenomenology and psychology, we stand a better chance of developing a framework which is transdisciplinarily relevant. If so, we will go beyond classical semiotics to cognitive semiotics (Sonesson, 2017, p. 111)

In the present study mind and meaning are not viewed as physical phenomena, rather, what is the foundation here is a view of mind and body (Merleau-Ponty, 2012) as being interconnected, thus turning from a *Cartesian dualism* as it is seen in Descartes and Hegel (Heinämaa, 2018; Hoffman, 2008; Martin, 2008). The body is not seen as a mere tool, and while the mind is not just a physical phenomenon, it is also not seen as a detached entity. Body and mind are intertwined in symbiosis and when we speak it is not simply the mind using the body's speech organs like a puppeteer a puppet. This is embodied cognition. The philosopher Sara Heinämaa notes:

> Living bodies do not just appear to us as biological organisms but are also given as practical tools, as communicative means, as emotive expressions and as our very means of perceiving and acting on environing things (Heinämaa, 2018, p. 533)

Emotions are both physical and psychological (that is, psychological as non-physical) phenomena, they are bodily experiences. The present study aims to investigate the possible manifestation of these bodily experiences in language, not directly in words but in grammatical constructions, thus illuminating the connection between body and mind and the connection between physical and psychological. This manifestation of the bodily experiences in grammatical constructions is seen as a form of meaning making.

2.1.2 The conceptual-empirical loop

The conceptual-empirical loop begins with *pre-theoretical intuitions about particular concepts* (Pielli & Zlatev, 2020), and these concepts are then continually revised through *philosophical questions* and *specific empirical studies* (Pielli & Zlatev, 2020). In this process the researcher works towards a theory – the conceptual-empirical loop is thus a process with theory as its goal and not its outset.

My main concept in the current study is influence of emotional state on language structures. As should be evident from the introduction this concept came to my mind seven years ago stemming from pre-theoretical intuitions and experiences. My secondary concepts are linguistic creativity and emotional state. These secondary concepts have come to exist during the process of working with and revising my main concept, the process of which they are supporting.

The main concept is operationalised so as to conduct empirical studies (my bachelor's thesis and the present study). In the present study, the main concept is operationalised by first defining two secondary or sub-concepts: linguistic creativity operationalised by divergent language measured against a Danish language corpus; and emotional state operationalised by self-rating scores in questionnaires, and dopamine levels measured by way of eye blink rates. The main concept is then operationalised as grades of divergent language under grades of emotional state, i.e. as a relationship between the two sub-concepts measured by different types of analysis.

The present study does not end in a grand theory; rather, it serves as a stepping-stone towards a theory, and hopefully it is helping prevent *diffuse concepts* (Zlatev, 2015). This is how the conceptual-empirical loop is used in the present study. Like an LP set in loop we go through the same developing process several times, each revision leading to new knowledge and understanding about details or the concept as a whole.

2.1.3 The pheno-methodological triangulation

The *pheno-methodological triangulation* (P-MT) deals with three different levels of methods: *1st person* methods, *2nd person* methods, and *3rd person* methods (Zlatev, 2015). The 1st person

methods are the methods with the most direct access to the phenomena at hand, in these methods the perspective is *subjective*. In the 2nd person methods the researcher's access to the phenomena is via others, here the perspective is *intersubjective*. The 3rd person methods are the most detached and objectified view on the phenomena, here the perspective is *objective*. With the P-MT a goal is to unify research fields and methods, and advocate for incorporating the three different kinds of methods in each project, and, not least, being explicit about it. For the P-MT all three different kinds of methods have a value, when they are explicitly accounted for within each of their respective areas of study (Zlatev, 2015).

To exemplify, my work with the data from the experiments has aspects of all three levels: my *intuitions* on what the data means (1st person); my *empathy* with the participants to make interpretations (2nd person); and *calculations* based on this (3rd person). The corpus analyses also have aspects of all three levels. Here, I use my native speaker intuition to work with the Danish language corpus and have direct access to the phenomena (1st person). My empathy with the authors of the data in the corpus allows me to access the phenomena via them (2nd person). Finally, statistical analyses let me see the phenomena from an objective viewpoint (3rd person). Table 1 summarizes how each of the P-MT levels is represented in the present study.

Table 1. Representation in the present study of the three levels of pheno-methodological triangulation; 1st person, 2nd person, and 3rd person methods.

Level	1st person	2nd person	3rd person
Applications in study	Initial unsystematic intuitions and, later, more systematic intuitions about what linguistic creativity, emotional state, and their relation is Use of native speaker intuition for coding the data Corpus analyses	Empathetic interactions with participants during the study, including the debriefing part after the experiment Discussions with co-researchers Corpus analyses	Measures of MI Measures of EBR Analyses where I operationalised whether the grammatical constructions were more or less divergent Correlation analyses Corpus analyses

2.1.4 Transdisciplinarity

To be a proper transdisciplinary field the cross-disciplinary study should be integral to the researchers and not simply representatives of various disciplines coming together for a onetime collaboration, it should permeate their work, and influence the different represented disciplines as well as knowledge in general (Zlatev, 2015). This is the case for cognitive semiotics. The field does not simply work with *meaning* as a certain empirical area, rather, meaning as well as the insights used in research and reached through research is seen as permeating and influencing disciplines and knowledge in general.

> Cogsem can be seen as a true transdisciplinary field since meaning does not constitute a specific empirical domain but rather cuts "between and across" disciplines (Zlatev, 2015, p. 1062)

In the present study the transdisciplinarity is evident from the incorporation of linguistic theory and methods (e.g., construction grammar as well as the identification and analysis of grammatical constructions), neuroscientific theory and methods (e.g., regarding creativity and dopamine relations), psychological theory and methods (e.g., mood induction in an experiment, as well as definitions of creativity), philosophical theory (e.g., phenomenology and definitions of creativity), literary theory and insights (insights from the my bachelor's thesis), and evolution theory (Darwin being an early inspiration for the study). The study could not be without this transdisciplinarity, which is also not just seen as a passing occasion but a condition.

2.2 Construction grammar

Grammar is treated in this thesis from a construction grammar perspective (Croft, 2001; Fried, 2015; Goldberg, 1995, 2019; Herbst & Hoffmann, 2018). The present study takes its theoretical starting point in the construction grammar of Goldberg.

Construction grammar is a metalinguistic theory about linguistic structures and speakers' linguistic knowledge, it is a *functional* approach that is oriented toward the *cognitive* (Fried, 2015). The theory revolves around the following notion of constructions.

> [Constructions are] conventionalized clusters of features (syntactic, prosodic, pragmatic, semantic, textual, etc.) that recur as further indivisible associations between form and meaning (Fried, 2015, p. 974)

Importantly, the constructions are seen as *signs*, and the sign is the fundamental unit that is subject to analysis, since the sign is seen as a *symbolic unit*.

> [T]he idea of a sign as a symbolic unit that represents a conventional association between form and meaning/function (Fried, 2015, p. 975)

An inherent and important idea in construction grammar regarding *linguistic structure* is that form, meaning, and communicative function are interconnected.

Construction grammar has four main methods and research goals: 1) the theory does not distinguish lexicon from grammar. This does not mean that it rejects the notions of lexicon and grammar, but rather, that lexical items and grammatical patterns are seen as two points on a continuum; 2) general cognitive principles and regular communicative strategies are believed to be able to explain universals and language-specific properties; 3) the methodology is empirically grounded; and 4) constructions are, apart from units of analysis, "hypotheses about speakers' linguistic knowledge" (Fried, 2015, p. 978).

> A grammar [in the view of construction grammar] consists of a repertoire of constructions, which are organized in networks of overlapping and complementary patterns (Fried, 2015, p. 975).

In construction grammar, a grammar is, as signs are, complex, and encompassing a number of features. This should help construction grammarians deal with unusual grammatical patterns.

2.2.1 Grammatical constructions

What is a construction? Goldberg first defines constructions as the following.

> [P]airings of syntax and semantics that can impose particular interpretations on expressions containing verbs which do not themselves lexically entail the given interpretations (Goldberg, 1995, p. 220)

Later, Goldberg simplifies the definition to:

> [Any stored/learned] pairings of form and function (Goldberg & Jackendoff, 2004, p. 533; Goldberg, 2019, p. 2)

In construction grammar, we are dealing with a construction, when the meaning of the words, morphemes, or phrases, when these are only parts of a construction, cannot bear the complete meaning of that construction, that is, we cannot infer the meaning of the construction in its entirety from its individual components (Ramonda, 2014).

Verbs have played an important role in linguistic theory for many years when it comes to *sentence interpretation* and *argument structures* (Bencini & Goldberg, 2000), and this is one area where construction grammar stands out. In contrast to, e.g., a *generative approach* the verbs are not at the centre of attention in the *constructionist approach* (Ramonda, 2014), thus acknowledging the flexible nature of some verbs. The constructionists pay special attention to the link between argument structure and syntax, but what, then, is argument structure?

The argument structure, or, rather, *argument structure construction* (ASC) is the structure of semantic arguments such as Subject, Object, Verb, and Oblique – note that *word order* is not considered in ASCs, rather, the defining characteristics of an ASC are the arguments that it contains (Goldberg, 1995). ASCs are not the total of construction grammar, far from it, but they can be used as a tool in linguistic investigations.

> *[A]rgument structure constructions* are a special subclass of constructions that provides the basic means of clausal expression in a language" (Goldberg, 1995, p. 3, original italics)

Goldberg differentiates between, inter alia, the English argument structure constructions: the *resultative*, *caused motion*, *intransitive motion*, and *conative* constructions (Goldberg, 1995), and the *way construction* (Ramonda, 2014). To exemplify, the *caused motion* construction has the *form*: *Subject Verb Object Oblique*, and the meaning: *X causes Y to move Z* (Bencini & Goldberg, 2000; Goldberg, 1995), an example sentence being *the man dragged the meat out of the butcher shop*.

Goldberg has been criticised for providing too general an ASC, specifically the *reliance on construction* (Rostila, 2018). This specific ASC is not part of the present study; however, it is

important to note the criticism and be aware of this during the analysis of the spoken language data collected in the present study.

2.3 Backdrop of the investigation

In this section I zoom in on the following elements: *emotional states*, *linguistic creativity*, *the interrelationships between emotional states and creativity*, and the role of the neurotransmitter *dopamine*. These pillars make it possible to study the complex issue of the effects of emotional states on grammatical constructions. So, without further ado.

2.3.1 Emotional states (mood)

The emotional states relevant in the present study are *positive* and *negative mood*. Mood and emotional state are used interchangeably in the present study. These emotional states have been the conditioning effect and subject of discussion in several studies (e.g., Akbari Chermahini & Hommel, 2010; Akbari Chermahini & Hommel, 2012; Hill, Van Boxtel, Ponds, Houx & Jolles, 2005; Strack, Schwartz & Gschneidinger, 1985). The definition of positive and negative mood is subjective to each individual, and this could seem like quite a problem for studies intending to use these emotional states in empirical research. However, while it can make it difficult to streamline an experiment and the data it produces, the experimental design and elicitation can take into account the individualistic quality of the emotional states for a flexible and productive experiment. The present study considers this individualistic quality, exemplified by the use of dopamine (a neurotransmitter playing an important role in the human reward system) as a physiological indicator of mood in the experiment.

2.3.2 Linguistic creativity

The linguist Eugenio Coșeriu makes a distinction between language as *activity*, *knowledge*, and *product* (Coșeriu, 1985), where *activity* is especially notable in the context of the present study. In

language as activity, *creativity* is understood as language use surpassing the *norms* and *rules* of the *linguistic community*.

> [Language is] a creative activity, which makes use of […] an already acquired knowledge, in order, however, always to say something new, something in one way or another unique (Coșeriu, 1985, p. xxvii)

In this view creativity paves the way for language change.

The change or development of language is also seen in the view on creativity of the linguist Valentin Vološinov (Vološinov 1986/1929). For Vološinov it is in *creative activity* that *new forms arise from older segments* (Yengoyan, 1977). The present study takes a more individual perspective on creativity.

An alternative definition of linguistic creativity is provided by Plucker, Beghetto & Dow (2004):

> Creativity is the interaction among aptitude, process, and environment by which an individual or group produces a perceptible product that is both novel and useful as defined within a social context (Plucker et al., 2004, p. 90)

The above quote is an attested definition of creativity (Kaufman, Plucker & Baer, 2008). Even so, creativity is a difficult and complicated concept to explain, and it has been measured differently in various studies: creativity measured as *divergent and novel language use* (Goldberg, 2019; Herbst & Hoffmann, 2018); creativity measured as *greater association, and more cognitive flexibility* (Akbari Chermahini & Hommel, 2012; Isen, 1987); creativity measured in terms of *flexibility, originality, fluency, and elaboration* (Guilford, 1967); creativity measured as *processing of unconventional stimuli* (Kenett et al., 2015; Mirous & Beeman, 2012). In the present thesis, creativity is measured as *divergent language use*.

This, however, raises the question of what is *divergent*. David Schuldberg notes that it has something to do with producing *new*.

> *Divergent thinking,* [is] the generating of new and possibly useful ideas (Schuldberg, 2001, p. 7, original italics)

In the present study divergence is measured against frequency, more specifically, divergent language use is measured as the frequency of slot filling items in grammatical constructions where the less frequent something is in comparison to corpus data, the more creative it is deemed to be. The frequency of the slot fillers are determined through an analysis of the corpus of Danish language -KORPUS-DK in the tool CoREST. The present study defines and measures linguistic creativity in this way, because it is simple and convenient, and, although others might choose a different definition, the divergent language use definition leaves a very small margin for errors due to conceptual confusion. In addition, divergent thinking bears a great significance in the study of creativity.

> Divergent thinking is clearly the backbone of creativity assessment and has held this key position for many decades (Kaufman et al., 2008, p. 14)

Furthermore, other construction grammarians have worked with this definition, notably Goldberg:

> [F]amiliar formulations tend to be reused due to accessibility, and tend to be preferred over novel formulations because language is a shared cultural system. But when we wish to convey messages that are novel to varying degrees, we must generalize beyond the resources in memory: we need to use language creatively (Goldberg, 2019, p. 61)

The definition of divergent language use, where constructions or parts of constructions are used in a *less common* fashion, allows for the observation of subtle nuances in natural speech without the expectation or need for something to be completely unique.

2.3.3 Interrelations between emotional states and creativity

Several studies have shown that positive affect is linked to more flexible thinking, and more innovative and creative problem solving across a wide range of tasks and situations (cf. Isen, 2002). Alice M. Isen has studied the effects of positive affect extensively and has shown effects of positive mood on creativity (e.g., Isen et al., 1985; Isen et al., 1987a; Isen et al., 1987b) Akbari Chermahini & Hommel, 2012; Baas et al., 2008; Isen, 2002, finding that positive affect *enhances* creativity (Isen, 2002). Effects of negative mood on creativity have also been shown, such that lower creativity has been found to be associated with negative mood motivated in avoidance (Baas et al.,

2008). Baas et al. (2008) introduce the notion of activating moods, especially *promotion* and *prevention focus*. Promotion focus (joy, anger) lead to more creativity than neutral focus, and prevention focus (fear, anxiety) impede creativity. The present study makes use of happiness (related to *joy*) and *sadness*, respectively, in its experimental design, as *promotion focused* moods.

2.3.4 Experimenting with emotional states and creativity and the role of dopamine

Experimenting with emotional states and creativity is a complicated matter, and much has to be considered in the experimental design. Therefore, the experiment in the present study is based on an existing experimental design including both mood, creativity, and dopamine, namely that of Akbari Chermahini & Hommel (2012). Dopamine plays an important part in the experiment as a physiological marker of mood, both in the present study and in that of Akbari Chermahini & Hommel (2012). The findings in the study of Akbari Chermahini & Hommel (2012) suggest that *individual dopamine level* rose in connection with more *positive mood*. In measuring the dopamine level by way of *eye blink rates* (EBR) it is possible to measure participants' mood in an objective manner, without affecting their personal space and body with equipment such as electrodes.

In the following, the experiment in Akbari Chermahini & Hommel (2012) is briefly summarised. The first part of the experiment consisted of a *general mood assessment test* called *PANAS*, where the participants filled out a questionnaire, evaluating their general mood using 20 adjectives. The next step was the *mood inventory* (MI) questionnaire, where the participants evaluated their current mood filling out a questionnaire of three word pairs. This was followed by a *divergent-creativity task*, called *the alternate uses task* (AUT).

> [In the AUT] participants were asked to write down as many possible uses for a common household item as they could in 5 minutes (Akbari Chermahini & Hommel, 2012, p. 3)

Next, the *eye blink rate* was measured. Here, the participants had to look at a blank poster that had a cross in the middle. They were sitting circa 1 metre from the poster. The EBR was recorded using a *BioSemi ActiveTwo system*. After this, the *mood induction* part of the experiment was done, where participants had five minutes to write down a few sentences about an event in their life. This should be an event that had made the participant either happy or sad.

A second EBR was then recorded in the same way as the first one, but here the participants had to think about the event from the mood induction while looking at the poster with the cross. A second MI was performed, but with different words in the questionnaire from the one in the first MI. Finally, a second AUT was performed, where the participants wrote down the uses of a different household item than the one in the first AUT.

The current study draws on this design.

3 The present study

To answer the research question, a study was designed consisting of a suite of tasks intended to capture and then change mood through induction, as well as a speech elicitation task before and after the mood induction.

The experimental design builds on Akbari Chermahini & Hommel (2012) – although translated into Danish and with some small changes, which is explained below. An advantage of using a known design is that it has proven functional. However, the experimental design was not followed strictly in every sense, nor was it conducted in the same language or with the same number and type of participants. A disadvantage of using this design is that the objective of the investigation in Akbari Chermahini & Hommel (2012) was different from that of the present study: Akbari Chermahini & Hommel (2012) investigated the effect of mood on creativity, while the present study investigates the effect of mood on creativity in grammatical constructions.

4 Methods

4.1 Participants

A total of 16 participants were recruited using social media and recommendations between friends: eight female and eight male participants, all Danes with Danish as their first language (L1). Most participants lived in Denmark, while some lived in either Mexico or England. Some participants living in Mexico reported using Danish little or not at all in their daily lives, however, during the experiment I used P-MT first person methods (intuition and personal knowledge of the language) and assessed the participants' Danish skills as corresponding to native language use. The age range was from 20 to 67 years, with the majority being in their twenties. Some participants were my friends or acquaintances, this mostly in the male group. For more information on participants see Appendix A.

4.2 Materials

4.2.1 Experiment environment

The environment of the experiments was a mix of the virtual space of the video chat service Zoom and a PowerPoint presentation, and the physical space of the participant (in their house or apartment, often a living room or bedroom) and my physical space (in my apartment, combined bed- and living room, though filmed as a neutral space with the placement of the webcam).

Materials used by participants include: a computer (or tablet for one participant), a webcam, a microphone, headphones (for some participants), pen and paper.

4.2.2 Assessment of general mood (PANAS)

The Positive and Negative Affect Schedule (PANAS) is a tool for assessing participants' general mood (Akbari Chermahini & Hommel, 2012; Díaz-García, González-Robles, Mor, Mira, Quero, García-Palacios, Baños & Botella, 2020; Hill et al., 2005; Watson, Clark & Tellegen, 1988). The PANAS is made up of 20 words (adjectives), 10 negative and 10 positive valence words, with the charge (negative or positive) changing for every other word. For each word participants are asked to assess the extent to which it applies to their state of mind on a Likert scale of 1-5 (1 = the participant relates little to the word, 5 = they relate very much to the word). For an example see Figure 1.

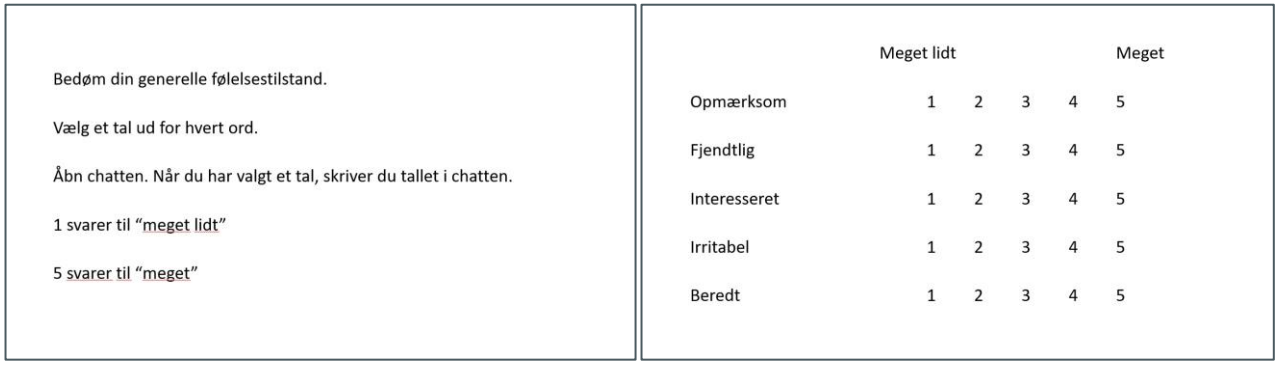

Figure 1. Two slides from PowerPoint used in experiments, 1) PANAS elicitation, and 2) five valence words in Likert scale.

The PANAS in the present study was translated into Danish using the original English version as reference, while cross-referencing with the Dutch and Flemish versions presented in Engelen, De Peuter, Victoir, Van Diest & Van den Bergh (2006). The PANAS was presented with PowerPoint, and the Zoom chat function was used for the participants to answer the PANAS. For the English, Flemish, Dutch, and Danish versions of the PANAS see Appendix B.

4.2.3 Mood induction task

The mood induction task in the experiment consisted of the *common mental-imagination procedure* (Akbari Chermahini & Hommel, 2012) where participants had five minutes to write on a piece of paper about an experience that had made them either happy or sad.

4.2.4 Assessment of current mood, mood inventories (MI)

Two mood inventories (MI) were used to assess the current mood of the participants (Akbari Chermahini & Hommel, 2012) before and after the mood induction part. The MIs consist of three pairs of words (adjectives) divided by a Likert scale consisting of nine points, with each pair of words consisting of a positive and a negative charged word, respectively. See Figure 2 as example.

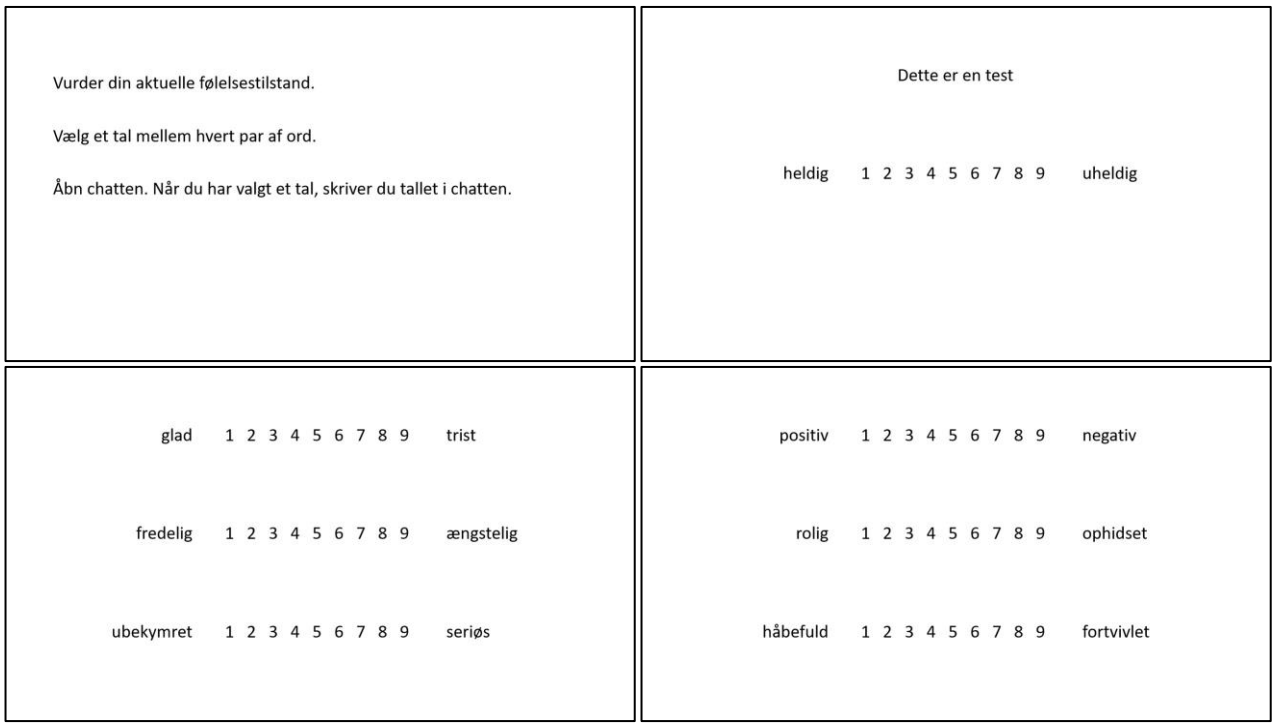

Figure 2. Four slides from PowerPoint used in experiments, 1) MI elicitation, 2) initial test sequence before actual MI1, 3) three words from MI1 divided by Likert scale, and 4) three words from MI2.

The MIs in the present study were translated into Danish from the English and Dutch words presented in Akbari Chermahini & Hommel (2012), for Danish version see Appendix C.

4.2.5 Language production task (LPT)

This part of the experiment differs from the Akbari Chermahini & Hommel (2012) experiment, where their experiment has an *alternate uses task.* The present study used a *language production task* (LPT), where the participants were asked to describe one image before and another but similar image after the mood induction part. I drew the images myself. The images showed a person with a ball at the top of some stairs and two persons in commotion in front of a house, respectively, hence, two images that were quite similar (see Figure 3).

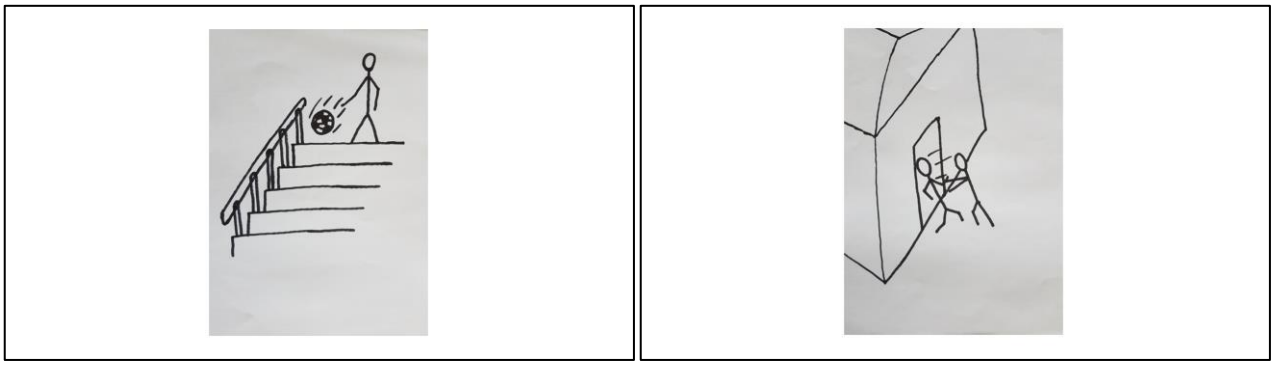

Figure 3. The two images as shown in the PowerPoint used in the experiments.

The images were intended to elicit the use of the *caused motion construction* (see 2.2.1). This was to try to get as homogenous a sample from the participants as possible. The caused motion construction looks like this: *Subject Verb Object Oblique*, and bears the meaning *X causes Y to move Z* (Bencini & Goldberg, 2000; Goldberg, 1995). Two examples from the data, both from participant 7:

(1) *en person smider en fodbold ned ad en trappe*

‘a person throws a football down a stair’

(2) *en person angriber en anden person*

‘a person attacks another person’

4.2.6 Eye blink rate (EBR) tracking

The impact of mood on creativity has been argued to depend on individual tonic dopamine level (Akbari Chermahini & Hommel, 2010). Dopamine is more concrete than emotions, but it is still important to recognise each individual’s level of dopamine (Akbari Chermahini & Hommel, 2012). The literature links higher dopaminergic activity to positive mood as well as to higher eye blink rates (EBR) (Akbari Chermahini & Hommel, 2012; Barkley-Levenson & Galván, 2016; Colzato, van den Wildenberg, van Wouwe, Pannebakker & Hommel, 2009; Jongkees & Colzato, 2016; Karson, 1983; Van Slooten, Jahfari & Theeuwes, 2019).

Given the suggested link between EBR and dopamine, participants’ EBR were tracked before and after the mood induction. Here, the Zoom video recording enabled me to count each blink within a timeframe of three minutes (beginning from when I had left the room and the participant was in an uninterrupted setting). To count the blinks a website was used that counts each click of a mouse (Scorecounter.com, 2021), which allowed me to observe the recording of the participant constantly while clicking the mouse for each observed eye blink.

4.3 Procedure

4.3.1 Ethical aspects

A consent form was sent via email to the participants (Appendix D) in which participants give their consent for the audio and video recordings to be used for analyses for scientific purposes, and as written examples illustrating the scientific study in, inter alia, scientific publications. They were asked to consent to this, since the audio and video recordings are imperative to the analytical work in this study. They were asked to consent to the use of the data as written examples, because the

examples are important for successfully communicating the research to peers and the general public.

Participants were further assured that all data would be anonymised in the published study. The supervisor for the present study had access to the data so as to be able to support the process of analysis and writing of the study. Further, participants were informed that all data would be kept safe on my computer until the study had been graded. After this, the video and audio data would be destroyed, while the transcripts would be kept in case there is ever a need for the study to be scrutinised in relation to the data and the analyses of these.

It is important to emphasise that the participants of the present study are not simply numbers on a paper, and we must treat them and their data accordingly. Much effort has been made to make the participants feel comfortable and safe. After the experiments each participant was debriefed in detail about the study and the experiment, and the reasoning behind them. The participants were also asked about both their experience as it had been during the experiment, and their retrospective thoughts on the experiment. I was very pleased to learn that many of the participants found the eye blink rate parts of the experiment meditative and pleasant. This was an unexpected thing that made the experience for some of the participants even better.

4.3.2 Experimental set-up

The experiments were conducted over the video chat service Zoom, and the participants were thus asked to use a computer with webcam and microphone – one participant did not have this and used a tablet instead. The participants were asked to position themselves so the main light source would not be behind them (i.e., to not sit in front of a window) – this was important, since I needed to be able to count the eye blinks for the EBR (this purpose was not disclosed until after the experiment was done). Some participants used headphones. Furthermore, the participants were asked to use a pen and paper for the mood induction part of the experiment.

In the suite each participant was first asked to evaluate their general mood in a questionnaire of 20 adjectives (general mood assessment, PANAS) whose significance changed for every second adjective between positive and negative connotations. Then, the participant

should evaluate their current mood by another questionnaire of three word pairs (mood inventory, MI), where they had to choose a number on a scale between the pairs. After this, the participant was asked to describe the action in an image (language production task, LPT) using sentences. The participant was then asked to look at a dot on the screen (eye blink rate, EBR) for three minutes. Next, the participant had five minutes to write about an experience (mood induction) that has made them happy or sad – depending on what group they were randomly assigned to – this with a pen and paper. The next steps in the suite were the second MI, the second LPT, and the second EBR, respectively – in the latter one the difference between this and the first EBR was that the participant was asked to think about the experience (from the mood induction part) while looking at the dot. A debriefing followed the suite.

4.3.3 Mood induction

During the mood induction task, the PowerPoint slide explaining the exercise stayed on the screen while the participants were writing about an experience that had made them either happy or sad. In Akbari Chermahini & Hommel (2012) the participants had to write about a life event with a few sentences, while in the present study they were asked to utilise the full five minutes and told that if they felt they were done writing after 30 seconds, then they should reflect upon the experience and what they had written for the remaining time. Note also that there is a difference between *experience* (Danish *oplevelse*) and *event* (Danish *begivenhed*). Akbari Chermahini & Hommel (2012) focused on calmness during the mood induction part of their experiment.

> Calmness was emphasized to keep the two emotional states comparable regarding activation and arousal (Akbari Chermahini & Hommel, 2012, p. 3)

In the present study the participants were simply asked to write about the experience, but not in any specific way, and not several experiences as in Strack et al. (1985).

4.3.4 LPT

The participants were shown images on screen and were asked to describe the action in the images and speak their descriptions out loud. Participants were asked to state when they were done describing the action, so I did not interrupt them. Then, I asked the participants what they thought would happen next in the image, that is, what would happen after the action they had just described. The two images in the experiment were different but similar, and the order of the images was counter balanced, so some participants described one image before the mood induction, while others described the other image before the mood induction.

The LPT task was recorded through Zoom, so the image descriptions could be transcribed accurately and then analysed.

4.3.5 EBR

The EBRs were collected following the methods of Akbari Chermahini & Hommel (2012), but with certain differences. Since the experiments were conducted over Zoom and run through a PowerPoint presentation and shared screen with me, participants were asked to look at a black dot on the white screen in a relaxed manner for three minutes, instead of looking at a poster from one metre's distance. For EBR2 (after mood induction) the participants were asked to think about the experience they had described earlier (mood induction) while looking at the dot. During the EBR's I left the room, so the participant was alone.

Since smoking and time of day have an effect on EBR (Akbari Chermahini & Hommel, 2012), participants were asked not to smoke before the experiment, and all but one session were conducted before 5 pm – this being Copenhagen time for the participants in Denmark and England, and Mexico City time for the participants in Mexico.

4.3.6 Summary of the experimental procedure

Table 2 summarises the entire experimental procedure.

Table 2. Summary of experimental procedure.

Stage	Description
PANAS	In the *general mood assessment*, the participant filled out a questionnaire, evaluating their general mood using 20 adjectives.
MI1	With the *mood inventory*, the participant evaluated their current mood filling out a questionnaire of three word pairs.
LPT1	In the *language production task*, the participant described the action in an image.
EBR1	The *eye blink rate* was recorded by video, while the participant was looking at a black dot.
Mood induction	The participant was asked to write about an experience.
MI2	The same questionnaire, but with different words from the one in MI1 was used.
LPT2	The participant described the action of a different image than the one in LPT1.
EBR2	Same as in EBR1, but this time the participant was asked to think about the experience they had described in the mood induction stage.
Wrap-up	Wrapping up the experiment session by a casual conversation. Here, the experiment and the thesis were explained, and the participant could tell about their experience of participating in the experiment.

4.4 Data treatment and coding

4.4.1 Mood assessment data

The PANAS for each participant was calculated by adding together the positive and negative scores, respectively. Then, a mean and standard deviation was calculated for the groups of positive and negative mood induced participants, respectively.

The MI score for each participant was calculated following Akbari Chermahini & Hommel (2012), reversing the scores and then adding them together, so a lower total indicates a negative or less positive mood. A mean and standard deviation was then calculated for the groups of participants that had been induced with a positive and negative mood, respectively. A percentage difference was then calculated for the MIs to compute any positive or negative development.

4.4.2 Transcription and coding of spoken LPT data

The spoken LPT data were carefully transcribed from the recordings and then analysed. The analysis consisted of several steps. The first step was to select the part of the spoken data that was appropriate for the later analysis – this was done using the P-MT second person methods by discussing it between me and my supervisor. The selection was made by identifying spoken data parts in LPT1 and LPT2 for each participant containing constructions that could then be compared within each participant's data. Then, the grammatical properties of each word were identified and labelled by word class (N for nouns, Pro for pronouns, V for verbs, Adv for adverbs and so on), manifesting the syntactic constructions, which have been called *the phrasal constructions*. After this, the predicate of each phrasal construction was identified, these predicates have been called *the word constructions*. Finally, the suffixes of the predicates were identified, and these has been called *the morpheme constructions*. The analysed and coded LPT data were used as a basis for the corpus investigation. Here, the identified constructions made it possible to check for their frequency in the Danish language corpus (-KORPUS-DK in CoREST), which would later be used to establish the level of creativity.

This was labelled syntactically with grammatical values. These labels were then translated into CoREST terms (for a list of the original labels and their meanings, and the labels in the language of CoREST see Appendix E). In the LPT2 (after induction) participant 15 describes the picture:

(3) *en person, der skubber en anden ind ad en dør*

'a person who shoves another in through a door'

The phrase was labelled syntactically:

[Indef Art] [N] [Pro] [V] [Indef Art] [Pro] [Adv] [PP] [Indef Art] [N]

In CoREST terms:

[pos="P"] [pos="N"] [pos="U"] [pos="V"] [pos="P"] [pos="P"] [pos="D"] [pos="T"] [pos="P"] [pos="N"] within s.

4.4.3 Computing EBR data

In the present study the EBR was counted by me looking at the recorded footage and clicking the mouse every time he saw a blink (half blinks were counted as well) using a click-counter website (Scorecounter.com, 2021). Then, the number of blinks in EBR1 and EBR2, respectively, for each participant was divided by three (the number of minutes where blinks were counted). Thereupon, a mean and standard deviation was calculated for each of the two groups of participants being induced with a positive and a negative mood, respectively. Finally, a percentage difference was calculated for the EBRs to see any positive or negative development.

4.4.4 Three construction levels and grammatical divergence

Three different levels of constructions were employed to investigate a possible relationship between the emotional states of the participants and the grammatical creativity (divergence) in their produced language in the experiments: phrasal constructions, word constructions, and

morpheme constructions. The divergence in each level of construction was computed by looking at the frequency of the specific constructions in -KORPUS-DK in CoREST (Asmussen, 2021a).

Phrasal constructions are strings of grammatical properties in a clause. In the present study these grammatical properties were given labels such as V (verb) and Adv (adverb), and this uniformity enabled the phrasal constructions to be compared. *Word constructions* are the predicates (main verb) of the clauses. *Morpheme constructions* are the morphological transformations of the lemmas, the conjugations of the main verbs.

I wanted to analyse the data for each construction type (phrasal, morpheme, word), but I also wanted to look at a *general grammatical construction (GGC)* as part of my construction grammar perspective. When looking at the LPT data the frequencies are often quite far from each other, and there are big differences within some of the categories. This might be differences such as seen in the word constructions, where in one case 128 matches are found for the lemma *slås* 'fight' used before the mood induction, and 38,825 matches for the lemma *sende* 'send' used after the mood induction. At the same time, the differences in the morpheme constructions data are much smaller. This makes it difficult to compile the data of the three categories of constructions into one general grammatical construction.

I have compiled this GGC in two ways. In the first compilation I used the P-MT third person method to evaluate for each participant whether the development in a construction type was more or less divergent, or if the development was very small or showing no development at all leaving the construction equally divergent or equally non-divergent (see Table 3). The development refers to the difference from LPT1 to LPT2 for each of the three different construction types. A less divergent development would be given the value of 1, a more divergent development would be given the value of -1, and a small development or no development would be given a 0. Then, the values of the three construction types would be added together for each participant leaving us with an *Evaluated Grammatical Divergence (EGD)* score representing a general grammatical construction.

Table 3. Phrasal constructions, word constructions, and morpheme constructions from the language production task (LPT) data found as either more divergent (MD), less divergent (LD), equally divergent (ED), or equally non-divergent (END). Also, the grammatical divergency evaluated on the basis of the three levels of constructions, marked as either divergent (Yes) or not divergent (No).

LPT1 Phrasal construction	LPT2 Phrasal construction	Divergency of LPT2	LPT1 Morpheme construction - verb	LPT2 Morpheme construction - verb	Divergency of LPT2	LPT1 Verb frequency/ word constructions	LPT2 Verb frequency/ word constructions	Divergency of LPT2	Grammatical divergency
14	878	LD	Lemma: 14,785 **"taber": 16.35%**	Lemma: 1,535 **"overfalder": 8.17%**	MD	**Lemma: 14,785** "taber"	**Lemma: 1,535** "overfalder"	MD	Yes
10	Fejl	MD	Lemma: 128 **"slås": 0%**	Lemma: 38,825 **"sender": 18.6%**	LD	**Lemma: 128** "slås"	**Lemma: 38,825** "sender"	LD	No
150	Fejl	MD	Lemma: 1,535 **"overfalder": 8.17%**	Lemma: 14,785 **"taber": 16.35%**	LD	**Lemma: 1,535** "overfalder"	**Lemma: 14,785** "taber"	LD	No
2,602	200	MD	Lemma: 5,607 **"leger": 25.6%**	Lemma: 4,205 **"skubber": 17.3%**	MD	**Lemma: 5,607** "leger"	**Lemma: 4,205** "skubber"	MD	Yes
1	11,737	LD	Lemma: 14,785 **"taber": 16.35%**	Lemma: 27,984 **"hjælpe": 50.75%**	LD	**Lemma: 14,785** "taber"	**Lemma: 27,984** "hjælpe"	LD	No
1	3	ED	Lemma: 4,205 **"skubbet": 17.18%**	Lemma: 211 **"dribler": 11.25%**	MD	**Lemma: 4,205** "skubbet"	**Lemma: 211** "dribler"	MD	Yes
2,617	63	MD	Lemma: 6,197 **"angriber": 14.6%**	Lemma: 8,863 **"smider": 15.35%**	END	**Lemma: 6,197** "angriber"	**Lemma: 8,863** "smider"	LD	Yes
22	1	MD	Lemma: 2,597 **"sparket": 17.59%**	Lemma: 6,197 **"angriber": 14.6%**	MD	**Lemma: 2,597** "sparket"	**Lemma: 6,197** "angriber"	LD	No
14	115	LD	Lemma: 12,919 **"kaster": 21.35%**	Lemma: 4,205 **"skubber": 17.3%**	MD	**Lemma: 12,919** "kaster"	**Lemma: 4,205** "skubber"	MD	Yes
1,306	2,602	LD	Lemma: 1,535 **"overfalder": 8.17%**	Lemma: 5,607 **"leger": 25.6%**	LD	**Lemma: 1,535** "overfalder"	**Lemma: 5,607** "leger"	LD	No
34	25,192	LD	Lemma: 6,197 **"angrebet": 27.15%**	Lemma: 14,785 **"taber": 16.35%**	MD	**Lemma: 6,197** "angrebet"	**Lemma: 14,785** "taber"	LD	No
14	47	LD	Lemma: 5,221 **"skyder": 34.45%**	Lemma: 4,205 **"skubber": 17.3%**	MD	**Lemma: 5,221** "skyder"	**Lemma: 4,205** "skubber"	MD	Yes
14	3	MD	Lemma: 12,919 **"kaster": 21.35%**	Lemma: 4,205 **"skubber": 17.3%**	MD	**Lemma: 12,919** "kaster"	**Lemma: 4,205** "skubber"	MD	Yes
287	1,639	LD	Lemma: 4,205 **"skubber": 17.3%**	Lemma: 50,104 **"spiller": 29.25%**	LD	**Lemma: 4,205** "skubber"	**Lemma: 50,104** "spiller"	LD	No
Fejl	Fejl	ED	Lemma: 4,205 **"skubbe": 19.05%**	Lemma: 211 **"driblet": 10%**	MD	**Lemma: 4,205** "skubbe"	**Lemma: 211** "driblet"	MD	Yes
14	1	MD	Lemma: 12,919 **"kaster": 21.35%**	Lemma: 4,205 **"skubbet": 17.18%**	MD	**Lemma: 12,919** "kaster"	**Lemma: 4,205** "skubbet"	MD	Yes

The second compilation was done a little differently. Again, I used the P-MT third person method, but here the frequencies for each construction type were placed within a table of exponentially progressing ranges (0-50, 51-100, 101-200, 201-400 etc.) and given a value (1, 2, 3, 4 etc.) depending on the range they belonged to. These values were then used to find the development by

subtracting x from y (x = LPT1 data, and y = LPT2 data). The values of the calculated developments of the three construction types were then added together for each participant giving us different EGD scores.

4.4.5 Corpus investigation and analysis

The corpus investigation with CoREST was done to help identify the divergence in the LPT data by comparing the frequency of the constructions used by the participants in their produced language to the frequencies of those same constructions in -KORPUS-DK. When frequencies were lower than those of other constructions, when checking the participants' LPT data against the corpus, divergence would be identified. Then, this information could be used to see if there was a correlation between the emotional state of the participants and their creative use of grammatical constructions by running correlation analyses.

4.4.5.1 CoREST and -KORPUS-DK

Corpus Retrieval System & Tools (CoREST) (Asmussen, 2021a) is a tool that can be downloaded on the computer, and that is linked to several corpora. This tool allows the user to find words, phrases, word classes, conjugations, concordances, etc., in corpora. In the present study CoREST was used to investigate phrasal constructions, word constructions, and morpheme constructions taking advantage of several of the different functions in the tool such as the function to find conjugations in the investigation of the morpheme constructions. CoREST has some limitations which have required some workarounds, e.g., when some words in CoREST were not labelled according to the full spectrum of word classes they can actually possibly belong to, or they were simply labelled with a seemingly random label (examples below). These limitations might have something to do with the fact that the CoREST used in this investigation was the standard edition, and not the more complex edition used by Den Danske Ordbog (Asmussen, 2021a).

The corpus used for the investigation was the Danish -KORPUS-DK found in CoREST. This corpus of the Danish language contains around 110 million words from different sources of

actual language use (literature, newspapers, diaries, blogs, magazines, and more) between the years 1985-2010 (Asmussen, 2021b).

4.4.5.2 Searching for constructions

First, the grammatical property labels were translated into the language of the search tool CoREST (see Appendix E for the original labels and those in the language of CoREST). Then, the phrasal constructions translated to CoREST terms were run through the CoREST search tool looking for matches in -KORPUS-DK. After this, the word constructions were run through CoREST, that is, the predicates of the constructions, the main verb of each construction – to do this the lemma was identified using the P-MT first person method (native speaker knowledge). The focus here was on identifying the frequency or total number of matches of each lemma as it appeared in the corpus. During the search process for each lemma CoREST showed the matches for a single word form and also for all the possible conjugations including the lemma itself. Thus, it was possible to investigate the morpheme constructions at the same time as the word constructions – investigating the morphological transformations of the lemmas. Again, for the morpheme constructions the focus was on the frequency: while searching for the lemmas the relevant conjugations for the verbs, that is, the conjugations used in the constructions were revised and the percentages of each conjugation in relation to the total number of matches of the lemmas were noted.

In searching for the phrasal constructions, it was necessary to make some changes to the constructions, since *der*, *som*, and *at* are all labelled "U" in CoREST, while *der* and *som* (both 'who') are pronouns and labelled as such in the original coding, even though there is a label for pronouns in CoREST, and *at* 'that' is a conjunction and labelled as such in the original coding. Besides this there were some fixed expressions in the data as part of the constructions, labelled "FE" in the original coding, while this was not possible according to the CoREST coding, therefore other solutions had to be found. One solution used in these cases was identifying (using the P-MT first person method of native speaker knowledge) equivalents to the fixed expressions that were presented by a single word, e.g., reading the fixed expression *i gang med* as the preposition *ved* (both the '-ing' in English as in 'I'm learning Danish'), since they are at least near synonyms

considered possible and appropriate to use interchangeably. While searching for the phrasal constructions, other issues came up, e.g., when one participant said *sparket eller kastet* 'kicked or thrown', that is, using two main verbs. Here, the issue was resolved (using the P-MT second person method of conferring between me and my supervisor) by following the principle of considering the first uttered formulation as the first idea in the mind of the participant, and that is what I am looking for in this case, thus, the first formulation was chosen.

4.4.5.3 Statistical analysis

The data is presented using descriptive statistics (means and standard deviation, SD), and, where applicable, percentages.

The data were analysed statistically using the Pearson correlation analysis option in the computer software jamovi (Jamovi, 2021). The differences between the first measurement and the second measurement were analysed, i.e. the development from before the mood induction to after the mood induction. This development was found by subtracting the first measurement from the second measurement. When there was a negative development, that is, a smaller number after the mood induction, the development was represented by negative numbers. Each of the three different construction types (phrasal, morpheme, word) as well as the EGDs were analysed with the Pearson correlation analysis. These data were analysed together with the MIs and EBR, respectively.

5 Results

In this chapter the results of the analyses of the experimental data and corpus analysis are presented. First, I present the results of the measured mood (questionnaires and EBR) and the mood induction. Second, I present the results of the analyses of the grammatical constructions. Lastly, I present the results of the analyses of a possible relationship between emotional state and grammatical divergence.

Recall that *mood induction* is the part in the experiment that is supposed to stimulate a change in mood either to a positive or negative mood. That is, the participant should theoretically feel more positive or more negative than before the induction part. *Grammatical divergence* is defined as a low frequency of grammatical constructions with the term construction being defined by construction grammar, and more grammatical divergence is understood in the present study as more creative use of grammatical constructions. The positive *mood induction group* is the group of participants receiving a positive mood induction, while the negative mood induction group is the group of participants receiving a negative mood induction.

Analysis of the data has been done in two ways. First, by me personally evaluating and comparing the data. Then, by plotting the data into the computer software jamovi (Jamovi, 2021) and running correlation analyses (Pearson correlations).

5.1 Mood, EBR, and changed emotional states

5.1.1 The Positive and Negative Affect Schedule (PANAS)

Looking at the general mood assessment, PANAS, all participants but one reported that they feel positive in general, that is, they gave more points to the positive adjectives than the negative adjectives in the questionnaire. For the positive mood induction group the mean was 57.5 (*SD* 5.01). For the negative mood induction group the mean was 59.88 (*SD* 9.61).

5.1.2 Mood inventories (MI)

According to the MIs 10 participants felt more positive after the mood induction, while four felt more negative, and two felt the same (see Table 4 and 6). For the positive mood induction group the before-induction mean was 20.63 (*SD* 4.34), and the after-induction mean was 23.38 (*SD* 3.54). For the negative mood induction group the before-induction mean was 20 (*SD* 3.7), and the after-induction mean was 20 (*SD* 5.26). Both groups were similar before the mood induction, but only the positive mood induction group showed any effect before and after induction.

Table 4. Mood inventory (MI) results for each participant from MI1 and MI2.

Participant	1	2	3	4	5	6	7	8	11	12	13	14	15	16	17	18
MI1	24	22	24	13	15	21	24	24	14	23	25	21	20	16	19	20
MI2	26	22	27	24	18	20	26	17	21	27	26	14	24	12	19	24

5.1.3 Eye blink rates (EBR)

Eleven participants had an increased EBR after the mood induction (see Table 5 and 6), something that has been found to correlate with an increase in positive mood (Akbari Chermahini & Hommel, 2012), while four participants had a decreased EBR, which has not been directly associated with more negative mood (Akbari Chermahini & Hommel, 2012). One participant had an increase of just 0.67 or 7.18% blinks per minute, which is thus categorised as *not changed*. For the positive mood induction group the before-induction mean was 12.92 (*SD* 8.7), and the after-induction mean was 17.13 (*SD* 14.86). For the negative mood induction group the before-induction mean was 12.71 (*SD* 5.95), and the after-induction mean was 22.25 (*SD* 10.88). Again, the groups were similar before the mood induction, but the before and after means suggest a substantial shift in EBR following mood induction in both groups.

Table 5. Eye blink rate (EBR) results for each participant from EBR1 and EBR2.

Participant	1	2	3	4	5	6	7	8
EBR1	21.33	20.67	12.67	17.33	4	20.33	6.33	6.33
EBR2	14	41	39	14	1	28	3.67	15.67
Participant	11	12	13	14	15	16	17	18
EBR1	29.33	10.33	7.33	11.33	7.33	6	15	9.33
EBR2	39.33	16.67	9.33	18.67	10	34	20.67	10

5.1.4 Evaluated emotional states (EES)

The percentage difference was calculated for the MIs and EBRs in order to investigate whether a participant felt more positive or more negative after the mood induction (see Table 6). If the MI data and EBR data for a participant showed different results in relation to how the participant was affected by the mood induction, then the data with the highest value was seen as the most powerful evidence. An example is participant 4, where the MI data showed that the participant had changed their emotional state to a positive mood after the mood induction, while the EBR data showed a change to a negative mood. Since the percentage difference in the MI data was much higher than the percentage difference in the EBR data the MI data was judged to be the most powerful evidence of a changed emotional state.

Another example is participant 5 who also showed a more positive mood after the mood induction according to the MI data and a more negative mood according to the EBR data, however, here the data with highest percentage difference was the EBR data, and so the participant's mood was understood to have changed for a more negative mood after the mood induction. Thirteen participants were found to feel more positive after the mood induction, while three were found to feel more negative.

In 11 participants the mood induction was found to be unsuccessful or ineffective, while in five it was found to be successful or effective. This was measured by comparing the emotional state of the participants after the mood induction with the type of mood induction, either positive or negative, respectively.

Table 6. Changed emotional state (evaluated emotional state) judged from the percentage differences in the Mood Inventory (MI) data and Eye Blink Rate (EBR) data.

Participant	MI1	MI2	Percentage difference Formula: ((y-x)/x)*100 x = original number	Change in MI scores	EBR1	EBR2	Percentage difference Formula: ((y-x)/x)*100 x = original number	Change in EBR	Changed emotional state
1	24	26	8.33%	More positive	21.33	14	34.36%	Decreased	Negative
2	22	22	0%	Not changed	20.67	41	98.36%	Increased	Positive
3	24	27	12.5%	More positive	12.67	39	207.81%	Increased	Positive
4	13	24	84.62%	More positive	17.33	14	19.22%	Decreased	Positive
5	15	18	20%	More positive	4	1	75%	Decreased	Negative
6	21	20	4.76%	More negative	20.33	28	37.73%	Increased	Positive
7	24	26	8.33%	More positive	6.33	3.67	42.02%	Decreased	Negative
8	24	17	29.17%	More negative	6.33	15.67	147.55%	Increased	Positive
11	14	21	50%	More positive	29.33	39.33	34.09%	Increased	Positive
12	23	27	17.39%	More positive	10.33	16.67	61.37%	Increased	Positive
13	25	26	4%	More positive	7.33	9.33	27.29%	Increased	Positive
14	21	14	33.33%	More negative	11.33	18.67	64.78%	Increased	Positive
15	20	24	20%	More positive	7.33	10	36.43%	Increased	Positive
16	16	12	25%	More negative	6	34	466.67%	Increased	Positive
17	19	19	0%	Not changed	15	20.67	37.8%	Increased	Positive
18	20	24	20%	More positive	9.33	10	7.18%	Not changed	Positive

5.2 Grammatical constructions and grammatical divergence

5.2.1 Phrasal constructions

Seven participants were found to use more divergent (MD) phrasal constructions after the mood induction, and seven were found to use less divergent (LD) phrasal constructions, while two were found to use equally divergent (ED) phrasal constructions before and after the mood induction.

An example is participant 15. This participant showed a more positive mood after the mood induction and, as expected, a more divergent use of grammatical constructions (see Table 7). In the LPT1 (before induction) participant 15 describes the picture:

(4) *en mand, der kaster en bold ned ad en trappe*

'a man who throws a ball down a stair'

The difference between the two utterances in terms of the syntactic labels is an N (noun) in one utterance and a Pro (pronoun) in the other. The first phrasal construction (with the noun) was found 14 times in -KORPUS-DK in CoREST, while the second phrasal construction (with the pronoun) was found three times, thus, the second construction was considered more divergent.

Table 7. Participant 15, mood inventories (MI), eye blink rates (EBR), language production task (LPT), phrasal constructions, morpheme constructions, word constructions, more divergence (MD).

Participant	MI1	MI2	Percentage difference Formula: ((y-x)/x)*100 x = original number	Change in MI scores	EBR1	EBR2	Percentage difference Formula: ((y-x)/x)*100 x = original number	Change in EBR	LPT1 Phrasal construction	LPT2 Phrasal construction	Divergency of LPT2	LPT1 Morpheme construction - verb	LPT2 Morpheme construction - verb	Divergency of LPT2	LPT1 Verb frequency/ word constructions	LPT2 Verb frequency/ word constructions	Divergency of LPT2
15	20	24	20%	More positive	7.33	10	36.43%	Increased	14	3	MD	Lemma: 12,919 **"kaster": 21.35%**	Lemma: 4,205 **"skubber": 17.3%**	MD	**Lemma: 12,919** "kaster"	**Lemma: 4,205** "skubber"	MD

Three other examples (see Table 8) are participant 1 with a less divergent use of phrasal construction after the mood induction, participant 6 with an equally divergent use, and participant 7 with a more divergent use.

Table 8. Phrasal constructions shown with syntactic labels for participants 1, 6, and 7, and the frequency and type of argument structure construction.

Participant	Phrasal construction	Frequency, -KORPUS-DK	Argument structure construction
1 LPT1	[DET] [N] [Pro] [V] [DET] [N] [Adv] [Adv] [PP] [DET] [N]	14	Caused Motion Construction
LPT2	[DET] [Pro] [V] [DET] [Pro]	878	Transitive Construction
6 LPT1	[DET] [N] [AUX] [V] [Adv] [PP] [DET] [N] [PP] [DET] [Pro] [N]	1	Caused Motion Construction
LPT2	[DET] [Interj] [N] [Pro] [V] [PP] [DET] [N] [Adv] [PP] [DET] [N]	3	Caused Motion Construction
7 LPT1	[DET] [N] [V] [DET] [Pro] [N]	2,617	Transitive Construction
LPT2	[DET] [N] [V] [DET] [N] [Adv] [PP] [DET] [N]	63	Caused Motion Construction

In one ED phrasal construction, the difference between how many times the constructions used before and after the mood induction were found in the corpus -KORPUS-DK was a difference of just two. That is, the construction before the mood induction was found once in the corpus, and the construction after the induction was found thrice – it was found eight times, but five of these were from the same passage in the bible, and the construction was found as part of another construction in a way that it seemed difficult to justify including it. In the other example of an ED both constructions that were searched for did not yield any matches in the corpus, therefore, they have been marked with the Danish *fejl* ‘error’.

It should be mentioned that several constructions in the corpus that match the constructions searched for are possibly part of one or several other constructions. However, since some of these count several hundreds or thousands of matches in the corpus, the constructions that might be disqualified have not been identified for practical reasons.

5.2.2 Word constructions

Eight participants were found to use more divergent word constructions after the mood induction, and eight were found to use less divergent word constructions after the induction. To exemplify data on the word constructions let us again look at participant 15. Here, we look at the predicate in each of the two utterances:

(5) *en mand, der kaster en bold ned ad en trappe*

'a man who throws a ball down a stair'

(6) *en person, der skubber en anden ind ad en dør*

'a person who shoves another in through a door'

The predicates are *kaster* 'throws' and *skubber* 'pushes', respectively. As can be seen in Table 7, the lemma for *kaste* 'throw' was much more frequent than the lemma for *skubbe* 'push', thus, I considered the latter to be more divergent.

5.2.3 Morpheme constructions

Ten participants were found to use more divergent morpheme constructions in the main verb after the mood induction, while five were found to use less divergent morpheme constructions, and one was found to use equally non-divergent (END) morpheme constructions with a difference of just 0.75 or 5.14% before and after the mood induction – it was judged to be "non" divergent, since both conjugations each made up around 15% of the total matches of the lemma *angribe* 'attack'. The lemma *angribe* had nine conjugations with the most divergent being *angrebes* making up just 0.05% of the total, then *angrib*, *angribende*, *angrebne*, and *angribes*, respectivley, came before

angriber, and *angribes* made up 4.5% of the total. The lemma *smide* ‘throw’ had six conjugations, where *smid* made up 3.15% and *smides* made up 3.45% of the total.

Again, the data is exemplified with participant 15. Let us look at the morpheme constructions for *kaster* ‘throws’ and *skubber* ‘pushes’, respectively. The verb *kaster* is conjugated using the suffix r in relation to the lemma *kaste*. This morpheme construction made up 21.35% of the total matches for the lemma *kast*e in the CoREST search results. The verb *skubber* is also conjugated using the suffix r in relation to the lemma *skubbe*. This morpheme construction made up 17.3% of the total matches for the lemma *skubbe* in the CoREST search results. I considered the second morpheme construction to be more divergent.

5.2.4 Grammatical divergence

A general result has been found for the grammatical divergence in each participant by combining the results from the three construction levels: phrasal, word, and morpheme. This functions as more of an abstract level of grammatical construction rooted in the three concrete levels that ot is then possible to compare to the emotional states of the participants (see EGD in 4.4.4).

Nine participants were found to use more grammatical divergence after the mood induction, while seven were found not to use more grammatical divergence after the induction.

5.3 Emotional state and grammatical divergence – correlation analyses

In eight of the participants there was a possible relationship between emotional state and grammatical divergence, and in eight there was no relationship. For there to be a relationship the participant should either both be in a positive emotional state and produce grammatical divergence, or they should be in a negative emotional state and produce no grammatical divergence.

If only the MI data is considered as evidence for the emotional state, and the grammatical divergence is derived from a combination of the three construction levels, phrasal, word and morphological, then, there was a relationship between the emotional state and the creative use of grammatical constructions in nine participants. If, then, only the MI data and the phrasal level is

considered, the number of participants, where a possible relationship is detected between emotional state and creative use of grammatical constructions is nine. If only the MI data and the word level is considered, the number is eight. Considering only the MI data and the morpheme level, the number is seven.

If only the EBR data is considered as evidence for the emotional state, and the grammatical divergence is derived from a combination of the three construction levels, phrasal, word and morphological, then, there was a relationship between the emotional state and the creative use of grammatical constructions in six participants. Now, if only the EBR data and the phrasal level is considered, the number of participants, where a relationship is detected between emotional state and creative use of grammatical constructions is six. If only the EBR data and the word level is considered, the number is seven. Finally, if only the EBR data and the morpheme level is considered, the number is nine.

A suite of correlation analyses was performed to examine the relationship between the various measures. In the correlation analyses an evaluation of the highest percentage difference – emphasising either the MI data or the EBR data – was not done. Rather, both the MI and EBR data were used in the analyses with the different grammatical constructions, but they were used separately and independently of each other.

The Pearson correlation analyses revealed no correlation between the two different EGDs and the MI, nor between the two EGDs and the EBR. Further, no correlation was found between the phrasal construction data and the MI nor between the data and the EBR. Turning to the morpheme and word construction data, no correlation was found between these data and the MI.

However, the correlation analyses showed a significant and positive relationship between EBR and word constructions with a Pearson's r of 0.712 (see Table 9), when analysing the frequencies of the lemmas – the frequency being how many times a lemma used by a participant has been used and represented in the corpus. This means that higher blink rates correlated with higher frequencies for the lemmas, i.e. less divergence and thus less grammatical creativity, contrary to expectations. There was also a moderate positive relationship between EBR and

Table 9. Pearson correlation analysis of EBR and word construction data.

Correlation Matrix

		EBR	Word constructions
EBR	Pearson's r	—	
	p-value	—	
Word constructions	Pearson's r	0.712 **	—
	p-value	0.002	—

Note. * p < .05, ** p < .01, *** p < .001

morpheme constructions with a Pearson's *r* of 0.530 (see Table 10), when giving the morpheme frequencies either a 1 or a -1 value based on whether they were more or less divergent.

Table 10. Pearson correlation analysis of EBR and morpheme construction data with morpheme constructions given either a 1 or -1 value.

Correlation Matrix

		EBR	Morpheme constructions alternative
EBR	Pearson's r	—	
	p-value	—	
Morpheme constructions alternative	Pearson's r	0.530 *	—
	p-value	0.035	—

There was also a moderate positive relationship between word constructions and EBR with a Pearson's *r* of 0.616 (see Table 11), and a significant and positive relationship between morpheme constructions and EBR with a Pearson's *r* of 0.635 (see Table 12). Here, both the word constructions and the morpheme constructions had been given values based on exponentially increasing ranges.

Table 11. Pearson correlation analysis of EBR and word construction data with word constructions given values based on exponentially increasing ranges.

Correlation Matrix

		EBR	Word constructions
EBR	Pearson's r	—	
	p-value	—	
	Spearman's rho	—	
	p-value	—	
Word constructions	Pearson's r	0.616 *	—
	p-value	0.011	—

Table 12. Pearson correlation analysis of EBR and word construction data with word constructions given values based on exponentially increasing ranges.

Correlation Matrix

		EBR	Morpheme constructions
EBR	Pearson's r	—	
	p-value	—	
	Spearman's rho	—	
	p-value	—	
Morpheme constructions	Pearson's r	0.635 **	—
	p-value	0.008	—

With these results the hypothesis of the present study (see Introduction) was not supported. On the contrary, the results point to the opposite relation between emotional state and grammatical constructions: speakers in a more positive mood are less creative in their use of grammatical constructions.

The data from the corpus (-KORPUS-DK in CoREST) investigation, and the divergence analyses can be found in Appendix F.

6 Discussion

This study set out to investigate a possible relationship between emotional state and the degree of creative use of grammatical constructions. Drawing on a design by Akbari Chermahini & Hommel (2012), the study tested whether mood affected grammatical creativity, defined as divergence, in elicited spontaneous speech. The results revealed that there is to some extent a relationship between our emotional state and the degree of creative use of grammatical constructions, more specifically a relationship between eye blink rate (EBR) and word constructions, and between EBR and morpheme constructions. Contrary to expectations, this relationship is defined by a positive mood being linked with less grammatical creativity.

The data were examined with varying degrees of P-MT first person methods to third-person method-based analyses. The analyses with incorporated P-MT first person methods give an indication of a possible relationship, while the correlation analyses provide a concrete fundament for those inferences. This goes beyond the previous literature, a literature that has not studied the relationship between mood and linguistic creativity and specifically grammatical creativity (Akbari Chermahini & Hommel, 2010; Akbari Chermahini & Hommel, 2012; Baas et al., 2008; Estrada et al., 1994; Mumford, 2003; Vosburg, 1998).

Interestingly, the hypothesis in this study was that a positive emotional state of a speaker would coincide with more creative use of grammatical constructions. This hypothesis was based on previous literature on the relationship between mood and creativity, such as Isen (2002). However, the results show the opposite pattern. A possible reason for why the hypothesis was not supported could be that emotions and creativity have a different relationship depending on the domain of the creativity, for example grammatical constructions. A possible interpretation of the relation that speakers in a more positive mood display less grammatical creativity as defined here could be that we might not react that strongly when we are in a positive mood, we might be more in balance and therefore follow the norms. Maybe we reflect less on ourselves and our situation when we are in a positive mood. Going back to Darwin, an early inspiration for the present thesis, it is not positive mood that is mostly highlighted as affecting the body in a noticeable way. Darwin

discusses positive emotions less than other ones, and when he does, he mainly talks about laughter and laughter related movements and sounds. It is possible that reactions are simply stronger when it comes to other moods than positive ones.

> With all or almost all animals, even with birds, Terror causes the body to tremble. The skin becomes pale, sweat breaks out, and the hair bristles (Darwin, 1872, p. 77)

Again, this could affect different domains of creativity, where different uses of household items (as investigated by Akbari Chermahini & Hommel, 2012) is one domain of creativity, while using less common grammatical constructions is another.

The shift in grammatical behaviour based on the emotional state of speakers can potentially strengthen the bond between our mind and body as we understand it, as our emotions might manifest themselves not only as bodily reactions or through semantics but in the very structure of our linguistic expressions. We might, then, need new tools for linguistic investigation to be able to observe this kind of linguistic phenomena.

The present study based its experimental design on that of Akbari Chermahini & Hommel (2012) with a few tweaks because of its different research question and for practical reasons. There are differences in the outcome of the study of Akbari Chermahini & Hommel (2012) and the present study. One obvious difference is that the mood induction was not as successful in the present study. However, there was a change in the mood of the participants according to the MI and EBR measurements, making the current data viable.

> [D]epending on the particular characteristics and the corresponding distribution of individual dopamine levels in a given sample, the exact same mood-related manipulation can produce significant effects or null results alike, especially if the sample size is small (Akbari Chermahini & Hommel, 2012, p. 6)

Furthermore, Akbari Chermahini & Hommel (2012) note the link between *mood* and *neurotransmitters*, with a great effect of dopamine on positive mood, and a stronger link between serotonin and negative mood, which means that EBR could be affected more by positive mood and less by negative mood. With these notes in mind it seems possible that a bigger sample of participants might show a more successful mood induction. At the same time, it gives us an idea

of a possible need to take serotonin more into account in a future study of the relationship between emotional states and grammatical creativity.

Importantly, participants made comments after the experiment had ended, and many participants noted that they found the EBR parts of the experiment meditative and calm (see Appendix A). One participant reported crying during EBR2, but still said that the EBR parts and the experiment in general were calm and comfortable. It might be a nice feature to have a meditative sequence at the end of the experiment, if anyone wants to build on this research. It could be a good way for the participants to end the experiment, maybe especially for those who did experience feeling a more negative mood – maybe it should be implemented in more experiments in general. Many of the participants seemed happy or at peace, when I returned to the room after the EBR parts of the experiment. The calmness could have an effect on the grammatical creativity that goes beyond that of positive and negative mood.

> [P]eople in a relaxed and calm state are prevention focused but do not produce lower levels of creativity because their engagement and avoidance tendencies are reduced (Baas et al., 2008, p. 784)

Should I put an emphasis on the mood inventories (MI) or the eye blink rates (EBR), when I compare emotional state and grammatical constructions? On the one hand, the EBR's are, according to some literature, connected to dopamine, providing more concrete evidence of the participants' emotional states. On the other hand, the participants themselves have reported how they felt using the MI's, and I do empathise and respect the persons who have contributed crucially to this investigation. The EBR was done since it is recognised as a *clinical marker* of dopamine levels in individuals (Akbari Chermahini & Hommel, 2012). Thus, the EBRs are used as a physiological indication of change of mood by measuring the neurotransmitter dopamine, while the MIs are self-reports by the participants about how they feel – the MI2 can be biased from the participants figuring out the objective of having two MIs in the experiment, but the participants would not know what the purpose of the EBRs was until the debriefing. The function of EBR as a marker of dopamine level has been both embraced (Barkley-Levenson & Galván, 2016; Colzato et al., 2009; Jongkees & Colzato, 2016; Karson, 1983; Van Slooten et al., 2019), disputed (Dang, Samanez-Larkin, Castrellon, Perkins, Cowan, Newhouse & Zald, 2017), and looked upon

sceptically (McGovern, 2018; Sescousse, Ligneul, van Holst, Janssen, de Boer, Janssen, Berry, Jagust & Cools, 2018). Akbari Chermahini & Hommel (2012) embrace it and use it in their experiment that is here partly replicated, thus, I used the EBR in the present study. I have treated the MIs as measuring tools with equal significance as the EBRs, even though these are possibly not the most viable marker of the participants' mood. The circumstances of the MIs and the EBRs were kept in mind during the experiments and the analysis of the data, and they are still important to keep in mind as they affect the meaning of the results.

There are various steps and perspectives that could have been done differently in the present study, such as in the language production task. Here, the two images used were quite similar (see 4.2.5), and it might have prompted different results had the images been even more similar, e.g., had they both been of two persons in interaction, or both been of a person and an object. The perspective in the images can possibly have had an effect on the elicitation of produced language, one perspective being more at level with the person portrayed in the image, and the other being above from the two persons in the image. All in all, one could look at different information in a future study, different aspects, and maybe another point of view than construction grammar.

Finally, depending on how I look at the data I either see no relationship between emotional state and grammatical creativity, or I see some relationship. In a sense, then, the hypothesis of the present study has not been proved nor disproved. This has been an ambitious investigation for several reasons, but, even so, a more ambitious investigation should be carried out, if anyone has the desire to learn more about the possible relationship between our emotional states and the grammatical constructions we produce when we speak. More participants, different languages, other experimental techniques – much can be changed and improved for a future investigation of this fascinating possible relationship. It is a positive thing that the study can be changed in various ways, since this can *criticise* and even prove the hypothesis of the present study wrong (Popper, 2005). This study serves a good starting point for a bigger investigation in grammar. It is difficult to investigate, and we might need new and other tools.

7 Conclusion

The purpose of the present study was to explore a possible relationship between how we feel and how we structure our language. I focused on positive and negative mood and grammatical constructions in spoken language. The results suggest a possible connection between mood and language structure, but in an unexpected direction. Positive mood was found to relate to less creative use of word constructions (lemmas) and morpheme constructions (morphological transformation of the lemmas). This does not necessarily mean that linguistic creativity goes hand in hand with negative mood, but it does indicate that as speakers feel more positive, they tend to use more common grammatical constructions in their speech.

Returning to cognitive semiotics and the conceptual-empirical loop I want to briefly touch upon the new insights I have gained. Looking at the pre-operationalised main concept (influence of emotional state on language structures) and sub-concepts (linguistic creativity and emotional state), I have learned that emotional state possibly influences language structures when these are defined as grammatical creativity. Further, I have learned that linguistic creativity measured as divergent language use is quantifiable. Moreover, emotional state measured by self-rating questionnaires does not seem to have an effect on grammatical creativity as investigated with the setup in the present study. Furthermore, measuring emotional state by eye blink rates provides more diverse results than the self-rating questionnaires, and the eye blink rates, due to their relation to dopamine, provide a more objective image of the persons' emotional state. Overall, I have learned that more positive mood may well result in more common language use in the form of more common grammatical constructions.

P-MT has been important for the study because it has helped keep the objective of the study focused, and not blurred by discussions on the correct way to investigate the issue at hand. P-MT has also helped keeping it clear when 1st, 2nd, and 3rd person methods were used, even within the same approaches to the object of study, so as to not create confusion. Because of this, and because of the implementation of the conceptual-empirical loop, this is a cognitive semiotics study rather than, say, a study in cognitive psychology.

Although a body of literature has worked with a relationship between emotions and creativity (Akbari Chermahini & Hommel, 2010; Akbari Chermahini & Hommel, 2012; Baas et al., 2008; Estrada et al., 1994; Mumford, 2003; Vosburg, 1998), no or few studies have focused on the relationship between emotions and linguistic creativity. Thus, the present study has filled a gap in the research. The results of the present study show that there is indeed reason to investigate the relationship between emotions and grammatical creativity further, and maybe even to investigate further a relationship between emotions and grammar in general. One research area that could benefit from more investigation into this relationship is that of language acquisition both in L1 and second language (L2). Here, knowledge of the effects of emotions on linguistic creativity and on the structures of language could prove useful for teachers and learners alike, for example when planning classes, content material, and the learning space. Previous research has investigated the role of emotions in L2 acquisition (Shao, Nicholson, Kutuk & Lei, 2020), both working with *anxiety* (Teimouri, Goetze & Plonsky, 2019) and positive feelings such as *enjoyment* (Dewaele, Witney, Saito & Dewaele, 2018) – investigations springing from the present study can possibly offer a new perspective in this area of research.

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Appendices

Appendix A

Participants information

Participant	Gender	Age	First language (L1)	Country of residence	Relation to researcher	Found EBR part of experiment meditative
1	Female	X	Danish	Mexico	Stranger	Not stated
2	Female	X	Danish	Mexico	Stranger	Yes
3	Female	64	Danish	Mexico	Stranger	Not stated
4	Female	51	Danish	Mexico	Stranger	Yes
5	Female	29	Danish	Denmark	Former co-student	Yes
6	Female	20	Danish	Denmark	Stranger	Yes
7	Female	29	Danish	Denmark	Co-worker of friend	Not stated
8	Female	22	Danish	Denmark	Stranger	Calm and comfortable
11	Male	25	Danish	Denmark	Stranger	Not stated
12	Male	67	Danish	Denmark	Family friend	Not stated
13	Male	62	Danish	Denmark	Former friend of parents	Yes
14	Male	25	Danish	Denmark	Friend's boyfriend	Relaxing
15	Male	36	Danish	England	Former teacher	Not stated
16	Male	26	Danish	Denmark	Friend	Yes
17	Male	23	Danish	Denmark	Stranger	Not stated
18	Male	27	Danish	Denmark	Acquaintance	Yes

Appendix B

English, Flemish, Dutch, and Danish versions of the PANAS

No.	English	Flemish	Dutch	Danish	Positive affect	Negative affect
1	attentive	aandachtig	aandachtig	opmærksom	x	
2	hostile	vijandig	vijandig	fjendtlig		x
3	interested	geïnteresseerd	geïnteresseerd	interesseret	x	
4	irritable	vlug geïrriteerd	prikkelbaar	irritabel		x
5	alert	alert	alert	beredt	x	
6	guilty	schuldig	schuldig	skyldig		x
7	excited	opgewekt	uitgelaten	begejstret	x	
8	ashamed	beschaamd	beschaamd	flov		x
9	enthusiastic	enthousiast	enthousiast	entusiastisk	x	
10	nervous	gespannen	nerveus	nervøs		x
11	inspired	vol inspiratie	geïnspireerd	inspireret	x	
12	jittery	zenuwachtig	rusteloos	ængstelig		x
13	proud	zelfverzekerd	trots	stolt	x	
14	distressed	bedroefd	overstuur	ulykkelig		x
15	determined	vastberaden	vastberaden	fast besluttet	x	
16	upset	terneergeslagen	van streek	ked af det		x
17	strong	sterk	sterk	stærk	x	
18	afraid	bang	bang	bange		x
19	active	energiek	actief	aktiv	x	
20	scared	angstig	angstig	skræmt		x

Appendix C

Danish version of Mood Inventories (MI)

MI1

glad	1	2	3	4	5	6	7	8	9	trist
fredelig	1	2	3	4	5	6	7	8	9	ængstelig
ubekymret	1	2	3	4	5	6	7	8	9	seriøs

MI2

positiv	1	2	3	4	5	6	7	8	9	negativ
rolig	1	2	3	4	5	6	7	8	9	ophidset
håbefuld	1	2	3	4	5	6	7	8	9	fortvivlet

Appendix D

Consent form

CENTRE FOR LANGUAGES & LITERATURE
LUND UNIVERSITY

LUND UNIVERSITY

PO BOX 201, 221 00 Lund, Sweden

Samtykkeerklæring

Jeg giver hermed tilladelse til, at Toke Laursen, Kognitiv Semiotik ved Center for Sprog og Litteratur, Lunds Universitet, Sverige, må bruge dagens optagelser (lyd og video) til følgende formål:

(Marker venligst de relevante bokse,"❑", hvis du giver din tilladelse.)

❑ 1. analyser til videnskabelig undersøgelse;

2. som illustrationer af ovenstående videnskabelige undersøgelse i professionelle seminarer, undervisning, konferencer og videnskabelige udgivelser;

❑ som skriftlige eksempler.

Behandling og opbevaring af data

Alle data vil blive anonymiseret i rapporten. Observer, at vejlederen også vil have adgang til dataene. Indtil specialet er bedømt, vil alle data blive opbevaret på forskerens computer. Derefter vil forskeren slette dataene.

Frivillig deltagelse

Deltagelse er frivillig, og som deltager har jeg ret til at stoppe min deltagelse på ethvert tidspunkt.

CENTRE FOR LANGUAGES & LITERATURE
LUND UNIVERSITY

LUND UNIVERSITY

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Min anonymitet er garanteret. Under ingen omstændigheder vil min personlige identitet blive afsløret til andre end ovennævnte forsker (f.eks. vil ingen navne blive brugt i præsentationer af de skriftlige eksempler).

Navn Signatur Dato

_____

Deltagernummer:_____

Appendix E

List of the original grammatical property labels and their meanings, and the labels in the language of CoREST

Meaning	Grammatical property label	CoREST
Verb	V	V
Auxiliary	AUX	V
Adjective	Adj	A
Numeral	Num	L
Noun	N	N
Pronoun	Pro	P and U
Adverb	Adv	D
Conjunction	Conj	C
Preposition	PP	T
Indefinite article	Indef Art	P
Definite article	Def Art	P
Infinite particle	Infinite Particle	U
Noun, definite form	N Def	N
Interjection	Interj	I
Fixed expression	FE	-

Appendix F

Data from the corpus investigation, and the divergence analyses

Table F1. First part of Excel with raw and evaluated data from experiments. Mood inventory (MI), eye blink rate (EBR), language production task (LPT), less divergent (LD), more divergent (MD), equally divergent (ED).

Participant	MI1	MI2	Percentage difference Formula: ((y-x)/x)*100 x = original number	Change in MI scores	EBR1	EBR2	Percentage difference Formula: ((y-x)/x)*100 x = original number	Change in EBR	LPT1 Phrasal construction	LPT2 Phrasal construction	Divergence of LPT2
1	24	26	8.33%	More positive	21.33	14	34.36%	Decreased	14	878	LD
2	22	22	0%	Not changed	20.67	41	98.36%	Increased	10	Fejl	MD
3	24	27	12.5%	More positive	12.67	39	207.81%	Increased	150	Fejl	MD
4	13	24	84.62%	More positive	17.33	14	19.22%	Decreased	2,602	200	MD
5	15	18	20%	More positive	4	1	75%	Decreased	1	11,737	LD
6	21	20	4.76%	More negative	20.33	28	37.73%	Increased	1	3	ED
7	24	26	8.33%	More positive	6.33	3.67	42.02%	Decreased	2,617	63	MD
8	24	17	29.17%	More negative	6.33	15.67	147.55%	Increased	22	1	MD
11	14	21	50%	More positive	29.33	39.33	34.09%	Increased	14	115	LD
12	23	27	17.39%	More positive	10.33	16.67	61.37%	Increased	1,306	2,602	LD
13	25	26	4%	More positive	7.33	9.33	27.29%	Increased	34	25,192	LD
14	21	14	33.33%	More negative	11.33	18.67	64.78%	Increased	14	47	LD
15	20	24	20%	More positive	7.33	10	36.43%	Increased	14	3	MD
16	16	12	25%	More negative	6	34	466.67%	Increased	287	1,639	LD
17	19	19	0%	Not changed	15	20.67	37.8%	Increased	Fejl	Fejl	ED
18	20	24	20%	More positive	9.33	10	7.18%	Not changed	14	1	MD

Table F2. Second part of Excel with raw and evaluated data from experiments. Language production task (LPT), less divergent (LD), more divergent (MD), equally non-divergent (END).

Participant	LPT1 Morpheme construction - verb	LPT2 Morpheme construction - verb	Divergence of LPT2	LPT1 Verb frequency/ word constructions	LPT2 Verb frequency/ word constructions	Divergence of LPT2	Grammatical divergence	Changed emotional state	Mood induction	Effective mood induction
1	Lemma: 14,785 **"taber": 16.35%**	Lemma: 1,535 **"overfalder": 8.17%**	MD	**Lemma: 14,785** "taber"	**Lemma: 1,535** "overfalder"	MD	Yes	Negative	Positive	No
2	Lemma: 128 **"slås": 0%**	Lemma: 38,825 **"sender": 18.6%**	LD	**Lemma: 128** "slås"	**Lemma: 38,825** "sender"	LD	No	Positive	Negative	No
3	Lemma: 1,535 **"overfalder": 8.17%**	Lemma: 14,785 **"taber": 16.35%**	LD	**Lemma: 1,535** "overfalder"	**Lemma: 14,785** "taber"	LD	No	Positive	Positive	Yes
4	Lemma: 5,607 **"leger": 25.6%**	Lemma: 4,205 **"skubber": 17.3%**	MD	**Lemma: 5,607** "leger"	**Lemma: 4,205** "skubber"	MD	Yes	Positive	Negative	No
5	Lemma: 14,785 **"taber": 16.35%**	Lemma: 27,984 **"hjælpe": 50.75%**	LD	**Lemma: 14,785** "taber"	**Lemma: 27,984** "hjælpe"	LD	No	Negative	Positive	No
6	Lemma: 4,205 **"skubbet": 17.18%**	Lemma: 211 **"dribler": 11.25%**	MD	**Lemma: 4,205** "skubbet"	**Lemma: 211** "dribler"	MD	Yes	Positive	Negative	No
7	Lemma: 6,197 **"angriber": 14.6%**	Lemma: 8,863 **"smider": 15.35%**	END	**Lemma: 6,197** "angriber"	**Lemma: 8,863** "smider"	LD	Yes	Negative	Positive	No
8	Lemma: 2,597 **"sparket": 17.59%**	Lemma: 6,197 **"angriber": 14.6%**	MD	**Lemma: 2,597** "sparket"	**Lemma: 6,197** "angriber"	LD	No	Positive	Negative	No
11	Lemma: 12,919 **"kaster": 21.35%**	Lemma: 4,205 **"skubber": 17.3%**	MD	**Lemma: 12,919** "kaster"	**Lemma: 4,205** "skubber"	MD	Yes	Positive	Positive	Yes
12	Lemma: 1,535 **"overfalder": 8.17%**	Lemma: 5,607 **"leger": 25.6%**	LD	**Lemma: 1,535** "overfalder"	**Lemma: 5,607** "leger"	LD	No	Positive	Negative	No
13	Lemma: 6,197 **"angrebet": 27.15%**	Lemma: 14,785 **"taber": 16.35%**	MD	**Lemma: 6,197** "angrebet"	**Lemma: 14,785** "taber"	LD	No	Positive	Positive	Yes
14	Lemma: 5,221 **"skyder": 34.45%**	Lemma: 4,205 **"skubber": 17.3%**	MD	**Lemma: 5,221** "skyder"	**Lemma: 4,205** "skubber"	MD	Yes	Positive	Negative	No
15	Lemma: 12,919 **"kaster": 21.35%**	Lemma: 4,205 **"skubber": 17.3%**	MD	**Lemma: 12,919** "kaster"	**Lemma: 4,205** "skubber"	MD	Yes	Positive	Positive	Yes
16	Lemma: 4,205 **"skubber": 17.3%**	Lemma: 50,104 **"spiller": 29.25%**	LD	**Lemma: 4,205** "skubber"	**Lemma: 50,104** "spiller"	LD	No	Positive	Negative	No
17	Lemma: 4,205 **"skubbe": 19.05%**	Lemma: 211 **"driblet": 10%**	MD	**Lemma: 4,205** "skubbe"	**Lemma: 211** "driblet"	MD	Yes	Positive	Positive	Yes
18	Lemma: 12,919 **"kaster": 21.35%**	Lemma: 4,205 **"skubbet": 17.18%**	MD	**Lemma: 12,919** "kaster"	**Lemma: 4,205** "skubbet"	MD	Yes	Positive	Negative	No