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No affective priming in the semantic classification task

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Zusammenfassung

Bis heute ist es noch ungewiss, ob wertfreie, semantische Klassifizierungen von affektiven Bedeutungen beeinflusst werden können und wenn ja, welche Art von Verarbeitung diesem Einfluss zugrunde liegen: strategische, die von bewusster Wahrnehmung abhängig sind, oder automatische, welche wahrnehmungsunabhängig außerhalb des Bewusstseins operieren? Nach der Theorie der verkörperten Kognition scheint der automatische Ansatz der wahrscheinlichere zu sein, da alle Emotionen und Kognitionen auf körperlichen Erfahrungen basieren und deren Repräsentation in der Erinnerung. Deshalb scheint eine automatische motorische Reaktion auf einen affektiven Reiz logischer als eine strategische Verarbeitung seiner affektiven Bedeutung.

Um das zu überprüfen wurde das Bahnungsparadigma verwendet und eine semantische Klassifizierungsaufgabe vorgelegt. Die Probanden mussten räumliche Zielwörter als nach oben oder unten zeigend klassifizieren, nachdem sie durch entweder räumliche Bahnungswörter des gleichen Typs oder durch affektiv geladenen Bahnungswörtern “geprimed” wurden. Die Bahnungswörter wurden sowohl sichtbar vorgegeben, wie auch subliminal, indem sie maskiert wurden. Obwohl keine statistisch signifikanten Haupteffekte bei affektiv geladenen Bahnungswörtern gefunden wurden, lassen die signifikanten Interaktionen mit anderen Variablen Raum für Spekulationen offen.

Abstract

To date it is still uncertain, if non-evaluative semantic classifications can be influenced by affective semantics, and if so, what kind of processes are responsible for this influence: strategic ones that depend on conscious awareness, or automatic ones that are independent of awareness and operate outside of consciousness? According to embodied cognition theory (ECT) the automatic approach seems to be the one more likely, because all emotions and cognitions are rooted in bodily experiences and their representations in memory. Therefore an automatic motor reaction to an affective stimulus seems more reasonable than strategic processing of its affective meaning. To test this empirically, the priming paradigm was employed with a semantic classification task. Participants had to classify spatial target words as pointing up or down after being primed with either spatial words of the same type or with words polarized with affective meaning. The prime words were presented visibly as well as subliminally by masking them. Even though no statistically significant main effects were found for prime words polarized with affect, significant interactions with other variables leave room for speculations.

Table of Contents

1 Theoretical Background.....	4
1.1 Introduction.....	4
1.2 Metaphors of high and low.....	5
1.3 Embodying metaphors.....	7
1.4 The meaning and use of Priming.....	10
2 Empirical analysis.....	15
2.1 Purpose of this research.....	15
2.2 Methods.....	17
2.2.1 Participants.....	17
2.2.2 Aparatus.....	17
2.2.3 Stimulus Material.....	18
2.2.4 Experimental Design.....	20
2.2.5 Procedure.....	21
2.3 Results.....	22
2.3.1 Analysis of prime visibility.....	22
2.3.2 Analysis of reaction times.....	24
2.3.3 Analysis of error rates.....	28
3 Discussion.....	31
3.1. Limitations and implications for future research.....	36
3.2 Conclusion	40
4 References.....	41
5 List of Figures.....	46
6 List of Tables.....	46
7 Curriculum Vitae.....	47

1 Theoretical Background

1.1 Introduction

Every day, whether we are awake or asleep, our brain is constantly working, with or without our knowledge. Amongst its many functions, one of the most crucial to the way we understand the world, is the ability to store and recall information. Or, if we are to invoke the cognitive paradigm of viewing the brain as a computer, to “save information” and “load it later on, within a contextual network of meaning. Because of these automatic, unintentional processes (Bargh & Chartrand, 1999) the semantic network – the name given to that very same contextual network of meaning – in our mind, lets us make sense of the world we see before us, by rooting each and every thought and concept in a rich network of information. Through its function we are able to make complex evaluative judgements, and then follow them up with quick and concise action: the notion of a cloudy day, for example, will certainly make us consider taking an umbrella as we leave the house, because of the strong semantic bond between the two. Likewise, we usually do not cross a road at a red traffic light, but under certain circumstances – when we are not driving a vehicle, no cars can be seen or heard, no police officers can be spotted, and we are in a hurry – the same semantic network will connect the information we have perceived and will help us in our judgement whether it is safe to cross the road even though the traffic light is red.

When, however, emotions come into play the game changes. The Umbrella might be left at home after all when the owner is filled with joy and believes the clouds will hold. The red traffic light on the empty crossroad might become an impassable barrier when we feel scared or sad, or when a group of children is patiently waiting on the other side for the light to change and an urge of being a good role model rises up in us.

This paper aims to give an overview about the interplay of affect and cognition according to embodied cognition theory (ECT), followed by an explanation of how vertical dimensions are related to positive and negative metaphors. At the heart of this work is an experiment using the priming paradigm that was done at the department of

psychology at the university of Vienna, its results and their discussion. It aims to show how the experimental paradigm of priming contributes to our understanding of the influence valence exerts on semantic classification.

1.2 Metaphors of high and low

Since language is an important instrument we use to give meaning to the objects we observe and encounter, we can therefore learn more about how semantics are related by analysing language. In that sense, metaphors are a particularly interesting phenomenon, as they connect abstract concepts with objects we can perceive. That way, a person can be “cunning like a fox”, then calling this person that will exemplify just how cunning she or he is, as the fox is said to be a very cunning animal. In the same way, somebody is called to be “beating around the bush” when she or he cannot say something directly or tries to avoid a certain topic of conversation, so a way of thinking and talking is connected with a physical activity.

This paper will focus on one particular metaphorical phenomenon: the relation between vertical space (whether something is high or low in space) and valence (whether something has a positive or a negative connotation). If we are in a bad mood we might say that we are “feeling low”, yet we are elevated, so to say, when our mood “lifts” and we feel happy again. We “carry our head high” when we are proud but feel “our hearts hang low” when nothing works the way we want it. A series of bad decisions and negative consequences that lead to more bad decisions is sometimes called “a downward spiral” from which a person cannot escape. Thus it is easy to see how valence and verticality are related to each other: in our language and mental processes the positive is associated with an upward direction, whereas the negative is associated with a downward direction..(Lakoff & Johnson, 1980, 1999, Meier & Robinson, 2005).

Meier and Robinson (2004) made three experiments to test the relation between valence and vertical space. In the first one, they could observe that participants reacted faster to positive words that were presented on the upper half of a computer screen as well as negative words that were presented on the lower half of the screen. Their

second experiment showed “that evaluations bias spatial attention in a metaphor-consistent direction (e.g., ‘good’ activates ‘up’)” (Meier & Robinson, 2004, p. 246), so positive primes caused participants to focus on the upper half of the screen and negative primes lead awareness to the lower half. However, in their third experiment they could not produce any evidence that evaluations would be primed by focusing attention on different areas of visual space (so evaluations of positive words were not facilitated by a prime presented on the top half of the screen or vice versa). Yet they concluded that “when making evaluations, people automatically assume that objects that are high in visual space are good, whereas objects that are low in visual space are bad” (Meier & Robinson, 2004, p. 247).

In line with this thinking, Meier, Hauser, Robinson, Friesen and Schjeldahl (2007) analysed how very abstract concepts like “God” and “Devil” were linked to metaphors that could be rated on a vertical dimension. In a series of experiments they showed a strong relation of the abstract concepts of “God” and “Devil” with verticality: The concept of “God” was implicitly associated with words that could be rated “high” on a vertical axis while the concept of “the devil” was implicitly associated with words that could be rated “low” on the same vertical axis. As their results resembled those of Meier and Robinson (2004), they could show that reactions to words that were associated with the concept of the divine were faster when they were presented on a high position on a computer screen whereas words that were associated with concept of the infernal produced faster reactions when they were presented in a lower area of a computer screen.

Furthermore, Meier et al. (2007) were able to demonstrate a memory bias when participants claimed that they remembered pictures associated with “God” on a higher position on a computer screen and pictures associated with “the devil” on a respectively lower position. Further more, participants rated people that were shown to them on photographs as having more faith in god depending on the vertical position of the photographs on the computer screen. This effect was independent of how likeable or powerful the people on the photographs were deemed to be, which was to be evaluated as well. All together, the vertical dimension seems to have an influence not

only on reactions to but also on understanding of abstract concepts.

This phenomenon is not exclusive to visumotor tasks, and is observed in pairings of other senses with their respective stimuli. In an experiment by Weger, Meier, Robinson, and Inhoff (2007) participants were asked to classify the pitch of tones that were played as either high or low. When they were shown words that were evaluated as positive before the tone was played, classification of high pitched tones was facilitated, whereas when words that were evaluated as bad were shown before the tone, classification of low pitched tones was facilitated.

Looking at these evidences, it seems very convincing that there is a certain relatedness between valence (positivity and negativity) and the vertical dimension in space, not only for words but also for pictures and tones.

1.3 *Embodying metaphors*

Compared to the classic cognitive theory of the mind as a computer, Embodied Cognition Theory (ECT) has only started getting the scientific community's attention quite recently.. Even though the idea that things like bodily posture and facial expression have an active influence on emotions is as old as Charles Darwin's "The Expression of Emotions in Man and Animals" (1872), the limited technological possibilities, and the way the brain was understood, caused many scientists to neglect the emotional part of the mind and rather come up with models of information processing that only involved "higher" cognitive processes (Niedenthal, 2007).

In classic cognition, the mind is seen like a disembodied computer: sensory input devices feed stimulus material into the brain-hardware whose purpose is to deliver the necessary processing power to mental-software-processes that encode the data and then "save" or "store" it so it can be used later. This encoding processes bring the actual sensual data into an abstract form that in turn is stored in regions that are independent of the actual senses that the data came from. Higher cognitive processes, like categorizing and remembering, are then made possible by the use of this abstract data that is in an arbitrary relationship with perception (Fodor & Pylyshyn, 1988). "Conveniently, the models also do away with the priority of emotion in information

processing. And the sensory, motor, and affective systems are not required for thinking or language use” (Niedenthal, 2007, p. 1003).

Contrary to this trend, ECT offers a more holistic approach: Thoughts are construed as mental simulations of bodily experiences (Barsalou, 1999, Lakoff & Johnson, 1999). These experiences are then not saved “somewhere else” but rather close to the neural area of the sense in question, so when the experience is remembered, sensations and the feeling that were connected with it are reproduced as well, generating an affective state similar to the original one. “Put another way, the grounding for knowledge – what it refers to – is the original neural state that occurred when the information was initially acquired” (Niedenthal, 2007, p. 1003). Niedenthal (2007) explains this with an example of an encounter with a snarling bear: When somebody takes a walk in the woods and all in a sudden that person spots a bear that snarls viciously, a lot of things happen at the same time within the brain. The bear is seen, which results in the bear’s image being saved in the visual system of the brain. The snarl is heard, which leads to it being saved in the auditory system. Besides these external impressions received from the bear, the person becomes aware of inner feelings, as this happens, which are then in turn saved in the affective system. If later the appearance of the bear is to be remembered, the same parts of the visual system will be reinstated, which in turn might also activate the other parts of the brain that were active at that time, eventually causing the person to remember the sound of the snarl as well as the dominant feelings at that time as well.

One specific theory of embodied cognition is the “perceptual symbol system theory” of Barsalou (1999). It emphasizes on the importance of the interplay between episodic memory and sensory perception to connect semantic knowledge with sensumotor representations. Because there could be no cognition without a body and each semantic meaning is connected with some sort of sensumotoric use, the sensory as well as motor systems are activated automatically while mental concepts are in use (Barsalou, 1999; 2008).

Glenberg and Paschak (2002) gave another example of embodied cognition with their “action-sentence compatibility effect”. Participants of their experiment were

asked if sentences made sense or whether they were nonsense sentences. They had to answer by pushing a button on a response box that was placed on the lap, only one experimental group had to say yes by pressing the button closest to the body and the other experimental group had to press the button furthest away from them. All sensible sentences implied a direction and results showed that a sentence like “close the drawer” would take the group with the “yes” button close to the body longer to categorize correctly as sensible than the other group with the yes button far from the body, thus implying evidence that “at least some language understanding taps into an action-based system” (Glenberg & Kaschak, 2002, p. 561).

Among those technological advancements that lead to a higher popularity of ECT are more refined neurological methods and their applications in researching affect and emotion. For instance, Zhang, Guo, Lawson, and Jiang (2006) conducted a brain imaging study (fMRI) that revealed a mental pattern of affective processing which was similar to semantic processing. This can be argued to be another indicator that ECT is correct.

Another crucial advancement was a methodical one: the development of various “implicit measures”.

The term implicit measures already indicates, that it is the opposite of an explicit measure, such as a personality questionnaire where participants are asked to explain their own view about themselves, or a typical test in school, where pupils are asked certain questions and the answers to those questions will then be used to directly measure the pupils knowledge on the given topic of the test. De Houwer (2006, p. 12) explains implicit measures as follows: “the term ‘implicit measure’ refers to certain functional properties of measurement outcomes. The outcome functions as an index of an attitude or cognition despite the fact that participants are unaware of the impact of the attitude or cognition on the outcome, are not aware of the attitude or outcome, or have no control over the outcome.”

One of the most famous implicit measures is the “Implicit Association Test” (IAT; e.g., Greenwald, McGhee, & Schwartz, 1998) which uses the priming paradigm to test various attitudes that participants are less likely to admit in traditional questionnaires.

The eye-tracking study by Gozli, Chow, Chasteen, and Pratt (2013) can be seen as an example of all the criteria for implicit measures mentioned above: They instructed their participants to look at a computer screen and to read the words that were presented to them. If the word would be related to a feeling or mood (i.e., “happy”) they should do a horizontal saccade (to the left or to the right), whereas they should withhold any eye movement if the word described a piece of furniture (i.e., “table”). The actual unit of measurement, however, was the deviation of the horizontal line that participants’ gaze were supposed to travel. Their results showed that when reading positive words, participants’ horizontal eye movements deviated significantly ($0,02^\circ$) to the upper half of the computer screen and non-significantly ($0,003^\circ$) to the lower half of the computer screen, when reading a negative word.

1.4 The meaning and use of Priming

“Priming refers to the phenomenon that previous experience with a given stimulus (e. g., word or picture) biases or alters subsequent behaviour (e. g., faster response time, improved accuracy, or biased response to the same or similar stimulus)” (Zhang, Guo, Lawson, & Jiang, 2006, p. 317).

The most important indicator in an experiment using the priming paradigm is the so called congruence effect, introduced by Holender (1986): We speak of congruence, if two stimuli, of which one is used as prime and the other one is used as target, are similar to each other in a relevant dimension (i.e., both stimuli have the same valence in an affective evaluation task, or both stimuli are objects of the same category in a semantic classification task). It is called a congruence effect if the measured reaction times or error rates indicated a more rapid or more accurate reaction to the target stimulus, when a congruent prime stimulus preceded the target, compared to when the preceding prime stimulus was incongruent (i.e., an object of a different category or an emotion of opposite valence), which would lead to longer reaction times and higher error rates.

We can differentiate between different forms of priming. On one hand, there is response priming, which is considered an automatic motor reaction that happens

because a target stimulus conveys the same reaction as does the prime stimulus preceding it in a congruent condition (i.e., both would require pushing the same button, or saying the same word into a microphone). In that sense, the congruence effect is produced directly by the prime without taking the actual target into account, because the prime already activated the necessary motor reaction which facilitated the faster reaction to the target stimulus. When, however, the congruence effect is observed over time a constant decrease can be observed with increasing reaction time (Damian, 2001).

Bartholow, Riordan, Sauls, & Lust (2009) found evidence on a psychophysiological level that the response system has an important role in producing affective congruence effects in the evaluative decision task in an EEG study (in the evaluative decision task participants have to judge whether presented stimulus material is either positive or negative; EEG measures levels of activation across specific cortical areas, so called Event Correlated Potentials). They could show that it is not the evaluative category of the prime which drives a response activation at prime onset, but the likelihood of a congruent condition and the reaction that would be expected from that.

On the other hand, when the reaction to a target stimulus of a certain category (i.e., “chair” as part of the category “furniture”) is facilitated by a prime stimulus of the same category (i.e., “table”), because the category has been pre-activated by the semantically related prime stimulus, we speak of semantic priming (Neely, 1977). One essential component of this is that participants automatically extract semantic information from a prime, even though they were specifically instructed to refrain from it (Storbeck & Robinson, 2004). Figure 1 shows the different routes of activation between response priming and semantic priming schematically.

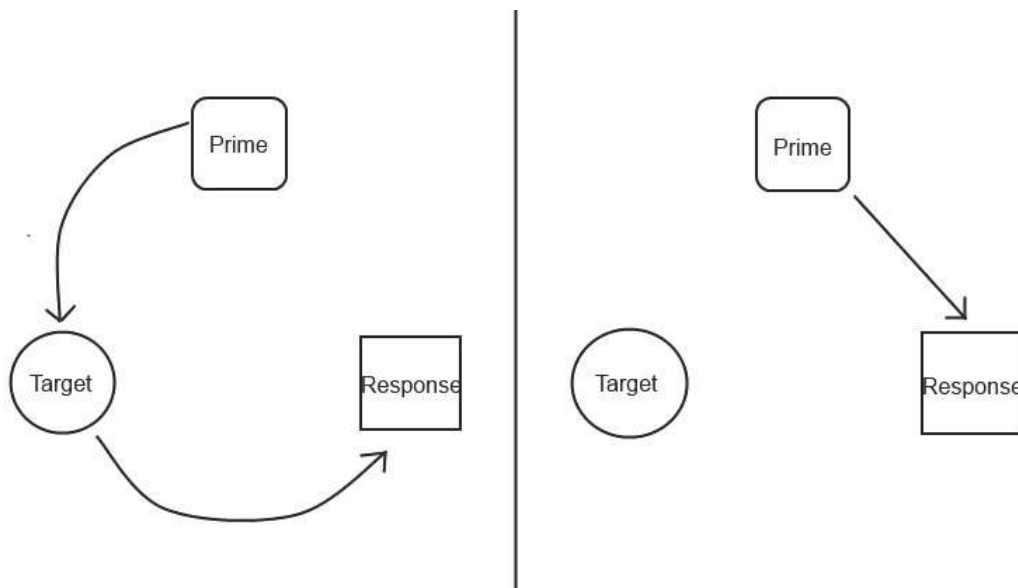


Figure 1: Schematic difference between semantic priming (left) and response priming (right). Arrows represent activation.

Besides response priming and category priming there is a third form: affective priming. The nature of affective priming effects has been the cause for some dispute in the scientific community. Scientists like Zajonc and colleagues advocate that affective priming has unique features that sets it apart from other forms of priming (Zajonc, 1980; Murphy & Zajonc, 1993; Winkielman, Zajonc, & Schwarz, 1997), while others say it can be seen as a special form of semantic priming, because the mechanisms seem to be similar (Klauer & Musch, 2001; De Hower, Hermans, Rothermund, & Wentura, 2002; Storbeck & Robinson, 2004). More recent research that compares the effects of “classical” semantic priming and affective priming (e.g., Eder, Hommer, & De Houwer, 2007; Storbeck & Robinson, 2004; Spruyt, De Houwer, Hermans, & Eelen, 2007) is in favour of the latter theory, as it points out the similarities between the two.

In a typical affective priming experiment, a prime stimulus of a certain valence is used to influence a following task. Those primary tasks are usually (but not exclusively) the evaluative judgement about an object, the naming of an object or the

pronunciation of a word. Regardless of the task, the priming effect always depends on the congruence of the prime, only that congruence in an affective sense means similar valence of both prime and target stimulus (Spruyt, Hermans, De Houwer, Vandromme, & Eelen, 2007). That means a positive prime word (i.e., “happy”) facilitates the pronunciation of a word with the same valence (i.e., “joyful”), or a negative prime word leads to a faster reaction on an evaluative judgement task where another negative target word is to be classified. The affective priming effect could be shown with various types of stimuli that were employed as primes, reaching across almost all senses (Fazio, 2001). This also holds true when prime and target are different types of stimuli that are only congruent on their affective dimension, like picture-word pairs (Zhang, Li, Gold, & Jiang, 2010). Hermans, De Houwer, and Eelen (2001) pointed out inter-individual differences, as affective priming effects seem to be stronger for participants that tend to consciously evaluate various things in their surrounding more often than others.

Affective priming effects can be observed even when the actual prime is presented subliminally, that is, without the conscious awareness of the participant (e.g., Damian, 2001; Klauer, Eder, Greenwald, & Abrams, 2007; Ansorge, Khalid, & König, 2013). While there are numerous ways of making a prime stimulus impossible to perceive by human senses, the method of masking is one used frequently, because of its effectiveness (Forster, 1998). In the masked priming paradigm, a prime stimulus is preceded and/or followed by a mask that completely hides it (i.e., a prime word is preceded and/or followed by a string of random letters that occupies a larger space on a computer screen than the prime word itself, or a white screen filled with various spots is used to hide a picture prime). The purpose of this method is to eliminate “the opportunity for higher processes to influence the response to the target” (Forster, 1998, p. 210). In other words, the meaning of masking is to prevent top-down processes, such as reasoning or planning, from influencing the outcome of an experiment using the priming paradigm.

Even though our visual cortex identifies and classifies visual stimuli, no matter if we are aware of them or not (Storbeck & Clore, 2007, Damian, 2001), congruency

effects of masked semantic priming are usually smaller and more difficult to detect (Klauer, Eder, Greenwald, & Abrams, 2007). Therefore masking is used to prevent an intentional use of the semantic content of a word, which in turn would lead to more response priming (Ansorge, Kiefer, Khalid, Grassl, & König 2010). On the other hand, Klauer, Eder, Greenwald, and Abrams (2007) could show masked priming effects for novel stimuli, which are stimuli that participants could not have practised during the course of the experiment. Hence they argued for a two-component explanation of masked priming: The first component are response-related stimulus-associations that participants could practise over the course of the experiment called short-term meaning. In other words, what participants are supposed to do when a stimulus is presented. The second component is the semantic long-term meaning of the masked prime represented in memory. This means how objects are actually remembered and what actions they usually convey. For instance, the long-term meaning of the word “chair” holds everything that someone might do with a chair, how a chair looks like, how it feels like and what sets it apart from other things, like a stool, a table or cupboard. The short-term meaning of the word “chair” is what response participants are supposed to give once that word is presented (i.e., push one of two buttons).

Wentura and Degner (2010) also found subliminal priming effects for non-practised, novel stimuli. They pointed out, however, that the speed condition was a crucial factor for obtaining robust masked affective priming effects. A key component for finding stable masked affective priming effects was also that the prime and target stimuli were of the same type of relevance, that is if the object in question is relevant to the task at hand. This leaves room for speculations, whether some kind of control processes are at work outside of participants’ awareness, which regulate the processing of subliminally presented stimuli.

An experiment done by Ansorge (2004) showed that this might be the case. When participants had to process two different masked primes for two different spatial classification tasks which followed an irregular sequence throughout the course of one experiment, the congruence effect for the more frequent task decreased over time as the other task interfered with the processing of the first prime, producing “evidence for

top-down contingencies of the processing of non-consciously registered visual information”, in a way that “invisible primes exert their influences on information processing to the extent that their features match currently active control settings directed to visible analogues of the masked primes” (Ansorge, 2004, p. 1145).

2 Empirical analysis

2.1 Purpose of this research

The question that was introduced above is now to be analysed empirically: How are valence and verticality related to each other? To be more precise, what is the exact relation between positivity and high vertical position as well as negativity and low vertical position?

A classic priming paradigm was utilized in the present experiment, where primes were presented subliminally – that is, without the participants awareness – so it could be shown, whether this relation is based on willingly used, strategic processes or unconscious, automatic process. The analysis then took a closer look at any possible congruence effects that would show up in the end.

Two theories come to mind *a priori*: (1) words portraying verticality (i.e., “below”) might influence participants’ responses classifying words polarized with affect (i.e., “war”) when they are used as preceding prime stimuli and (2) prime words polarized with affect (i.e., “puppy”) might influence participants’ responses when later classifying words portraying verticality (i.e., “high”). Because of available resources, only the second theory will be put to the test here.

Put in other words, do word primes that are polarized with affect influence the time needed to classify the semantic meaning of words indicating a vertical position in space, or the accuracy of this classification?

To further analyse the necessary degree of conscience as well as the necessary processes of elaboration, the prime words were presented subliminally. To achieve this, prime presentation time was set to 34 ms and the prime stimuli were preceded by

a mask (forward mask) as well as followed by a similar one (backward mask). So in the experimental condition a masked prime was presented which was a word polarized with positive or negative affect (i.e., “love” or “war”). Then a target word was presented that described a vertical position in space (i.e., “above” or “under”) and this target had to be classified as quickly as possible, whether it described a high or low vertical position in space.

Several other conditions were implemented to act as control conditions. To get a frame of reference, prime words were used that described a vertical position in space as well, as a priming effect on target words of the same type could be expected *a priori*. In order to compare the effects of the masked primes, a visible control group had to be introduced as well. The primes were presented in the same way as in the masked condition, only forward and backward mask were replaced with a blank screen (see Ansorge, Khalid, & König, 2013)

As to the nature of the underlying processes, two alternate hypotheses apply. If the processes underlying an affective priming effect are automatic and unconscious, then the congruence effect should decline over time, so with answers that took very long (high RT) the congruence effect should reach a minimum. If, however, strategic processes are causing a priming effect, then the congruence effect should remain stable over time. Because of the speed condition in the experiment, error rates will have to be analysed to check for speed-accuracy trade-offs.

The null hypothesis would say that there are no statistically significant effects of affective priming at all.

All hypotheses concerning the relation of congruence effect (CE) spread across the five quintiles (qX) are formalized in Table 1 below.

Table 1: *Formalization of Hypotheses*

Hypothesis	Relations of dependent variables
<i>H1</i> : Automatic Process	$CE(q1) > CE(q2) > CE(q3) > CE(q4) > CE(q5)$
<i>H2</i> : Strategic Process	$CE(q1) \simeq CE(q2) \simeq CE(q3) \simeq CE(q4) \simeq CE(q5)$
<i>H0</i>	$p(CE) > 0.05$

2.2 Methods

2.2.1 Participants

A total of twenty-six people (seven male) participated in the experiment, of which four were recruited out of the personal circle of acquaintances and twenty-two were psychology students who had to participate in a number of experiments for the department of common psychology, which was a course requirement. The psychology students were randomly assigned by RSAP administration software. Two participants had to be excluded from the analysis because their mean error rates were higher than double the standard deviation. Mean age of the remaining 24 participants was 21.8 with a range of nineteen to twenty-seven years. All of the twenty-four participants included in the analysis spoke German fluently and three of them were left-handed. Every participant had normal vision or corrected to normal vision by glasses or contact lenses.

2.2.2 Apparatus

The windowless room was dimly and indirectly lit by two table lights only. The head of each participant was mounted on a chin mounting to assure a distance of fifty-seven centimetres from the seventeen inch CRT display and to keep the viewing direction constant. Both displays had a refresh rate of 60 HZ.

The testing itself was done on two Pentium S DOS computers, allowing two participants to be tested simultaneously. One Computer was clocked at 133 MHz and equipped with 64 MB RAM, the other was clocked at 75 MHz and equipped with 16 MB RAM. Both were able to run ERTS (Experimental Run Time System) software which was used to analyse the response data that were recorded on a standard keyboard..

The buttons “4”, “5” and “6” of the numeric keypad were used in the experiment. Button “5” was used to continue to the next testing sequence (of a total of two-hundred-forty sequences times two sessions) and buttons “4” and “6” as answer buttons. The twenty-four testing sessions were divided into four settings: in setting one

and three participants had an answer key mapping of “4” for “up” as well as “prime and target are congruent” and “6” for “down” as well as “prime and target are incongruent” and in setting two and four it was the other way around; settings one and two were first presented with the item set of the masked prime condition and later with the item set of the unmasked prime condition; settings three and four worked with the unmasked primes before the masked ones. The answers on the keyboard were recorded automatically and the data was later analysed with PASW statistics software.

2.2.3 Stimulus Material

Prime and target words were four times ten German words. One group of words had a semantic connection to a high vertical position in space (“up”-words), another group had a semantic connection to a low vertical position in space (“down”-words). The other two groups were words polarized with positive or negative affect. The words that were used as primes were taken from all four groups whereas the words that were used as targets were only taken from the first two groups that were describing a vertical position in space, in other words, the “up”-words and the “down”-words.

The list of words was a sample taken from a previous study by Klauer, Eder, Greenwald, and Abrams (2007) and are shown in table 2. Each of the twenty target words was paired with the remaining thirty-nine prime words, resulting in a prime-target set of $20 \times 39 (= 780)$ different pairs. Those pairs were distributed evenly throughout all conditions and had an even chance of being congruent or incongruent. The combination was at random, though the prime word was never identical to the target word, to avoid repetition priming (Forster, 1998).

Selection of the stimulus material was based on their relative similarity of the text bodies, their relative similarity in length, and on how easily they were to be discerned as members of one category and not the other. The stimulus material was presented in black font ($< 1 \text{ cd/m}^2$) on a grey background (24 cd/m^2) on the centre of the computer screen with an interstimulus stimulus interval (ISI) of 0 ms.

Table 2: *List of words used as primes*

“up”-words	“down”-words	Positive words	Negative words
oben (at the top)	unten (below)	baby (baby)	eklig (disgusting)
darueber (above)	darunter (beneath)	erde (earth)	killer (killer)
hinauf (up)	hinab (downstairs)	schoen (beatiful)	krieg (war)
aufwaerts (upward)	abwaerts (downward)	sanft (gentle)	mord (murder)
empor (aloft)	herab (down)	huebsch (pretty)	wirr (confused)
hoch (high)	niedrig (low)	melodie (melody)	habsucht (avarice)
gehoben (heightened)	gesenkt (lowered)	komik (comedy)	hass (hate)
erhoeht (elevated)	abfallend (gradient)	welp (puppy)	boes (evil)
aufsteigend (ascending)	sinkend (sinking)	lilie (lilly)	satan (satan)
steigend (rising)	tief (deep)	lied (song)	untat (misdeed)

Table 3: *List of words used as targets*

“up”-words	“down”-words
oben (at the top)	unten (below)
darueber (above)	darunter (beneath)
hinauf (up)	hinab (downstairs)
aufwaerts (upward)	abwaerts (downward)
empor (aloft)	herab (down)
hoch (high)	niedrig (low)
gehoben (heightened)	gesenkt (lowered)
erhoeht (elevated)	abfallend (gradient)
aufsteigend (ascending)	sinkend (sinking)
steigend (rising)	tief (deep)

Every trial sequence began with a fixation cross that was presented for 750 ms. In the case of a masked prime, the fixation cross was followed by a string of ten random capital letters that were presented for 200 ms to act as forward mask, then the prime word was shown for 34 ms, followed by a backward mask of the same kind as the first mask that was presented for 34 ms. After that, the target word was presented for 200 ms. In the case of an unmasked (visible) prime, forward mask and backward mask were replaced by a blank screen with the same presentation times. Thus a stimulus

onset asynchrony (SOA) of 68 ms was realized. The order and time course of a masked trial as well as an unmasked one are shown schematically in figure 2. Stimulus presentation times were taken from a previous study with low visibility of prime stimuli (Ansorge, Khalid, & König, 2013).

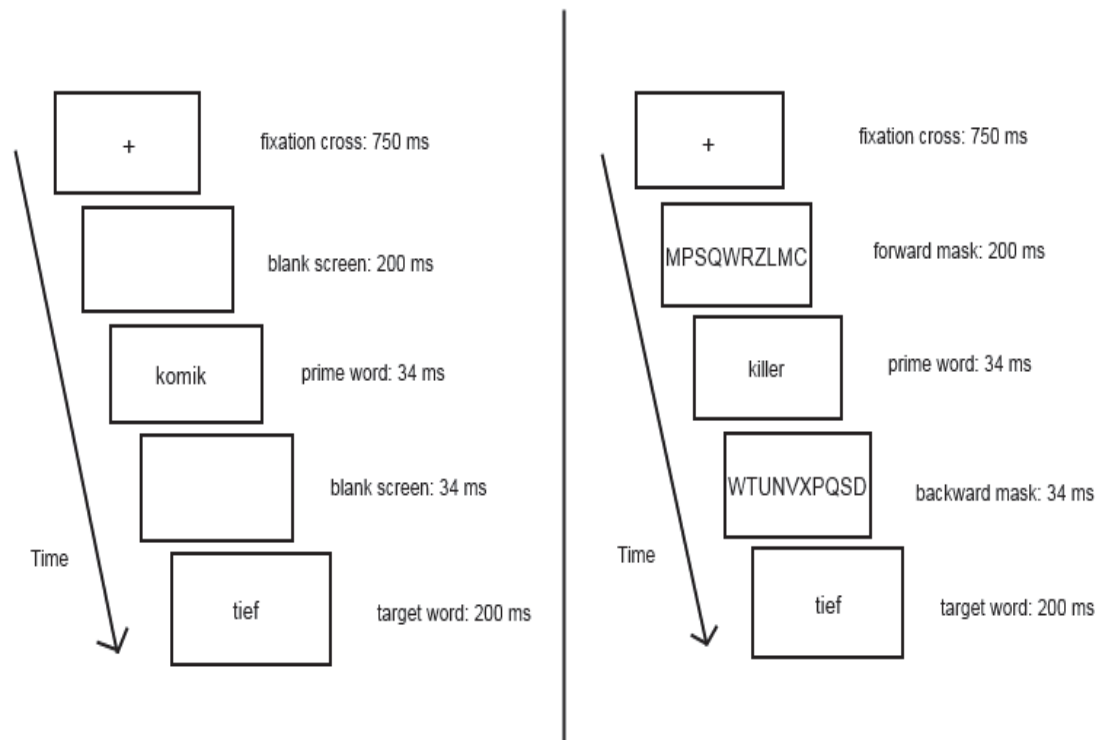


Figure 2: Schematic of a sequence with a visible, incongruent, affective prime on the left and one with a masked, congruent, affective prime on the right.

2.2.4 Experimental Design

Every experimental trial consisted of one experimental part and one evaluation part. In the experimental part, participants should react to the target word (classifying it as an “up”-word or a “down”-word) by pressing a key with the index finger of their dominant hand on the numeric keypad according to instruction (either “4” or “6” on the numeric keypad). After that, in the evaluation part, they were asked by a text on screen to judge whether the prime word was congruent with the target word (i.e., a word polarized with positive affect before an “up”-word target) or incongruent with it

(i.e., a word polarized with negative affect before an “up”-word target). The same keys were used for the evaluative answers that were used for the semantic classification task, in a way that the key indicating an “up”-classification was also used for a congruent judgement. Whether prime-target pairs were congruent or incongruent was varied at random each trial with the chance of an incongruent trial as high as the chance of a congruent one (see table 4 for a description of incongruent and congruent trials).

The sequence of the two conditions was varied, so half of the participants started with masked primes and the other one with visible ones. Whether the “4” key was used for “up” classifications as well as congruent judgements was also balanced across participants, thus creating 4 different settings for the experiment. There were 240 trials in each setting that were preceded by 20 practice trials.

Table 4: *Possible prime-target pairs and correct answers to classification as well as evaluation task for settings 1 and 3 (settings 2 and 4 had opposite key-mapping)*

Seq.	Target	Prime	Congruence	Category	Target classification	Prime evaluation
1	up-word	up-word	congruent	same	Key N° 4	Key N° 4
2	down-word	down-word	congruent	same	Key N° 6	Key N° 4
3	up-word	positive word	congruent	different	Key N° 4	Key N° 4
4	down-word	negative word	congruent	different	Key N° 6	Key N° 4
5	up-word	down-word	incongruent	same	Key N° 4	Key N° 6
6	down-word	up-word	incongruent	same	Key N° 6	Key N° 6
7	up-word	negative word	incongruent	different	Key N° 4	Key N° 6
8	down-word	positive word	incongruent	different	Key N° 6	Key N° 6

2.2.5 Procedure

All testing was done in room TRK-5 in the basement of the psychological faculty

building. Two people were always tested simultaneously. After filling out some demographic data, everybody had to sign a consent form, saying that they were willing to participate in a psychological experiment and that the data they generated could be used for scientific purposes.

Instructions were given on the computer screen in the beginning of each block. Additionally, all participants received an oral explanation, to make sure that instructions were understood completely. If any questions would come up during the testing, participants could ask them at any time, as every trial required the pressing of the “5” key to set off the next prime-target sequence. That way, participants could take a break whenever they felt in need of one and there was a scheduled break between the two blocks as well. Including instructions and breaks, each testing took between 70 and 85 minutes, though one participant was able to finish both blocks in 45 minutes.

The only feedback participants would receive was when they were giving a wrong answer or took too long (more than 1250 ms) to press the right button in the classification task. If so, a remark was shown on screen for 750 ms, indicating a wrong answer or telling the participant to work faster, in order to assure speed and accuracy of the participants’ answers. No feedback was given after the evaluation part, when judgements on prime-target congruence or incongruence should be given, since neither speed nor accuracy were an issue with that task.

All testing could be completed without any disturbances or complications and each participant was offered a small chocolate bar as a tiny token of appreciation when he or she was done.

2.3 Results

2.3.1 Analysis of prime visibility

It is important for all the rest of the analysis to be certain that the experimental design worked the way it should have and the two different forms of prime presentation really made a difference to prime visibility. So the d' -value (see Reingold & Merikle, 1988) of all four prime types must be computed and while the primes in

the masked condition should not differ significantly from zero, the primes of the visible condition should.

The correct judgement of a congruent trial as “congruent” was noted as a “hit”, while the incorrect judgement of an incongruent trial as “congruent” was noted as “false alarm”. The individual d' values were computed as the difference of the z-transformed hit-rates and the z-transformed false alarm rates. Then the mean values of the four conditions (masked spatial; masked affective; visible spatial; visible affective) were tested against zero via t -test. A significant result – if the value of d' was significantly different from zero – would indicate the visibility of the prime, while a non-significant result – if the value of d' did not differ significantly from zero – would indicate a prime’s lack of visibility, as correct discerning of the prime would then be near chance level (50%).

The spatial primes of the visible condition were the most clearly visible for all 24 participants that were included in the analysis, with a mean d' of 0.93 ($t(23) = 6.04, p < 0.01$), followed by the affective prime of the visible condition with a mean d' of 0.39 ($t(23) = 2.72, p = 0.01$). With both primes of the visible condition clearly differing from zero in their d' -values, visibility of the prime words was proven. The masked condition reveals that neither of the primes differ significantly from zero (masked affective prime: $d' = 0.01, t(23) = 0.26, p = 0.80$; masked spatial prime: $d' = 0.08, t(23) = 1.38, p = 0.18$), so the masking procedure can be deemed successful.

These results (depicted in figure 3) show that assumptions about the design were correct and that there is a clear difference in prime visibility between both conditions.

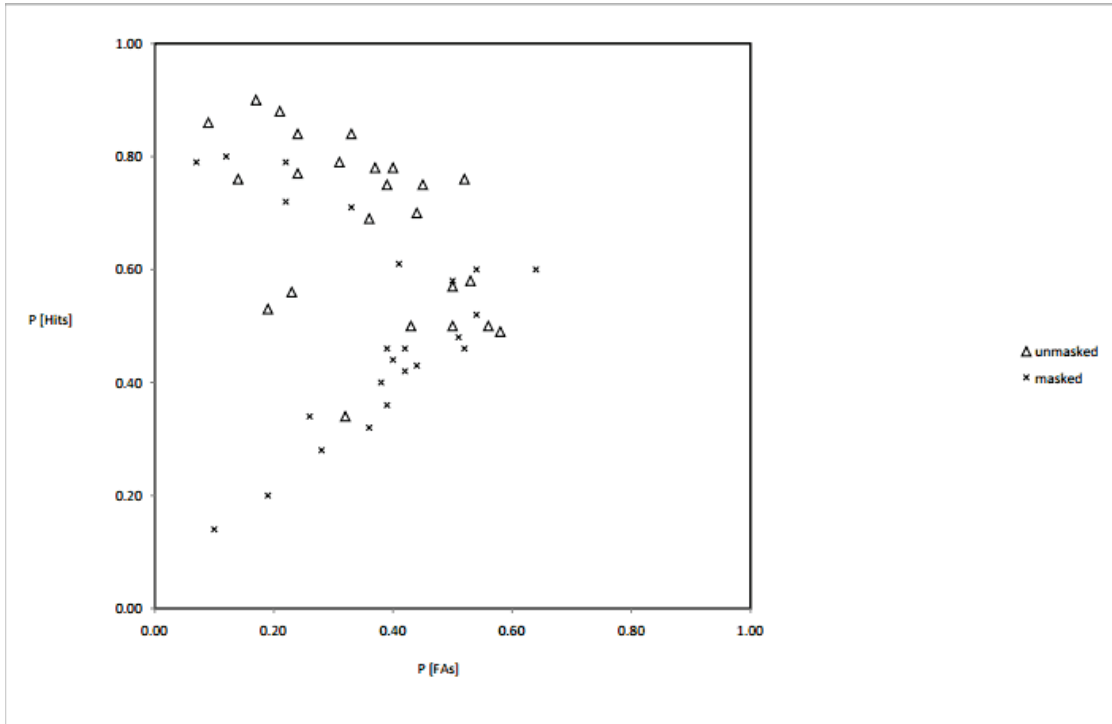


Figure 3: Individual hit rates on the y-axis as a function of the individual false alarm rates on the x-axis.

2.3.2 Analysis of reaction times

A four-way-ANOVA was computed to compare the mean values of reaction times. Variable 1 was Prime Visibility (masked or unmasked), variable 2 was Quintiles (*post hoc* clustering of reaction times into fastest, second fastest, medium speed, second slowest, and slowest), variable 3 was Prime Type (whether it was an affective or a spatial prime word) and variable 4 was Prime-Target Congruency (congruent versus incongruent). All variables were dichotomous except for Quintiles which had five values, thus making it a 2x5x2x2 design.

There was a significant main effect for Visibility, $F(1, 23) = 17.14, p < 0.01$, partial $\eta^2 = 0.43$. So the reaction times of the masked condition ($M = 768$ ms) were significantly lower than those of the unmasked condition ($M = 876$ ms), which means respondents were faster with their reactions in the masked condition.

As was to be expected, there was also a significant main effect for Quintiles with, $F(4, 20) = 98.70, p < 0.01$, partial $\eta^2 = 0.952$. So respondents in the first quintile were

fastest and those in the last quintile were slowest ($M1 = 664$ ms, $M2 = 734$ ms, $M3 = 797$ ms, $M4 = 881$ ms, $M5 = 1034$ ms).

There was, however, no main effect for Prime Type, $F(1, 23) = 2.07$, $p = 0.16$, partial $\eta^2 = 0.08$, indicating that there was no significant difference in response time between affective prime words ($M = 826$ ms) and spatial prime words ($M = 818$ ms).

With Prime-Target Congruency yet another significant main effect was found with, $F(1, 23) = 11.38$, $p < 0.01$, partial $\eta^2 = 0.33$. This means that mean reaction times were significantly lower in congruent trials ($M = 814$ ms) than in incongruent trials ($M = 830$ ms).

Of the two-way interactions only Visibility with Quintiles and visibility with congruency emerged as significant, with Visibility x Quintiles, $F(4, 20) = 2.89$, $p < 0.05$, partial $\eta^2 = 0.37$ and Visibility x Congruency $F(1, 23) = 4.34$, $p < 0.05$, partial $\eta^2 = 0.16$. All other two-way interactions as well as all three-way interactions failed to reach significance, all F s < 2.2 , all p s > 0.05 . So the only conclusions that can be drawn at this point are that respondents in each quintile responded significantly faster if the prime was masked and that it took respondents longer to answer if prime and target were incongruent and the prime was unmasked (see figures 4, 5 and 6; mean values and standard deviations are noted in table 5).

However, the four-way interaction missed significance very closely, with $F(4, 20) = 2.77$, $p = 0.056$, partial $\eta^2 = 0.36$. Thus no valid conclusions can be drawn from this (see figure 7).

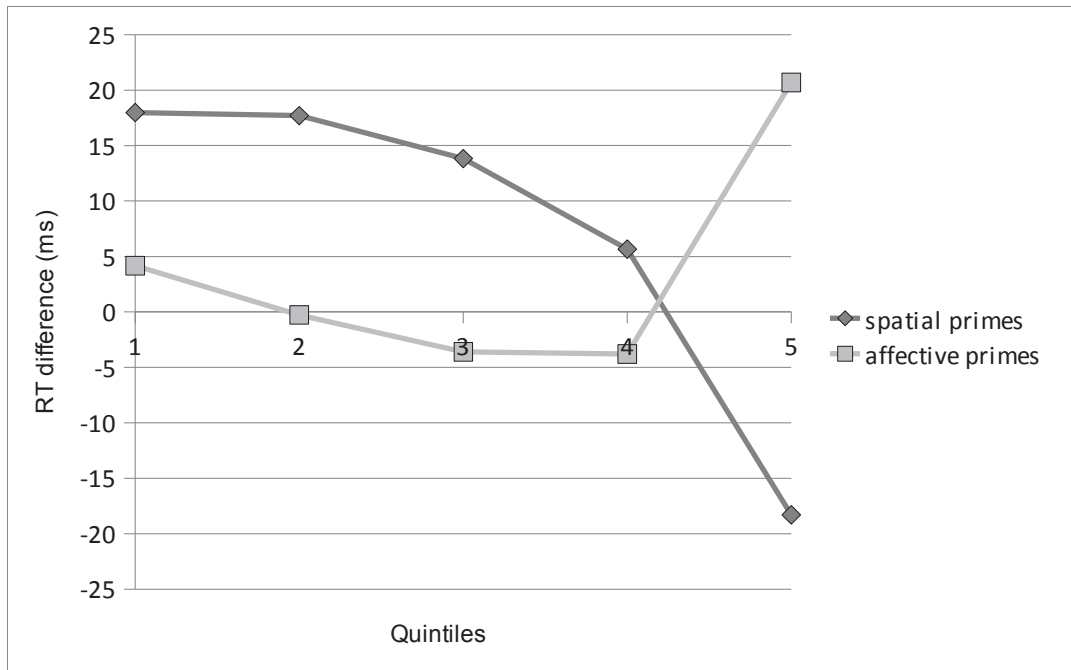


Figure 4: Time course of the congruence effect ($CE = RT_{\text{incongruent}} - RT_{\text{congruent}}$) for masked primes across quintiles

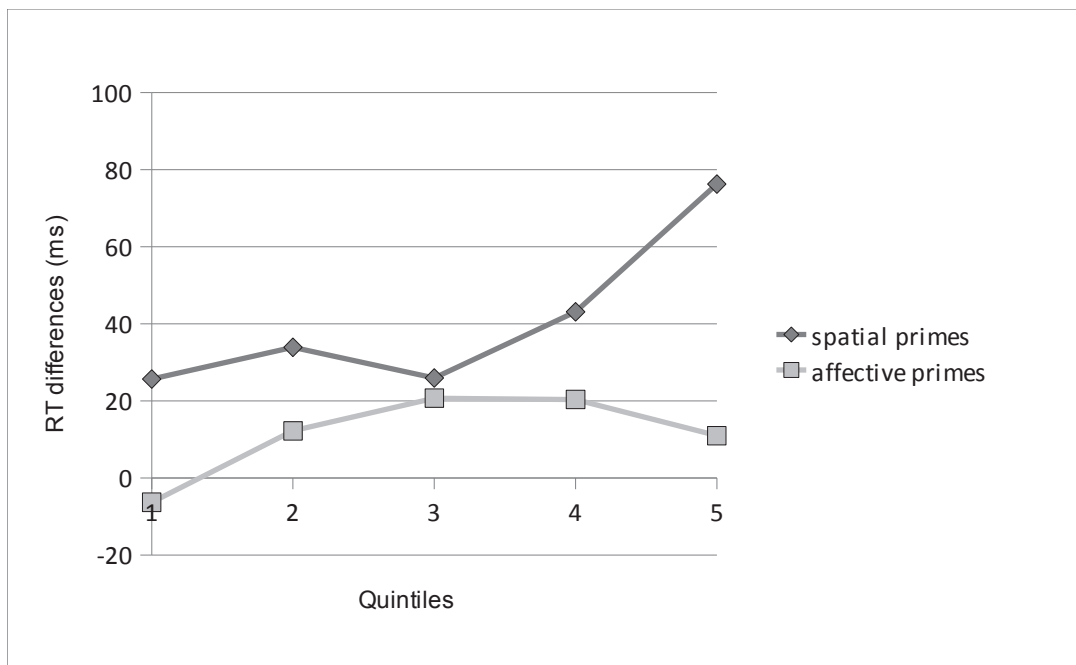


Figure 5: Time course of the congruence effect ($CE = RT_{\text{incongruent}} - RT_{\text{congruent}}$) for visible primes across quintiles

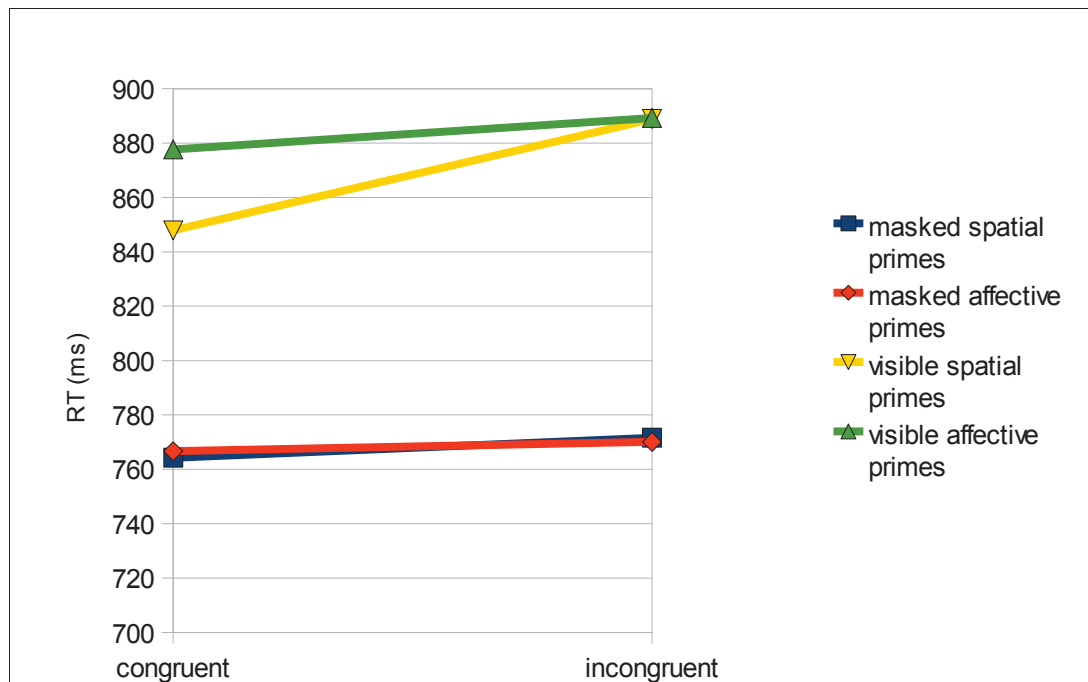


Figure 6: Difference between mean reaction times for all four priming conditions, comparing congruent trials with incongruent trials

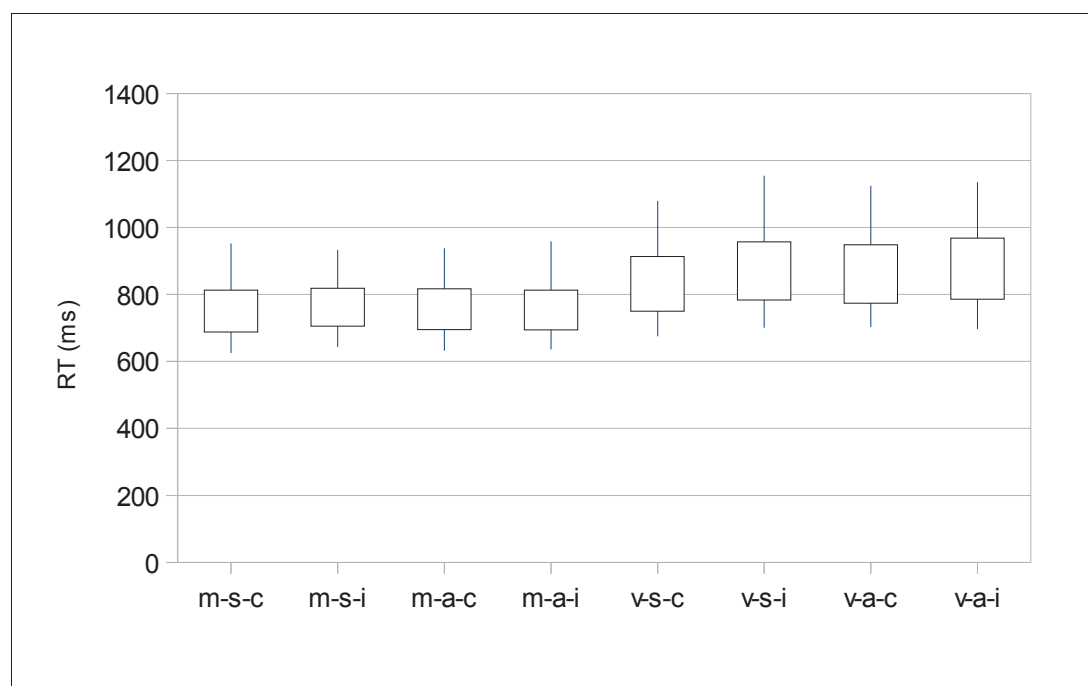


Figure 7: Plot Diagram of mean RTs in all conditions (on x-axis: m = masked condition, v = visible condition, s = spatial primes, a = affective primes, c = congruent trials, i = incongruent trials)

Table 5: Mean reaction times (in ms) and standard deviations across quintiles (fastest to slowest)

Visibility	Congruence	Spatial Prime Words		Affective Prime Words	
		Mean RT	SD	Mean RT	SD
<i>masked</i>	<i>congruent</i>	625,0854	91,42910	632,0250	78,30666
<i>masked</i>	<i>congruent</i>	687,4042	100,05905	694,6563	90,32033
<i>masked</i>	<i>congruent</i>	744,2854	111,49217	751,8896	104,85407
<i>masked</i>	<i>congruent</i>	812,8188	122,21910	816,5792	121,63412
<i>masked</i>	<i>congruent</i>	951,7000	156,88691	938,0729	148,31036
<i>masked</i>	<i>incongruent</i>	643,0688	70,28530	636,1958	87,66725
<i>masked</i>	<i>incongruent</i>	705,1062	93,54789	694,3812	96,50038
<i>masked</i>	<i>incongruent</i>	758,1083	111,44634	748,2917	105,08399
<i>masked</i>	<i>incongruent</i>	818,4792	128,58413	812,7854	117,19624
<i>masked</i>	<i>incongruent</i>	933,4083	162,40518	958,7563	164,95631
<i>visible</i>	<i>congruent</i>	675,0875	94,57943	702,8771	91,57736
<i>visible</i>	<i>congruent</i>	749,7021	99,26954	773,6438	103,24328
<i>visible</i>	<i>congruent</i>	822,6937	115,01370	839,9875	112,29086
<i>visible</i>	<i>congruent</i>	913,5167	133,48368	947,9146	154,45684
<i>visible</i>	<i>congruent</i>	1078,4167	216,99422	1124,0458	264,81213
<i>visible</i>	<i>incongruent</i>	700,7167	88,27223	696,5417	77,61866
<i>visible</i>	<i>incongruent</i>	783,5813	114,00420	785,8229	95,16168
<i>visible</i>	<i>incongruent</i>	848,6188	124,39449	860,6667	113,07227
<i>visible</i>	<i>incongruent</i>	956,5792	172,26192	968,2500	136,92535
<i>visible</i>	<i>incongruent</i>	1154,6583	236,89716	1134,9833	202,76835

2.3.3 Analysis of error rates

A three-way-ANOVA was computed for the error rates (ER) with Visibility as variable 1, Prime Type as variable 2 and Prime-Target Congruency as variable 3. A significant main effect was found for Visibility, $F(1, 23) = 4.76$, $p = 0.04$, partial $\eta^2 = 0.17$. Participants had a clearly higher ER in the visible condition ($M = 6.8\%$) than in the masked condition ($M = 3.2\%$).

Prime Type failed to reach significance, $F(1, 23) = 1.21, p = 0.28$, partial $\eta^2 = 0.05$, so no difference in ER was found between spatial prime words ($M = 5.2\%$) and affective prime words ($M = 4.8\%$).

Another significant main effect was found for Prime-Target Congruency, $F(1, 23) = 15.81, p < 0.01$, partial $\eta^2 = 0.41$. Participants had a significantly higher ER in the incongruent condition ($M = 6.3\%$) than they had in the congruent condition ($M = 3.7\%$). Compared with the results found in the RT analysis, this indicates that there was no speed-accuracy trade-off that would label the congruence effect a research artefact.

A significant two-way interaction was found for Visibility and Prime-Target Congruency, $F(1, 23) = 20.70, p < 0.01$, partial $\eta^2 = 0.74$. While there was no significant difference in ER in the masked condition between prime-target congruent trials ($M = 3.2\%$) and prime-target incongruent trials ($M = 3.3\%$), there was a significant difference in the visible condition, where participants had significantly higher ER in incongruent ($M = 9.3\%$) than in congruent ($M = 4.2\%$) trials.

Prime Type and Prime-Target Congruency also showed a significant two-way interaction, $F(1, 23) = 8.73, p = 0.01$, partial $\eta^2 = 0.28$. With spatial prime words there was a large difference between congruent ($M = 3.3\%$) and incongruent ($M = 7.2\%$) trials whereas this difference was small with affective prime words ($M = 4.1\%$ for congruent and $M = 5.5\%$ for incongruent trials). These results were in accordance with those found in RT analysis.

No significant two-way interaction could be found for Visibility and Prime Type, $F(1, 23) = 0.46, p = 0.50$, partial $\eta^2 = 0.02$, so no differences between ER could be seen in any condition.

The three-way interaction also failed to reach significance, $F(1, 23) = 0.09, p = 0.77$, partial $\eta^2 < 0.01$.

Mean values of ER as well as their standard deviations are listed in table 6 and a visual depiction of mean error rates is shown in figure 8.

Table 6: Mean error rates and standard deviations for all eight

Visibility	Congruence	Spatial Prime Words		Affective Prime Words	
		Mean ER	SD	Mean ER	SD
<i>masked</i>	<i>congruent</i>	0,0300	0,05200	0,0333	0,04860
<i>masked</i>	<i>incongruent</i>	0,0425	0,04204	0,0238	0,03360
<i>visible</i>	<i>congruent</i>	0,0358	0,05477	0,0487	0,05310
<i>visible</i>	<i>incongruent</i>	0,1008	0,09250	0,0854	0,06978

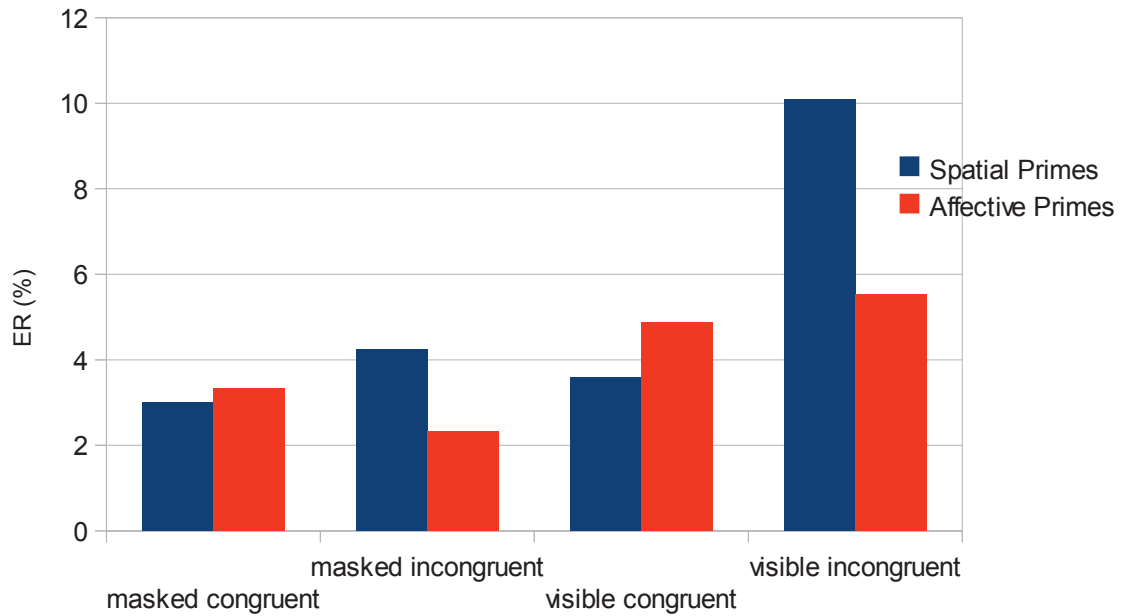


Figure 8: Mean error rates for spatial and affective primes across all four conditions

3 Discussion

The aim of this paper was to show how valence (whether something has a positive or a negative connotation) influences the classifications of verticality (see Ansorge, Khalid, & König, 2013; Meier & Robinson, 2004, Weger et al., 2007). The intention was to assess, whether it depended on conscious, strategically controlled processes, or unconscious, automatic ones. Embodied cognition theory would favour the latter explanation to be more likely, as it says that while elaborating a word, its sensumotor representation is automatically activated, therefore leading to automatic response priming, as portrayed by Damian (2001).

To answer that question empirically a priming paradigm was employed, where visible primes were used as well as a masked primes. In both conditions, words related to positive or negative affect (i.e., “melody” or “misdeed”) were used as prime stimuli in experimental trials, and words describing a vertical position in space (i.e., “ascending” or “below”) were used as prime stimuli in control trials. The target words in all trials throughout both conditions were exclusively those that described a vertical position in space. To see if there were any congruence effects, variances of reaction times and error rates of target classifications were analysed, depending on the variables Prime Visibility, Prime Type, and Prime-Target Congruency. In the case of reaction times, their means were clustered into quintiles, reaching from fastest to slowest.

The results of previous research (see Meier & Robinson, 2004; Meier et al., 2007; Weger et al., 2007) indicated associations between valence and verticality as a congruence effect could be observed. That is, participants reacted faster and more accurate to the target words in congruent conditions – when the prime word was positive (i.e., “beautiful”) and the target word of higher spatial meaning (i.e., “aloft”), or the prime word was negative (i.e., “murder”) and the target word of lower spatial meaning (i.e., “below”) – than in incongruent conditions.

However, a recent study done by Ansorge, Khalid, and König (2013) indicated

that while this is true in the reverse case – when target words are of positive or negative valence and the prime words confer spatial meaning – they could show in their experiment 2 that no significant congruence effects were to be found with spatial target words and affectively polarized prime words. Since the present study is a direct replication of experiment 2 by Ansorge, Khalid, and König (2013), only with valence primes taken from Klauer, Eder, Greenwald, and Abrams (2007), expectations were mixed.

The results of the present study are in line with Ansorge, Khalid, and König (2013), as neither reaction times nor error rates revealed any congruence effects with masked affective prime words. Visible affective prime words failed to produce significant congruence effects as well, therefore the question, whether valence primes influence the classification of semantic targets through conscious, strategic processes or unconscious, automatic ones, cannot be answered, as those results point out that they do not exert any influence at all.

Still, two interesting observations could be made: (1) The distribution of RTs across the five quintiles with affective primes in the masked condition (see figure 4) is U-shaped, with the (still insignificant but positive) congruence effect being roughly five times higher in the last quintile (longest RTs) than in the first one (shortest RTs), while the less extreme quintiles even produced a tiny negative congruence effect. In absolute numbers, this means that in trials where participants took a whole second to classify the target, a difference in RT of averagely 20 ms could be observed between incongruent and congruent trials, while faster reactions only produced a difference of roughly 3 ms (4 in the first, 0 in the second, and -3 in quintiles number 3 and 4, actually indicating, that participants answered more quickly in incongruent trials than in congruent ones). That is in line with the results of Degner (2009), who showed in her experiment 3 that moderate time pressure, resulting from a response deadline, caused participants' efforts to moderate the effect of affective priming to fail. Thus it could be interpreted, that while participants stressed their reaction speed as best as they could, affective priming effects could not take hold, but when they were less in a rush an affective priming effect could be observed.

This can be related to the findings of Naccache et al. (2005) who studied the activity of the amygdala in three epileptic patients who had to classify subliminally presented, novel emotional words as threatening or non-threatening. They observed that the amygdala's activity was modulated at a long latency, roughly 850-950 ms (Naccache, Gaillard, Adam, Hasboun, Clémenceau, Baulac, Dehaene, & Cohen, 2005). To Klauer, Eder, Greenwald, and Abrams (2007) this could be seen as evidence that the emotional valence of these words was accessed semantically. So, even though the current results are not statistically significant, they are not *insignificant*, as they might give a hint on the amygdala's importance for the automatic elaboration of various affective stimuli.

Also, (2) RT differences between the incongruent and congruent condition for affective primes in the slowest quintile seem to contradict the theory that masked primes produce weaker effects than visible primes (Klauer et al., 2007). In the present study, responses that fell into the slowest quintile produced a congruence effect in the masked condition that was nearly twice the size of the congruence effect in the visible condition (20,7 ms in the masked condition versus 10,9 ms in the visible condition). Spruyt, De Houwer, Hermans, and Eelen (2007) hypothesized that selective attention on semantic features of a stimulus rather than on affective ones would hamper affective processing of the stimulus. According to this, it could be argued that the visible condition together with the long reaction times might promote these processes which in turn dampen the effects of the affective prime words.

These two findings, taken together with the more or less constant (yet still not significant) congruence effect of visible affective primes and the higher error rates in the visible condition as well as with incongruent trials, it could be hypothesized that strategic, awareness-dependant processes are at work that promote affective influence in lack of awareness but hamper it once most of the necessary information is gathered. This seems consistent with the popular theory, that rational decisions need more time than emotional ones, as well as many recent findings in social cognition (see Bless, Fiedler, & Strack, 2004 for references).

In other words, the findings of the present study – even though not statistically

significant – suggest that effects of affective priming are more likely to be related to semantic priming rather than response priming. This might seem to be at odds with embodied cognition theory which says that cognitive processes are linked directly to sensorimotor experiences which in turn activate the same sensorimotor areas. However, Storbeck and Clore (2007) conclude that affective information is represented together with semantic information in a single semantic network, where semantic information has the necessary priority, since an object has to have meaning first before it can have an emotional valence. This holds particularly true for written words which must be semantically encoded (= understood) first, before they can transport any kind of affect.

The control condition – with prime words and target words being of the same kind – produced significant results. A significant congruence effect could be observed in the visible as well as the masked condition and the analysis of error rates bolsters this result, as participants were able to classify the target words faster and made fewer mistakes in congruent trials than in incongruent trials. This is in line with previous research on semantic priming (i.e., Klauer et al., 2007; Ansorge et al., 2010; Ansorge, Khalid, & König, 2013) and the significant results in the masked condition lead to the conclusion that the method which was employed in the experiment was sensitive enough to measure processes of unconscious elaboration of subliminal stimuli.

A closer look at RT distribution across quintiles reveals a different time course of the (statistically significant) congruence effect for semantic primes between the masked and the visible condition. In the visible condition, there is a more or less constant increase of the congruence effect, as the positive difference between RTs for classifying a target word in an incongruent trial and RTs for classification in a congruent trial became more with higher, absolute RT. In other words, when it took participants longer to react to the target word, their reactions were facilitated more by the prime words congruent with the target, as the mean difference of 76,2 ms between incongruent and congruent trials in the last quintile shows, compared to a mean difference of 25,6 ms in the first quintile (with mean differences of 33,9 ms, 25,9 ms, and 43,1 ms for quintiles 2, 3, and 4).

In the masked condition, the direct opposite could be observed. While the

congruence effect in the fastest and second fastest quintiles was high with 18,0 ms, and 17,7 ms respectively, it approached zero in the second slowest quintile (5,7 ms) and became negative in the slowest one, with -18,3 ms. This negative congruence effect that could be observed with the slowest answers indicates a reversed priming effect, which can be attributed to strategic correction processes (Fockenberg, Koole, & Glaser, 2006). DeHouwer, Hermans, Rothermund, and Wentura (2002, p.648) explain negative priming effects with “a response conflict on trial n-1” that “leads to the inhibition of the semantic representation of the irrelevant information that caused the response conflict. If the information that was irrelevant on trial n-1 is relevant on trial n, this inhibition needs to be overcome and responses will be delayed (e.g., Tipper, 1985)”. This seems to be a viable explanation for the present experiment, as trials with semantic prime words as well as affective prime words were presented in a random sequence. Thus it seems feasible that affective prime words represented this “irrelevant information” in the present study.

Although these results do not contribute directly to answering the question, how affectively polarized prime words influence the classification of semantic targets, they point to conclusions which are backed up by statistical significance. As the graphs in figure 4 and figure 5 show, (1) the congruence effect in the visible condition seems to be based on semantic priming, which means the predominance of conscious, strategic processes that facilitate the response to a target. These processes become more effective the longer a respondent takes to classify the target. In contrast to this, (2) evidence of response priming can be found in the masked condition, as the congruence effect constantly decreases over time (see Damian, 2001). Yet, it is not certain whether this comes from a truly automatic process in the form of a pure visumotor reaction that is influenced by the prime stimulus alone, or a strategic process that induces response conflict, as explained above by DeHouwer, Hermans, Rothermund, and Wentura (2002).

The results of Bartholow, Riordan, Sauls, and Lust (2009) who used EEG data gained from participants completing an evaluative decision task, are in favour of the strategic explanation. Even though these results were produced in an affective priming

paradigm, the similar nature of the evaluative judgement task and the semantic classification task justifies a direct comparison.

This means that strategic processes seem to be the reason for semantic priming as well, but the conclusion of Damian (2001) about response priming being an automatic process cannot be falsified by the present research, as the present results might ultimately depend on the fact that trials with semantic prime words were randomly mixed with trials where affectively polarized prime words were presented as well.

3.1. Limitations and implications for future research

The present research was limited to the study of “the sequence of non-evaluative versus evaluative meaning extraction with regard to only one particular class of stimuli (words) and one particular type of non-evaluative meaning (spatial meaning).” Therefore, it cannot be told “whether a similar sequence holds with other stimuli and alternative types of meaning. It is possible, for example that specific valence stimuli, such as emotional facial expressions, are processed as quickly or even quicker than certain stimuli with a non-evaluative meaning” (Ansorge, Khalid, & König, p. 13).

One particular problem with words is that their meanings seldom transport the same valence to everybody. This can have various reasons, such as cultural upbringing, personal preferences, or lived experiences. This leads to an equal number of confounding factors regarding the affectively polarized words. While culture did not seem to be a large factor, as all participants were university students with German as their mother tongue, there was more discussion about values, before the list of affective stimuli was finalized. The list of affective prime stimuli was taken from Klauer et al. (2007) and initially contained words like “gold” and “treasure” as positive prime words. Those were dropped later and replaced by others, as a discussion came up of whether participants that would happen to have post-materialist values could evaluate them as negative instead. Regarding the final list of positive prime words, however, it can be argued that this discussion could have expanded on various other topics that people could have different opinions on. The word “baby”, for instance, might be evaluated more negative by a person disliking children and the

word “lily” might not be affectively polarized at all for a person not interested in nature and even be negative to someone who is reminded of a funeral. On the other side of the spectrum, the evaluation of words like “war” or “killer” may vary greatly between participants as well. People spending their spare time with paint-ball or popular violent computer games might first be reminded of those hobbies than of real world events. Similar arguments could be valid for other words from the list of negative prime words that have been used. Normally, inter-personal differences are not the focus of cognitive science and it is questionable, whether the method employed in the current experiment could be fine tuned to portray these differences at all.

Another reason for criticism might be that no neutral condition was used, neither for affective primes nor for spatial ones. In a recent study Werner and Rothermund (2013) found a way to both integrate a neutral condition into the affective priming paradigm and keep the answer options dichotomous. They asked participants to evaluate target words as “valent” or “neutral” and then measured the affective congruence effect as valent trials could still be divided into congruent trials and incongruent ones, because valent words were either positive or negative. While they found a significant associative priming effect for targets with semantically related prime words that exemplified the accuracy of their method, no affective congruence effect could be obtained by comparing RTs and ERs. They concluded, that because their method eliminated the possibility of response competition and no significant affective congruence effect was found, “affective congruency effects might be overshadowed by response competition effects” (Werner & Rothermund, 2013, p. 128).

It might be worthwhile to look more closely into this matter, maybe even going one step further, asking what would happen if spatial primes were grouped the same way with a neutral condition comprising words like “around”, “between”, or “middle”, since Klauer and Musch (2001) already argued that affective priming is just a specific form of semantic priming.

The test for prime visibility seemed to be troublesome as well. While it is evident that statistical certainty, whether masked primes were really invisible and unmasked

primes were really visible, is necessary for further analysis of the primary task (the classification of spatial words), it is possible that the evaluation task which was employed as visibility test became a confounding factor.

Ansorge, Khalid, and König (2013) concluded from previous studies that their prime visibility scores were no artefacts of that specific method. They further proved experimentally that their observed congruence effects, when the target words were affectively polarized words to be classified as positive or negative and the prime words had spatial semantic meaning, were neither artefacts of their visibility test that was done after the classification task. However, the extra amount of cognitive load that this method of testing visibility put on every participant was never analysed. Degner (2009) showed that high cognitive load minimized effects of affective priming and Ansorge (2004) found out that top down processes interfere with automatic semantic priming in a more complicated dual-task experiment. Thus it is impossible to rule out that the evaluation task that followed every single classification task and the extra cognitive load it produced, was not confounding the congruence effect for affective prime words.

The large difference in visibility between spatial and affective prime words should be mentioned here as well. One would not expect that much influence of Prime Type on the visibility of prime words in the masked and the visible condition *a priori*, yet the differences are substantial ($d' = 0,93$ versus $d' = 0,39$ for visible spatial primes and visible affective primes, and $d' = 0,08$ versus $d' < 0,01$ for the masked condition respectively). Two explanations for this phenomenon come to mind.

The first is in line with the argument above about the cognitive load and would prove the point, that the evaluation task produced a higher cognitive load for participants. The low visibility scores, compared to spatial primes, might have been the result of more mistakes in the evaluation task (an artificially high False Alarm rate, resulting from more frequent “congruent” answers in case of ambiguity – i.e., “earth” and “low”), at least in the visible condition. This cannot explain the difference in visibility in the masked condition, though, as participants could only guess, whether the prime-target pairs were congruent or not, when they could not see the primes

because of the masking procedure.

The other explanation is that those prime words that were nouns could not be interpreted correctly because they were spelled wrong. All participants went through at least twelve years of school, before they were admitted to university. This means twelve years of learning how to spell German words correctly. Spelling German nouns without a capital first letter is not correct, but that was due to the settings of the experiment. This might be an indication for top-down processes that interfered with word perception.

The final point of criticism lies in the explanation that preceded the experiment and the focus it set for participants. First, it seemed to be too complicated, since several participants expressed that they did not understand what exactly they were supposed to do, after reading the two computer screens full of instruction. So oral explanations were needed to simplify the information and clarify what the evaluation task (congruent versus incongruent) was requiring of them. This observation bolsters the argument about the cognitive load from above, which might have lead to a dampening of the following affective priming effect. Second, and more importantly, explanations focused on the semantic short-term meaning of the affectively polarized prime words (the meaning they would have only throughout the experiment). In a nutshell, it said positive words would be equivalent to up-words and negative words would be equivalent to down-words, so judgements of congruence and incongruence should be done accordingly (while the primary task was still to classify only the up- and down-words as one or the other).

As it was already discussed above, putting the focus on semantic content sets the relevance of affective polarity in the background, thus dampening any possible affective priming effect (Spruyt, De Houwer, Hermans, & Eelen, 2007). The question that needs to be asked here is – also as an idea for future research – would there be different results if the explanation of the visibility test (the congruent versus incongruent evaluation task) was explained the other way around? If the explanation was something similar to “up-words are good and down-words are bad”, would the focus be shifted sufficiently to the affective content and thereby facilitate the affective

priming effect? One could go even further and implement metaphors in the explanation that are linked to embodied cognition theory. If participants were told, for instance, to give a “thumb-up” to positive words as well as up-words and negative words and down-words would get a “thumb-down” instead, would there be a significant congruence effect for a sequence of two “thumb-up” words, and would a similar time course for the congruence effect be observed that would indicate response priming according to ECT?

3.2 Conclusion

In the present experiment, no significant effects of affective priming could be found on the semantic classification of spatial direction when using words as both prime and target stimuli, neither with masked prime words nor visible prime words. The control conditions of spatial prime words paired with spatial target words produced a significant effect with both visibility conditions, indicating a sufficient sensitivity of the method that was employed.

While no scientific method can ever truly verify a hypothesis, the results of the present study point towards a high likelihood of the null hypothesis, that affectively polarized prime words do not effect the semantic classification of target words, neither in speed nor accuracy. So the question, whether any priming effects would be due to automatic, unconscious processes or strategic, conscious processes has to remain unanswered.

Analysis of the control condition, however, indicated that in the case of true semantic priming, both kinds of processes might be at work, depending on the visibility of the prime stimulus. This understanding results from the time-course analysis of the congruence effect across quintiles that showed a pattern related to automatic response priming when primes were invisible and one that is typically seen with category priming when primes were visible.

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5 List of Figures

<i>Figure 1: Schematic difference between semantic priming and response priming</i>	12
<i>Figure 2: Schematic of a sequence with a visible, incongruent, affective prime on the left and one with a masked, congruent, affective prime on the right</i>	20
<i>Figure 3: Individual hit rates on the y-axis as a function of the individual false alarm rates on the x-axis</i>	24
<i>Figure 4: Time course of the congruence effect for masked primes across quintiles</i>	26
<i>Figure 5: Time course of the congruence effect for visible primes across quintiles</i>	26
<i>Figure 6: Difference between mean reaction times for all four priming conditions, comparing congruent trials with incongruent trials</i>	27
<i>Figure 7: Plot Diagram of mean RTs in all conditions</i>	27
<i>Figure 8: Mean error rates for spatial and affective primes across all four conditions</i>	30

6 List of Tables

<i>Table 1: Formalization of Hypotheses</i>	16
<i>Table 2: List of words used as primes</i>	19
<i>Table 3: List of words used as Targets</i>	19
<i>Table 4: Possible prime-target pairs and correct answers to classification as well as evaluation task for settings 1 and 3</i>	21
<i>Table 5: Mean reaction times (in ms) and standard deviations across quintiles (fastest to slowest)</i>	28
<i>Table 6: Mean error rates and standard deviations for all eight</i>	30

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