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The Effect of Emotional Cue Words on Autobiographical Memory Recall

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I hereby declare that I've written this bachelor thesis on my own and solely with the use of cited sources, literature, and other scientific materials.

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Abstract: On account of the constructive nature of autobiographical memory, emotional cue words presented in the recall situation impact the valence of autobiographical memories in a congruent way. Furthermore, the valence of autobiographical memories might be potentially impacted also by the constructive effect of participants' preceding affective evaluation, however, more data and perhaps also experimental design changes might be needed to validate the shown tendencies. Both results are discussed in the context of current theories of emotions and autobiographical memory.

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1 Introduction

Previous research suggests that emotions impact how we remember our past personal experiences. This thesis aims to explore the effect of standardized emotional cue words on the valence of autobiographical memories. It draws on the premise that autobiographical memories, including their emotional component, are constructed at recall rather than retrieved from a structure of homogenized information (Rubin, 2012). Due to this characteristic, they could be prone to interference at retrieval in the way that positively or negatively valenced cue words could alter their emotional tone (Buchanan, 2007).

In the Theoretical Basis section of this thesis, theoretical development around the concept of autobiographical memory and its inclusion into existing theories of memory organization is outlined. Special attention is paid to the link between autobiographical memory and emotions. To explore this topic in its complexity, some room is also devoted to theories of emotional memory in general or studies analyzing how emotions are encoded, retained in and retrieved from episodic memory.

The Empirical research section lists some interesting examples of various emotional cues and their effects on autobiographical memory recall that have been demonstrated in previous studies.

The description of the conducted experiment starts at the Methods section and continues to the Discussion, which outlines the experiment results in light of the presented theories.

2 Theoretical basis

2.1 Conceptual background

2.1.1 The concept of autobiographical memory

Rubin and Umanath (2015) define autobiographical memory as a *"general term for an area of study encompassing what people can remember of their lives or imagine as occurring in their futures"* (p. 15). This type of memory occupies a specific place within the theories of memory organization. Whereas some memory types are defined based on the duration of the memory retention and others according to the type of preserved content, the autobiographical memory is specifically characterized by its relation to an individual's self (Conway & Pleydell-Pearce, 2000). Fivush and Graci (2017) refer to this characteristic as "autobiographical consciousness", a term they introduced to emphasize that the content of autobiographical memory isn't just a chronological list of experiences, but a notion of the subjective perspective on these events that happened to the individual. The relation to the autonoetic experience of self is a common distinction that most of the authors addressing autobiographical memory agree on in their works. Another often cited characteristic is that autobiographical memory allows an individual to mentally "travel in time" and re-experience the respective event (Schacter et al., 2008). This "time travel" can be directed not only to the past but also to the future to allow the planning of future events (Baddeley, 2012).

2.1.2 Autobiographical memory organization

A problem researchers don't agree on is the way autobiographical memory should be integrated into existing theories of memory organization. The following section outlines various approaches researchers took to investigate this matter.

2.1.2.1 Modal approach

The traditional modal approach by Atkinson and Shiffrin (1968) offers a straightforward solution of assessing autobiographical memory as a subtype of the long-term memory category (Vlčková, 2005), however, it doesn't capture it with all its unique characteristics.

2.1.2.2 Semantic and episodic memory

A common context to which autobiographical memory is sometimes set is Tulvings's (1972) distinction between semantic and episodic memory systems. Even though some literature sees autobiographical memory as a synonym for episodic memory, most of the theories place it at the intersection of episodic and semantic memory (Baddeley, 2012; Rubin, 2006) and describe it as an overreaching cognitive process that contains episodic as well as semantic memory components (Willoughby et al., 2012). In this context, the episodic component of autobiographical memory is related to the recall of sensory and perceptual details, emotional content, and the ability of mental "time travel", the rich re-experience of the respective event (Tulving, 2002). Tulving also states that the semantic component, on the other hand, serves as a storage of self-related facts.

2.1.2.3 Self-memory system

Other theorists look at the memory system from a whole new angle to describe autobiographical memory more specifically. An example of this approach is the model of the self-memory system introduced by Conway and Pleydell-Pearce (2000). According to this theory, there is a self-memory system consisting of a long-term memory knowledge-base that contains all possible types of declarative information and serves a general purpose. Specific autobiographical memories are then formed out of the content retrieved from this knowledge base. Conway and Pleydell-Pearce further cite that the specific types of knowledge that autobiographical memories are formed from are Lifetime periods, General events, and Event-Specific Knowledge.

2.1.2.4 Narrative approach

Some attention has also been given to the narrative aspect of autobiographical memory (Čermák, 2004). Čermák discusses the link between autobiographical memory and an individual's life story. They draw on the aspect of autobiographical memories as qazi fiction, which is being changed and adjusted whenever it's being retrieved. The reason for this, according to this perspective, is that the individual's self, which is an essential part of autobiographical memory, is also changing. They point out the interesting idea of autobiographical memories as building blocks that are selectively forgotten or remembered to hold the narrative of an individual's life in the form that makes sense to them.

2.1.2.5 Socio-cultural approach

Other theories emphasize the socio-cultural aspect of autobiographical memory. Among these is the Socio-cultural developmental model by Robyn Fivush and Katherine Nelson. Their model

focuses on the relationship between social and cultural environment and autobiographical memory (Fivush, 2012; see also Fivush & Nelson, 2004; Fivush & Graci, 2017). In their point of view, the key role in autobiographical memory plays the development of language skills, as language is a crucial tool people use to express autobiographical memories and it also enables the organization of memories around a narrative structure. According to their theory, all this is subject to development under the influence of children's upbringing and other social contexts, and thus autobiographical memory must be under the influence of culture.

2.1.2.6 Basic-Systems Model

An important personality in the field of memory research is David Rubin. Their first contribution was the edition of a book integrating contributions of all contemporary researchers attending the subject of autobiographical memory (Rubin, 1986). Among other publications, they introduced the Basic-Systems Model of Episodic memory (Rubin, 2006). According to this theory, episodic memory consists of many independent systems, namely vision, audition, olfaction, other senses, spatial imagery, language, emotion, narrative, motor output, explicit memory, and search and retrieval. Even though all of these systems have all been extensively studied and documented before, Rubin was the first to propose that these systems are all interactive components of episodic memory. They later attempted to apply this model to explain the concept of autobiographical memory and concluded that all autobiographical memories are constructed from the interactions of these systems (Rubin, 2012). Rubin puts it in contrast to the belief that memories were built from a cognitive structure of homogenized information. According to this theory, there are three systems responsible for coordinating all inputs and associating them into autobiographical memories: 1) a "dumb" hippocampus-based event-memory system that combines inputs into one event automatically based on the time they occurred, 2) a "smart" emotion system that binds the information according to the discrepancy between the expected and actual outcome, surprise, interest, and emotional arousal and 3) a "smarter" frontal search system that searches for memory components based on cues and inhibits other components that don't fit the cue's criteria.

2.1.2.7 Construction of scenes

A more recent contribution to the theories of autobiographical memory represents the model of the dimensional organization of memory proposed also by David Rubin (2019) later in their career. They argue that to incorporate autobiographical memory into the general memory organization, we need to change the perspective. They suggest giving up Squire's traditional hierarchical structure of human memory (Squire, 1987) and focus on a new dimensional organization

of memory featuring Self-reference, Event memory, and Explicitness as three continuous dimensions that individual memories can be placed at. In the light of this approach, autobiographical memories can qualify as such, as long as they contain at least a minimal level of a "scene" or spatial organization, the essence of the Event memory dimension. Memories with no "scene" component would, according to Rubin, qualify only as knowledge (according to the traditional point of view, they would fall into the category of semantic memory). The topic of mentally constructed scenes represents a development in Rubin's attempt to explain autobiographical memory using the basic-systems model and is becoming a core theme of their theoretical approach (Rubin & Umanath, 2015; Rubin et al., 2019; Rubin, 2020; Rubin, 2021). Rubin and Umanath (2015) discuss the aspect of the construction of mental scenes in the context of another differentiating characteristic of autobiographical memory, the mental "time travel" (or sense of reliving), and suggest that *"both a sense of reliving and a constructed scene are important properties of memories for events. However, for humans, we have accumulated more scientific knowledge about the behavior and neural basis of constructing scenes than about reliving"* (p. 2). They later develop this topic further by stating that the construction of scenes enables the sense of reliving (Rubin et al., 2019) and represents a stable individual difference that defines autobiographical memories (Rubin, 2020).

2.1.3 Functions of autobiographical memory

The functions of autobiographical memory are usually described around three categories: relationship to self, the direction of present or future behavior, and social bonding (Bluck, 2003; Kensinger & Ford, 2020).

The relationship to self is important as it reassures an individual that they're still the same person now as they were in the past and will be in the future. It ensures the notion of self-continuity (Conway 2005). The connection of self and autobiographical memory is also related to personality development (Holland & Kensinger, 2010).

The role of autobiographical memory in directing behavior is a frequently researched topic. Some researchers are focusing on the implicit influence memory has on our behavior (Do Monte et al., 2016). The implicit influence is often studied in the context of fear and is an important topic in the research around PTSD (Bergstrom, 2016). We also tend to use conscious memory retrieval to direct our future behavior, which can also be related to clinical problems. While conscious retrieval can help an individual to prevent mistakes made in the past, Kensinger and Ford (2020) argue that focusing too much on negative details of past events can affect wellbeing and that biases in how we remember negative events are often linked to affective disorders. Furthermore, the directive function is also important to problem-solving (Holland & Kensinger, 2010). An interesting example of the

directive function of autobiographical memory is the study of Sheldon et al. (2019). They explored the construction of memories on the neurocognitive level and found a distinction between conceptual e.g., *"I remember this event fondly as I was falling in love right then and there"* (p. 2) and perceptual e.g., *"We sat arm-in-arm on a picnic bench in Paris"* (p. 2) forms of remembering an event. In their point of view, these two forms of memory construction serve two specific functions of problem-solving, and shifting between them is the key to adaptive behavior. They state that *"conceptual remembering is useful to guide ambiguous decisions that have yet to be encountered whereas perceptual remembering is useful to guide decisions for well-structured tasks that have been previously experienced"* (p. 1).

As for the social function of autobiographical memory, it's related for example to the material available for conversation (Holland & Kensinger, 2010).

Another important category that is sometimes being added to the list of autobiographical memory functions is emotion regulation. According to Pillemer (2009), people choose to recall positively valenced memories to enhance positive emotions and diminish negative emotions: *"An airline passenger who is terrified during an unusually bumpy flight may think or talk about last week's calming vacation in order to counteract the negative emotions of the moment"* (p. 1197). Kensinger & Ford (2019) in their overview also list specific positive effects that have been demonstrated by positive cueing of autobiographical memories in a lab setting. They state that some studies were able to illustrate the increase of motivation, optimism, creativity, inspiration, and patience. Furthermore, Speer et al. (2014) mention in their study that the retrieval of positively valenced events have been linked to the activation of reward circuitry in the brain.

2.1.4 The constructive nature of autobiographical memory

According to Barlett (1932), memory retrieval *"is an imaginative reconstruction, or construction, built out of the relation of our attitude towards a whole active mass of organised past reactions or experience."* (p. 213). Their findings were introduced in contrast to the traditional idea of memories being exact recollections of past experiences. In their experiment they let student participants recall a set of stories and found that the recalled versions had varied from the originals in a specific way that supported the participants' cultural beliefs and pre-existing knowledge. In more recent studies, this effect was generalized also to the autobiographical memory paradigm (Holland & Kensinger, 2010).

In a light contrast to this approach, some researchers offer evidence of a direct retrieval of autobiographical memories. They present cued recall studies, in which participants report that memories come directly to their mind (Uzer et al., 2012; Uzer & Brown, 2017). However, the

literature suggests that even those vivid memories (also called "flashbulb" memories) are constructed and prone to retrieval inconsistency (Brown & Kulik, 1977; Conway, 2001).

One of the earlier, but important works advocating for the constructive approach to memory recall was the book *Cognitive Psychology* by Ulric Neisser (1967). Overall, the constructive approach is still an important topic in cognitive psychology as a whole as well as in the field of autobiographical memory research (Botzung et al., 2007; Conway & Pleydell-Pearce, 2000; Rubin, 2021).

2.1.5 Autobiographical memory and emotions

Emotions are seen as an integral component of autobiographical memories (Addis et al., 2004; Willoughby et al., 2012). Even though the theories about their encoding, retention, and retrieval vary. According to the classical view, emotions are part of the episodic (vs. semantic) component of autobiographical memory (Conway & Pleydell-Pearce, 2000). But for Rubin (2020), for example, emotions represent a separate system that just contributes to the whole process of encoding, retaining, and retrieving (constructing) autobiographical memories. An interesting perspective on the link between emotions and memory offers also Feldman-Barrett, who is focusing on the other side of the topic, the neuroscientific explanation of emotions alone. Based on their research, emotions aren't reactive responses, but proactive processes predicting the outcomes of future events. They argue that these predictions are made based on an individual's past experiences. In that sense, the neural representation of emotions could be direct products of memory, rather than being triggered by it or associated with it (Feldman-Barrett, 2019).

In the light of the constructive approach, autobiographical memories can be associated together from a spectrum of different inputs, which also allows for interferences at retrieval (Buchanan, 2007; Schulkind & Woldorf, 2005). One of the specific interferences that can alter the result of a retrieval attempt is the affective state that is present at the time of retrieval. This effect is an extensively studied topic and is also of special interest to this thesis. The ways affect can influence memory retrieval has been described e.g. by Buchanan (2007): *"factors such as prior retrieval, cue manipulation, and imagination can impact or even change what is retrieved from memory"* (p. 762) and also *"Affect could exert an influence over retrieval processes at the level of either the item (memory for an emotionally provocative stimulus) or the task (affective state that a participant happens to be in during retrieval attempt)"* (p. 762). In this context, Buchanan uses the term affect as a general term for both mood and emotion.

To understand how emotions presented at the time of retrieval can influence the retrieved information, it is also useful to look at the context in which the information was originally encoded.

That being said, it's necessary to take into consideration the existence of two paradigms in memory research, the episodic memory paradigm, and the autobiographical memory paradigm, as described by Kensinger and Ford (2019). Both paradigms are related and benefit from each other's findings, but on some levels, they're different and should be distinguished. The main difference between episodic and autobiographical memories is the higher self-relevance of the latter (Conway & Playdel-Pearce, 2000). The research of episodic memory is usually characterized by the shorter-term nature of the retrieved content, whereas autobiographical memory studies usually work with authentic content retrieved from months or years ago. The advantage of episodic memory studies is the possibility to control the respective memory not only at the time of recall but also at the time of encoding, which also allows for the evaluation of memory accuracy. Autobiographical memories, on the other hand, can be researched with better ecological validity. Even though both episodic and autobiographical research includes the topic of memory and emotions, episodic studies usually can't work with rich, real-life emotional states, but rather a transitory state of general pleasantness and unpleasantness. (Kensinger & Ford, 2019).

Buchanan's overview (2007) mentions a few studies conducted in the fashion of the episodic paradigm, i.e. they tested cues for their level of contribution to a successful recall of information previously learned within the same experiment. They describe how the context in which the information was learned impacts retrieval. For example, if the word "palm" is learned in the context of "palm tree", the word "hand" won't help with the retrieval as much as the word "tree". So the context memory is encoded in plays a role in the type of cues that contribute to the effectiveness of a retrieval attempt. Considering this theory, Buchanan further states that if an individual experienced an affective state at the time of encoding, this affective state could also function as a cue helping to recall that memory. This effect of cognitive processes at encoding having an impact on the situation of retrieval is also referred to as "transfer-appropriate processing" (Morris et al., 1977). There are other theories of memory based on a similar idea, e.g. "encoding specificity principle" (Tulving & Thomson, 1973) or "state-dependent effects on memory" (DuBrow et al., 2017).

2.1.5.1 Memory retrieval and mood

The term "mood" is used in the sense defined by Buchanan (2007), who describes it as a *"background affective state of an individual, lasting on the order of minutes and often not having a specific known antecedent"* (p. 761).

With regards specifically to mood, the theory of transfer-appropriate processing is related to the so-called "mood-dependent" and "mood-congruent" memory effects (Buchanan, 2007). Buchanan describes the "mood-dependent" memory effect as an easier recollection of information in

the situation when the affective state experienced by an individual at encoding matches the one the person is experiencing at retrieval. The "mood-congruent" memory effect on the other hand isn't related to the affective state experienced by the person while encoding information but to the affective characteristics of the encoded stimuli itself (Bower & Forgas, 2000). So it manifests itself in a situation in which one can match the emotions experienced at retrieval to the specific emotional characteristics of the memory. A positively valenced event (e.g. birthday) would be an example of a positive stimulus, which doesn't necessarily mean that the person encoding it at the time would be in a positive mood. According to the mood-congruent memory effect, this event would be easier to remember when the individual is in a positive mood at the time of retrieval. An example of the mood-dependent memory effect would be, if a person is in a positive mood and is experiencing a neutral event (e.g. shopping), according to this theory, this event would be easier to remember if the person is in a positive mood at retrieval.

However, the effects of mood on memory retrieval are debatable and findings regarding the phenomena seem to be inconsistent. Some studies fail to demonstrate the mood-dependent effect (Bower & Mayer, 1989), and others were able to prove it (Thorley et al., 2015). Buchanan (2007) argues that the mood-congruent effect has been, unlike the mood-dependent effect, well documented across several studies (e.g. Bower & Forgas, 2000). Another example is the study by Rusting (1999), who demonstrated that the mood-congruent memory effect exists and is influenced by personality characteristics.

To demonstrate the effects of affective states at encoding, it's necessary to control the conditions in which the information was encoded, and that is only possible in the episodic paradigm of memory research. Therefore, in the context of autobiographical memories, where the mood at encoding is hard to establish (Holland & Kensinger, 2010), the focus is usually only on observing the mere effect of mood on various characteristics of recalled memories without investigating whether the effect is caused by the mood at the time of encoding or by the affective nature of the memory itself.

Interestingly, these studies don't seem to replicate the effects demonstrated by studies conducted in the episodic paradigm. This could suggest that the mood-congruent effect is specific to the episodic paradigm of memory research and doesn't generalize to autobiographical memories.

One example of a study focused on the autobiographical paradigm is one by McBride and Cappeliez (2004), who alternated positive and negative mood states (induced by emotional cue words), but found no impact on autobiographical memories. Another interesting finding is one of Rusting & DeHart (2000). They found that their participants were more likely to recall positively valenced memories in a negative mood state, and so introduced the so-called "mood-incongruent

effect" and attributed it to the mood-regulation function of autobiographical memory. A recent study by Simpson & Sheldon (2020) didn't find any significant effect of mood on the valence of recalled autobiographical memories either, and even though they assume that an effect of mood on some aspects of autobiographical memory retrieval may exist, they state that this effect is still debated and requires further research.

2.1.5.2 Affect priming theories

The theoretical concept behind the influence of affect on cognition is explained by some researchers by the so-called "affect priming theory" (Bower & Forgas, 2000; Buchanan, 2007). This model attempts to explain the effect of both mood and emotions present at retrieval on cognition. Bower and Forgas (2000) suppose that the affective state of a memory is stored in a network of associations. When a similar affective state is activated later (e.g. induced by a cue word), memories that are associated with it are more likely to be accessed than other memories that aren't associated with it.

Forgas (1995) and Bower and Forgas (2000) later describe a newer version of this model and call it the "affect infusion model". This model specifies under which conditions the emotion content interferes with cognition and its basic premise is that the more ambiguous a situation is, the more prone it is to the impact of affect on the related cognitive process. According to the authors, the model applies not only to memory recall but also to any other process in which information is being constructed or generated.

2.1.5.3 The NEVER model

A more recent theory on how affect influences the recall from memory is represented by the NEVER model (Bowen et al., 2017). The abbreviation stands for "Negative Emotional Valence Enhances Recapitulation" and the model draws on findings related to the processes behind memory encoding and retrieval in general. However, the main focus is still on the explanation of memory for events and its strong interconnection with emotions. Also, it has a great added value, because it attempts to consolidate findings from both affective neuroscience and cognitive neuroscience. Even though the findings are mainly based on the research in the context of the episodic paradigm, its principles might be potentially important also for the connection between emotions and autobiographical memory.

The authors reviewed an extensive amount of literature on the topic of memory encoding, retention, and retrieval and came out with a model that differs from other models in three key areas: First, it highlights the importance of emotions presented at the time of memory retrieval. Second, it

stresses the role of sensory processing in the emotional aspect of memory. And third, it specifically demonstrates how the emotional valence of an event (at encoding) impacts how this event is later recalled.

The NEVER model draws on an interesting approach that considers encoding and recall as two overlapping concepts that both play an important role in the result of a retrieval attempt. The basic principle the authors use to explain retrieval from episodic memory is "recapitulation". The term refers, according to their approach, specifically to the effect confirmed by neuroimaging literature, that the neural activations present at the time of encoding re-engage again at the time of recall (Bowen et al., 2017; Waldhauser et al., 2016). In this context, the authors of the NEVER model argue that particularly the engagement of sensory circuits plays a crucial role in remembering events. Interestingly, this re-engagement has been demonstrated even in situations, in which the sensory input is not present at retrieval. Slotnick and Thakral (2011) for example demonstrated that if a piece of information was encoded in one modality (e.g. visual), the respective cortex is reactivated at retrieval and this happens even if the visual modality isn't part of the cue. According to the authors of the NEVER model, recapitulation is linked to memory success. The higher is the fidelity of recapitulation, the better is the result of a retrieval attempt. The authors also refer to studies, which have demonstrated that the re-engagement of networks related to studied tasks, happens also during sleep, especially during slow-wave-sleep.

Based on these findings, the authors argue that successful recollection of event-related emotional details from the past is predicted by the neural processes (especially activations of sensory circuits) at the time of encoding as well as by recapitulation of these processes that happen at retrieval. As for the maintenance of information in memory over a longer period, the key role plays, according to them, the occasional re-activations of the neural processes present at encoding that can occur among other situations also during sleep (Rasch et al., 2007).

One of the conclusions that Bowen et al. (2017) also imply is that the recollective experience (or mental "time travel"), could be explained by these reactivations of brain states that have been active at encoding.

An important part of this theory is the explanation of the impact of emotional valence on the way episodic information is encoded, retained, and retrieved. Based on the reviewed literature and the authors' own studies (Kark & Kensinger, 2015; Bowen & Kensinger, 2016), they assert that the negative valence of an event – independent of arousal – may enhance the way sensory brain regions are incorporated into emotional memory networks at the time of encoding as well as how they're recapitulated at retrieval. Of particular importance are, according to the authors, visuo-sensory processes which are enhanced at the time of encoding negatively valenced memories (Kensinger &

Schacter, 2008). Negative valence also promotes a greater recapitulation overlap between the visuo-sensory processes engaged at encoding and those engaged at retrieval, than positive valence (Bowen & Kensinger, 2016). Furthermore, the authors mention that sleep enhances the preservation of negative stimuli (e.g. Payne et al., 2012). Overall, the sensory recapitulation should enhance emotional memory and the confidence and recollection of negative memories (Kark & Kensinger, 2015; Bowen & Kensinger, 2016).

Based on these statements, the NEVER model predicts the following: 1) Negative stimuli should elicit a greater sensory-focused encoding and should also promote greater sensory recapitulation at retrieval; 2) Negative stimuli should be remembered in greater sensory detail than positive stimuli in case there is a delay long enough to include sleep; 3) Greater sensory recapitulation at retrieval should result in an enhanced objective and subjective memory for negative stimuli (Bowen et al., 2017).

2.2 Empirical research

A popular way of testing the impact of emotions on autobiographical memory retrieval is the cue-word technique (Crovitz & Schiffman, 1974; Rubin et al., 1986). The way autobiographical memory retrieval can be manipulated using emotionally charged cues has been studied using a variety of cue types. The following section lists some interesting examples of effects that have been demonstrated in this line of research.

2.2.1 Influencing memory retrieval by emotional cues

2.2.1.1 Memory retrieval time

Sheldon et al. (2020) have demonstrated how musical cues that varied in emotional valence and arousal can influence the accessibility of the material in autobiographical memory. In their study, positive emotional valence and high arousal have predicted faster memory retrieval. A similar effect of high emotional arousal predicting reduced response latencies has been observed before in a study conducted by Schulkind & Woldorf (2005). Some studies suggest that the retrieval time from autobiographical memory might be also subject to gender differences (Jacques et. al., 2011).

2.2.1.2 Memory specificity

Arousal alone (the degree of emotional intensity) seems to be a prominent factor for memory specificity. In the already mentioned study by Sheldon et al. (2020), high arousal of musical cues has predicted a higher number of episodic details participants used to describe their memories. These

results have been further explored in a follow-up study by Simpson and Sheldon (2020) using emotionally charged words as cues. Their study confirmed that arousal – independent of emotional valence – positively influences the number of episodic details participants recall. Whether the cue word's high arousal primes participants to recall a specific memory content in greater detail or primes them to search for a different memory content that is rich in detail is still subject to interpretation.

2.2.1.3 Memory valence

Simpson and Sheldon (2020) also found that the emotional valence (not arousal) of a cue word is congruent with the recalled memory's emotional tone. This impact of cue valence on the recalled memory valence has been shown before in the study by Ford et al. (2012) and Schulkind and Woldorf (2005), who suggest that the dimension of emotional valence plays an important role in the organization of autobiographical memory. However, the study by Simpson and Sheldon (2020) was the first to demonstrate this congruency using automated emotional text analysis on the side of the target memory as an objective measure. The match between cue and memory valence was also explored in a study by Young et al. (2012). Even though they confirm that among healthy participants, the valence of a cue matches that of the recalled memory most of the time, they also point out that there are some situations when this isn't the case and recommend further research of these situations.

2.2.1.4 Memory vividness

When using emotional cues to elicit memories, it's important to keep in mind that different cues impact memory recall in different ways. The effects of emotions on memory vividness have been studied for example in the context of musical cues. Belfi et al. (2016) asked the question of whether music is the most effective cue for memory vividness in comparison to other emotional cues. In their study, they let participants listen to 30 songs. If the participant rated a song as "autobiographical" (i.e. it reminded them of something from their past), they were asked to describe a memory. Memories were then transcribed and coded for vividness. They did the same process with famous faces instead of songs. Their concussion was that autobiographical memories evoked by music were more vivid than those evoked by faces. In addition to that, they also observed a greater vividness in memories reported by their female participants, and this effect has manifested itself for both music and faces. Similar effects of the high vividness of music-evoked autobiographical memories have been reported also from other studies (Jakubowski & Ghosh, 2019).

Furthermore, some studies suggest that the negative valence of emotional cues results in the lower vividness of recalled autobiographical memories (Destun & Kuiper, 1999; Schaefer & Philippot, 2005). Interestingly, an opposite effect has been observed for research in the episodic memory paradigm (Dewhurst & Parry, 2000; Mickley & Kensinger, 2009). However, other studies didn't show any differences in vividness of autobiographical memories caused by changes in valence (Manzanero et al., 2015). Another factor having an impact on autobiographical memory vividness is self-relevance, highly self-relevant memories seem to be remembered more vividly (D'Argembeau & Van der Linden, 2008).

2.2.1.5 Memory frequency of involuntary recall

Some studies suggest that the frequency of involuntary retrieval from autobiographical memory is linked to the emotional arousal of the recalled event. Rubin and Berntsen (2009) in their study chose an event that all of their 988 participants experienced once in their life (confirmation day) and using a telephone survey, they explored how frequently did they recall the memory on a voluntary and involuntary basis while also asking them to rate the memory on a few other variables. They found out that for both of the types of recall, the frequency is predicted by emotional intensity and significance for the participants' life story.

2.2.1.6 Memory arousal

The arousal, emotional intensity of a memory, can be influenced by a few factors. Some researchers report gender differences, in the way that women tend to recall autobiographical memories with a higher emotional intensity than men (Rubin & Berntsen, 2009). An already mentioned study by Schulkind and Woldorf (2005) was examining the effect of two cue characteristics, valence and arousal, on various aspects of the recalled autobiographical memories. They did find that the cue's valence matched the valence of recalled memories, but this wasn't the case for arousal. They found no relation between the cue's arousal and the arousal levels of the recalled memory.

3 Methods

3.1 Experimental design

The design of this experiment was inspired by a cued recall version of the autobiographical interview (Simpson & Sheldon, 2020; Söderlund et al., 2014). Similar to previous studies in this area, participants' memories were elicited by cue words varying in emotional valence.

Yet, the design of this experiment was modified by introducing a new condition in which a cue word was presented, but the participant wasn't prompted to recall a memory. In other words, some situations – participants' interactions with a cue word – weren't measured. This modification was introduced to control the possibility of the mere act of measuring having an impact on the nature of the observed situation – a phenomenon known as the observer effect in quantum mechanics and explored as "constructive effect of affective judgment" or "measurement effect" in the context of psychology by White et al. (2014, 2016).

White et al. (2016) in their study state that *"simply articulating how one feels about a positively or negatively valenced stimulus also leads to constructive effects"* (p. 2). One of their experiments from the 2016 study used emotionally charged images as stimuli. Participants rated them on their valence – whether they made them feel happy or unhappy. Each trial consisted of a presentation of two subsequent images in a specific valence combination (e.g. 1st negative, 2nd positive), while alternating conditions in which participants' rating of the image is sought and those when no rating is required. The results showed that a positive image following a negatively valenced image is more likely to be rated positively in the situation when both images have been rated, in contrast to the other condition, in which there was no prompt for a rating between the two images.

The experiment conducted within this thesis follows a similar procedure that White et al. (2016) pursued (among other stimuli) with images, but uses emotional cue words instead. In this study, each experimental session (for one participant, there was just one session) represented a set of 8 trials while each trial consisted of two emotionally charged cue words presented to the participant one after the other. Given the special condition described above, each trial resulted in either two recalled memories or one, depending on whether or not there was a prompt to recall a memory after the first word (double rating condition) or the first word was just viewed without a memory recall instruction (single rating condition).

Combining the cued recall version of the autobiographical interview with a design that allows the control of the measurement effect is an attempt to bring a new perspective into both research

areas, emotionally cued autobiographical memory recall and the constructive effects of affective evaluation. Whereas the latter has never been tested using autobiographical memories before.

The design of this experiment is illustrated on a diagram in Appendix 1.

3.2 Participants

Forty-three healthy young adults (24 women, 19 men) between the ages of 21 and 43 (M= 24, SD = 5.04) with Czech as the first language were recruited partly from a group of 3rd-year psychology students (as a course requirement) and partly from the general public (on a voluntary basis). All participants signed an informed consent form.

3.3 Material

Two lists of sixteen emotional cue words were used in the experiment, including eight of a positive and eight of negative valence. The words were selected from sets used in previous experiments (Table 1; Scott et al., 2009) and translated to the Czech language. The final list of translated words used in this experiment can be found in Table 1 in Appendix 3. The two lists of words were counterbalanced between participants and the order of the individual words was randomized for each participant session while always maintaining two representations of the following sequences of emotional valence for each session: positive → positive (PP); negative → negative (NN); positive → negative (PN); negative → positive (NP).

3.4 Procedure

The experiment consisted of a series of circa 40 minutes long sessions conducted with each participant individually in a quiet room with participants sitting across a table facing the facilitator. Shortly before each session, the participant's mood was assessed with the Positive and Negative Affective Schedule (Watson et al., 1988).

Each participant was informed about the detailed course of the experiment. The facilitator explained they'll be shown words printed out on small pieces of paper based on which they'll be instructed to recall a memory, create a title for it and write it down to a textual document on a laptop. They've been shown an example of the paper format the words will be presented on.

Participants were further instructed that two types of situations can occur after the presentation of each word: either they'll be verbally prompted to recall a memory and write it down, or the facilitator will recollect the word and show a different one without asking them to recall a

memory. This condition, in which the cue words were used only as primes without any prompt to recall a memory, was included to control the above-mentioned measurement effect.

The instruction also mentioned that participants should recall the first memory that came to their mind and that the memory did not necessarily need to involve the cue word. Following Simpson & Sheldon (2020), participants were instructed that the memory should represent a specific event, which was defined as a personal experience that occurred during a specific time (at least a day old and within the past few years), and in one place. Participants were given examples of what constituted a specific event prior to the task (e.g. Christmas eve with family).

The time between the presentation of each word and the prompt to recall and write down a memory (or the presentation of the following word in the no-measurement-condition) was set to 5 seconds. Participants were also given a 3 minutes time limit for the recall and writing of their memory and were asked to inform the facilitator once they had finished writing. The facilitator used a timer to measure the word presentation time, the overall 3 minutes limit for recall and writing, and the time gap between the facilitator's prompt and the moment the participant starts to write.

After a memory was formulated, participants, as instructed at the beginning of the session, informed the facilitator and proceeded with responding to a series of scales (1–9 labeled on both ends), assessing their perception of the just described memory in the sense of observed variables: valence, arousal, vividness, personal significance, and frequency of involuntary recall). After completing the scales, participants again informed the facilitator, who then presented the next word.

3.5 Hypotheses

The first goal of this experiment is to replicate the effect of emotionally charged cues on autobiographical memory recall, as shown e.g. by Simpson & Sheldon (2020). Their study demonstrated that the valence of emotionally charged cue words should be congruent with the valence of resulting autobiographical memories. In other words, the content of autobiographical memory can be impacted by emotional cues presented at retrieval. In line with their study, this experiment also aims to replicate this result using not only subjective rating but also objectively obtained measures of the emotional valence of the resulting memories (by using a system of categories for coding and automated text analysis).

Hypothesis 1: The valence (subjective and objective) of target memories will be congruent with the valence of target cue words used to elicit them.

The second goal of this experiment was to replicate the measurement effect shown in the studies by White et al. (2014, 2016), by observing the impact of the evaluation of the prime word (or

absence of such) on the valence of the target memory (recalled after the second word). In light of these studies, we expect that the situations, in which there was a memory recalled and evaluated for both words in a pair (double condition), will increase the positivity (increase rating) or negativity (decrease rating) of the memory elicited by the second word in a pair (target). We presume that this effect will manifest itself using subjective rating as well as objectively obtained measures of the emotional valence of the resulting memories. We expect this effect to be stronger in the negative-positive sequence of words than in the positive-negative sequence. Considering the results of the second study by White et al. (2016), the effect in the positive-negative sequence might not be significant.

Hypothesis 2: **Negative–positive** sequence of cue words will result in a more **positive** evaluation (subjective and objective) of target memories in the double condition than in the single condition.

Hypothesis 3: **Positive–negative** sequence of cue words will result in a **more negative** evaluation (subjective and objective) of target memories in the double condition than in the single condition, however, this effect might not be significant.

Hypothesis 4: **Negative–negative** sequence of cue words will result in a **more negative** evaluation of target memories in the double condition than in the single condition.

Hypothesis 5: **Positive–positive** sequence of cue words will result in a **more positive** evaluation of memories in the double condition than in the single condition, however, this effect might not be significant.

3.6 Data collection

3.6.1 Externally obtained measures of emotional valence

3.6.1.1 Categorical valence

A categorization system has been developed to allow the assessment of the resulting memories' emotional valence. The categories were inspired by existing systems used for assessing the pleasantness or unpleasantness of personal life events (Brantley et al., 1987; Cochrane & Robertson, 1973; Kanner et al., 1981; Kubany et al., 2000); Zautra et al., 1986). Each category had specified emotional valence, either positive, negative, or neutral. We've followed a standard procedure similar to a deductive content analysis with predefined categories where each memory was taken as one indivisible unit (Kyngäs & Kaakinen, 2019). A total of 528 memories were assigned to categories by two coders, with intercoder reliability of 96%. This way, the whole set of memories has

been divided into three sets representing either positively, negatively, or neutrally valenced memories. The valence obtained through this procedure is further in the text referred to as "categorical valence" and presents the first of the three valence-related dependent variables.

3.6.1.2 Software valence

A second objective measure of emotional valence was gained from natural language processing software by the company GENEEA Analytics s.r.o. (Ostrovní 2064/5, 110 00 Praha 1, Czech Republic, IČ: 03241394), which was generously granted by Geneea Analytics s.r.o. for free use in this study. The whole set of 528 memories was sent to Geneea Analytics, who ran the software and returned the set sorted into three categories: positive, negative, and neutral. There were also 22 memories labeled as "ambivalent", which the software couldn't establish the emotional valence for and which were subsequently included in the neutral category. The valence obtained through this software analysis is further in the text referred to as "software valence" and is the second of the three valence-related dependent variables.

3.6.2 Subjective measures

3.6.2.1 Rating scales

Data for other dependent variables, the subjective valence, arousal, vividness, personal significance, and frequency of involuntary recall, were collected using horizontal scales ranging from 1 to 9, labeled on both ends. Number 1 represented the lowest rating of the respective construct and 9 the highest. These scales were placed in a textual document and were available upon scrolling down below the blank lines dedicated for the description of participants' memories. Participants' responses were subsequently entered by the researcher into a digital spreadsheet for later analysis. The valence obtained using this subjective scale is further in the text referred to as "subjective valence" and is the third of the three valence-related dependent variables.

3.7 Data analysis

For hypotheses 1 to 5, the ordered probit hierarchical linear model (HLM) was used to predict the values of the subjective, categorical, and software valence of a memory elicited by the second cue word in a pair (target memories elicited by target cue words). The three types of valence were used as outcome variables. The predictions were made using a combination of conditions: (i) the presence or absence of measurement (single or double rating condition) (ii) valence of the first word in a pair (negative or positive) and (iii) valence of the second word in a pair (negative or

positive). The ordered probit model was chosen for its suitability for the analysis of ordinal variables and its parameters were estimated in a Bayesian framework. For interpretation, the model predictions were then transformed back to the original scales (1–9 for subjective valence, with lower numbers representing negative and higher positive valence and 1–3 for categorical and software valence, with "1" representing a negative category, "2" a neutral category and "3" a positive category).

For each result, a posterior probability interval (PPI) and probability of direction (pd) were calculated to establish the range and strength of the potential effect.

4 Results

4.1 Hypothesis 1

Hypothesis 1 was tested by looking at the medians from average ratings of target memories elicited by negative or positive target cue words. Taking into account the posterior probability intervals, it was possible to establish the probability of negative target words resulting in negatively valenced memories and positive target words resulting in positively valenced memories. The data were evaluated for each of the three types of valence separately while keeping also single and double conditions divided.

The medians from average values for memories elicited by ***negative*** target words turned out as follows:

- Subjective valence (single condition: M = 4.28, SD = 0.26, 95% CI [3.77, 4.80]; double condition: M = 4.28, SD = 0.27, 95% CI [3.74, 4.78]).
- Categorical valence (single condition: M = 1.24, SD = 0.07, 95% CI [1.12, 1.37]; double condition: M = 1.38, SD = 0.08, 95% CI [1.23, 1.54]).
- Software valence (single condition: M = 1.45, SD = 0.07, 95% CI [1.33, 1.59]; double condition: M = 1.46, SD = 0.07, 95% CI [1.34, 1.58]).
- (Subjective valence range was 1–9; Categorical and Software valence range was 1–3.)

For all measurements of *negative* targets we may say that with 95% probability, 95% of the *negative* target cue words elicited memories that were subjectively as well as objectively *negative*.

The medians from average values for memories elicited by ***positive*** target words turned out as follows:

- Subjective valence (single condition: M = 7.08, SD = 0.22, 95% CI [6.65, 7.50]; double condition: M = 7.15, SD = 0.22, 95% CI [6.71, 7.55]).
- Categorical valence (single condition: M = 2.51, SD = 0.09, 95% CI [2.32, 2.66]; double condition: M = 2.65, SD = 0.07, 95% CI [2.51, 2.79]).
- Software valence (single condition: M = 2.31, SD = 0.08, 95% CI [2.16, 2.46]; double condition: M = 2.29, SD = 0.08, 95% CI [2.13, 2.44]).
- (Subjective valence range was 1–9; Categorical and Software valence range was 1–3.)

For all measurements of *positive* targets we may say that with 95% probability, 95% of the *positive* target cue words elicited memories that were subjectively as well as objectively *positive*.

Hypothesis 1 could be confirmed if the valence (subjective and objective) of target memories was congruent with the valence of target cue words used to elicit them. Given these results, we can say that across the subjective as well as objective measures of emotional valence, positively valenced cue words resulted in positively valenced memories and negatively valenced cue words resulted in negatively valenced memories. Thus, hypothesis 1 has been confirmed.

The results for hypothesis 1 are illustrated in Table 1 Appendix 2. Histograms of valence ratings for each type of valence are shown in Graphs 1–3 in Appendix 2.

4.2 Hypothesis 2 to 5

Hypotheses 2 to 5 were tested by looking at differences between medians of ratings belonging to the memories elicited by the second cue word in a pair (target memories elicited by target cue words) in the single and double condition. This has been evaluated separately for each of the four cue word sequences (negative–positive, positive–negative, negative–negative, and positive–positive). This way, if the difference (median from single conditions minus median from double conditions) resulted in a negative number (< 0), it indicated that double conditions were rated higher (more positively) than single conditions. A positive number (> 0) indicated that the double conditions were rated lower (more negatively) than the single conditions. The following section cites the results of this analysis.

Hypothesis 2: In the *negative–positive* sequence, the target memories were rated *more positively* in double conditions than in single conditions across valences:

- **Subjective valence (M = -0.54**, SD = 0.41, 95% CI [-1.37, 0.26], pd 90.10),
- Categorical valence (M = -0.19, SD = 0.16, 95% CI [-0.50, 0.12], pd 88.00),
- Software valence (M = -0.10, SD = 0.15, 95% CI [-0.37, 0.19]), pd 75.13).

Hypothesis 2 could be confirmed if the *negative–positive* sequence of cue words resulted in a more positive evaluation (subjective and objective) for target memories in the double condition than in the single condition. These results show a tendency in the right direction, however, given the pd values, the tendencies aren't strong enough for hypothesis 2 to be confirmed.

Hypothesis 3: In the *positive–negative* sequence, the target negative memories were rated *less negatively* (*more positively*) in double conditions than in single conditions across valences:

- Subjective valence (M = -0.30, SD = 0.51, 95% CI [-1.22, 0.71], pd 71.55),
- **Categorical valence (M = -0.30**, SD = 0.14, 95% CI [-0.56, -0.03], **pd 98.80),**
- Software valence (M = -0.08, SD = 0.13, 95% CI [-0.35, 0.17], pd 73.23).

Hypothesis 3 could be confirmed if the *positive–negative* sequence of cue words resulted in a more negative evaluation (subjective and objective) of target memories in the double condition than in the single condition. It was also predicted that this effect will not be significant. These results show a tendency in the opposite direction than expected. Therefore, the original hypothesis cannot be confirmed. Also, there is a significant effect in this opposite direction for categorical valence.

Hypothesis 4: In the *negative–negative* sequence the target memories were rated *more negatively* in double conditions than in single conditions across valences:

- Subjective valence (M = 0.29, SD = 0.51, 95% CI [-0.72, 1.27], pd 72.05),
- Categorical valence (M = 0.05, SD = 0.15, 95% CI [-0.25, 0.33], pd 62.33),
- Software valence (M = 0.07, SD = 0.13, 95% CI [-0.19, 0.30], pd 71.13).

Hypothesis 4 could be confirmed if the negative–negative sequence of cue words resulted in a more negative evaluation of target memories in double condition than in single condition. These results show a tendency in the right direction, however given the pd values, the tendencies aren't strong enough for hypothesis 4 to be confirmed.

Hypothesis 5: In the *positive–positive* sequence the target memories were rated *less positively* in double conditions than in single conditions using

- Subjective valence (M = 0.40, SD = 0.42, 95% CI [-0.42, 1.24], pd 82.45)
- and Software valence (M = 0.17, SD =0.15, 95% CI [-0.11, 0.46], pd 86.45),
- but *more positively* using Categorical valence (M = -0.10, SD = 0.16, 95% CI [-0.40, 0.23], pd 74.98).

Hypothesis 5 could be confirmed if the positive–positive sequence of cue words resulted in a more positive evaluation of memories in the double condition than in the single condition. It was also predicted that this effect will not be significant. These results show a tendency in the opposite direction than expected (except for a small deviation of the categorical valence). Therefore, the original hypothesis 5 cannot be confirmed.

The results for hypotheses 2 to 5 are illustrated in Table 2. and Graphs 1–3 in Appendix 2.

5 Discussion

5.1 Constructive effect of emotional cue words

The first objective of this experiment was to replicate the effect of emotional cue words on autobiographical memory recall shown in previous experiments (Schulkind & Woldorf, 2005; Simpson & Sheldon, 2020; Young et al., 2012). Similar to Simpson and Sheldon (2020), this experiment aimed to replicate this effect using subjective as well as objective measures of emotional valence. For this purpose, besides asking participants for their subjective evaluation of memory valence, the texts of the recalled memories were also coded using a system of life events categories with specified valence and automatically analyzed using a natural language processing software.

The results of this experiment confirm the findings of Simpson and Sheldon (2020) that the valence of emotional cue words is congruent with the valence of the recalled autobiographical memories and the effect holds also for the objective measures of emotional valence. This conclusion could be interpreted in the light of those theories that see autobiographical memory recall as a constructive process, which is prone to interferences at retrieval. Especially related seems to be the Basic System Model theory by David Rubin (2012), who explains the autobiographical memory recall using three systems coordinating the organization of autobiographical memory. The "dumb" hippocampus-based event-memory system that combines inputs that happen at the same time into one event, the "smart" emotional system that binds the information according to more complex characteristics including their emotional content, and the "smarter" frontal search system that ensures the search for memory components when cued by other components. In line with this theory, the cue words presented in this experiment could have interfered with the "smart" emotional system coordinating the memory organization on the level of emotional content, and thus, the emotional content they carried could have become part of the information that participants' memories were constructed from during the retrieval process.

One question that remains unclear is whether the emotional cue word presented at memory retrieval impacted the original memory content by influencing its emotional tone or whether the cue word prompted the participant to search for a specific memory of this particular valence. In other words, it's not clear how the cue words impact the accuracy of the emotional component of the recalled memory. For this experiment, we might only theorize by offering an explanation using the already mentioned Affect Infusion Model by Bower and Forgas (2000), who assert that memories are always re-constructed to some degree and the level of emotional infusion depends on the ambiguity

of the situation. So the level of emotional adjustment that the cue words from this experiment introduced to the original content of participants' memories, could have been dependent e.g. on the fuzziness of the particular memory content that the participants targeted during recall.

In any case, the accuracy with which we remember the emotional content of autobiographical events would be an interesting topic to explore in future research. We know from previous studies that the human brain might have multiple reasons for altering the emotional content of autobiographical memory (Pillemer, 2009) and that doing so in the negative direction might be related to mental health problems (Kensinger & Ford, 2020).

Even though the knowledge gained through this experiment, that the emotional content (or search) in autobiographical memory can be manipulated using emotional cue words, doesn't give us a deep understanding of the causes behind these alterations, it might be a step in the direction of uncovering mental health problems that are thought to be related to the way we remember our past. In terms of future research, it might be beneficial to experiment with other types of cues and also compare these results with other studies focusing on involuntary recall from autobiographical memory, which is also an important way of remembering our past on an everyday basis. It might be also interesting to investigate the collected autobiographical memories in greater detail and explore the impact of cues on different types of autobiographical events.

In terms of methods used to pursue this goal of the experiment, even though the instructions were specifically designed for the participants to produce autobiographical memories and the collected descriptions were subsequently coded using life events categories ensuring that all memories fit the general criteria of an autobiographical event, it might have been beneficial to investigate in greater detail how does the recalled content match the dimensions described by the latest theories of autobiographical memory, e.g. self-relevance or the spatial dimension of a scene that is according to Rubin (2019) required for a memory to fit into the autobiographical category.

Also, the attempt to demonstrate the effect of emotional cue words on autobiographical memory recall using objective measures required the use of simple ordinal three-point scales that couldn't offer a detailed perspective on the intensity of the effect. On the contrary, the results show just raw information that the cue valence matched on the average the valence of the elicited memories. It's also important to mention that the three types of valences showed differences in the numbers of memories assigned to the positive, negative or neutral category. However, despite these differences, on average, they all confirmed the expected effect.

5.2 Constructive effect of an affective judgment

Another important objective of this experiment was to replicate the constructive effect of affective judgment (also referred to as the "measurement effect") demonstrated before by White et al. (2014, 2016). The question was whether recalling an autobiographical memory and evaluating it after seeing an emotional cue word will have a different effect on a subsequent memory recall and evaluation than just seeing a cue word without the recall and evaluation.

Overall, the analysis of the data from this part of the experiment didn't show significant effects. However, questioning conclusions presented by White et al. might be too early at this point. Even though it might mean that the measurement effect doesn't generalize to the context of the evaluation of autobiographical memories, it should be considered that the design of this experiment was in some ways considerably different from the studies conducted by White et al. (2014, 2016) and these differences could have influenced the intensity of the observations. Especially influential could have been the higher complexity of the task and the longer time participants spent on it in this experiment with memories. In the studies by White and colleagues (2016) participants viewed an advert and provided a simple rating on a dichotomous scale. In this experiment, on the other hand, participants were asked to recall an autobiographical memory and rate it on multiple 9 point scales featuring various dimensions. This way the constructive effect of affective evaluation could have been weakened due to the higher complexity of participants' activity. In future research, it might be beneficial to simplify the design by perhaps keeping just the memory recall and the evaluation of one dimension, e.g. valence. Also, the participant's description of the memory could be limited to just a few words, a title, or left out completely. Simplifying the experiment could also make it easier to increase the number of participants as well as to collect more data from one participant and so increase the chances that the experiment would cover the eventual variability of the effect.

5.2.1 Tendencies of negative prime stimuli

The most interesting result is one for the *negative-positive* sequence, which shows the strongest tendency in comparison to all other conditions in the experiment. Despite the probability of direction still under 95% and the quite wide posterior probability interval reaching slightly to the positive spectrum, the tendency goes in the expected direction. The embedded recall and rating of a negative memory in the double condition caused the response to the subsequent cue word to be more positive than in situations without the embedded recall and rating. So the embedded rating of negative stimulus intensified the valence of the subsequent stimulus. This tendency is congruent with the findings of White et al. (2014, 2016) and it is possible that simplifying the experimental design

and also collecting more data from more participants could demonstrate the expected effect. The results of the *negative-positive* sequence could be explained in the way that in the single condition, where there is no embedded rating before the target evaluation, the negative prime stimulus extends its effect onto the target rating and contaminates it with its negativity. Thus, the negative prime makes the positive target stimulus less positive in a single condition and more positive in the double condition where the embedded activity stops the transfer.

However, the results for *negative-negative* sequence (even though weak) contradict this theory, as the negative prime stimulus makes the negative target less negative in the single condition and more negative in the double condition. Thus, there is no valence contamination of the target stimulus by the prime stimulus in the single condition. There is however consistency in the *negative-positive* and *negative-negative* sequences in the way that the negative primes soften the target evaluation in the single condition and **intensify it in the double** condition.

5.2.2 Tendencies of positive prime stimuli

Interestingly, the positive prime stimuli seem to cause an opposite effect. They tend to intensify the evaluation of the subsequent stimuli in the single condition and **soften it in the double condition**. The *positive-negative* sequence even showed a significant effect of this kind on the categorical valence, where the second negative stimuli were rated less negatively in double condition than in single condition. Even though the low pd values of software and subjective valence call the significance of the pd value of categorical valence in question, their medians still go in the same direction.

The *positive-positive* sequence also showed a reasonably strong tendency to soften the positiveness of the second stimuli in double condition for subjective valence. Software valence shows a weaker tendency in the same direction and categorical valence's median lies already slightly in the "intensifying", rather than "softening" spectrum.

In the *positive-positive* sequence, we could again speak of valence contamination of the target stimulus by the prime stimulus in the single condition, in the way that the target stimulus is rated more positively in the single condition and less positively in the double condition. This, however, doesn't apply to the *positive-negative* sequence, where the single condition doesn't seem to enhance the positivity of the negative target, on the contrary, it makes it even more negative.

5.2.3 Possible interpretations

5.2.3.1 Target stimulus perspective

As already implied, one option we have is to look at the results from the perspective of the valence of the target stimulus. For some reason, the **positive targets** (*negative-positive* and *positive-positive*) tend to get contaminated by the prime valence in the single condition. This however doesn't work with the **negative targets** (*positive-negative* and *negative-negative*), which valence doesn't seem to follow the prime word in the single condition. On the contrary, the valence of the negative targets seems to go in the direction opposite from the prime valence in the single condition. Therefore, the theory of the prime word transferring its valence onto the target word when there is no embedded evaluation to stop this process could be applied only for the situations when the target is positive.

5.2.3.2 Same or inverse valence perspective

Another interesting way to look at the results is to consider a potential impact of situations in which the valence of the subsequent stimuli is identical or inverse (regardless of the valence quality). Whenever participants rated any target stimulus after an embedded rating (double condition) of the **same valence** (*positive-positive* and *negative-negative*), the target rating was always more negative. Without the "interruption" by the embedded rating (single condition), the same-valence sequence always produced a more positive rating. So, for example, the single condition in *positive-positive* sequence resulted in a more positive (higher) rating of the positive target and single condition in *negative-negative* sequence resulted also in a more positive (higher) rating of the negative target. On the other hand, embedded evaluation (double condition) of **inverse valence** seems to always have a positive effect on the target and the absence of the evaluation (single condition) negative. We could only blindly speculate that there might be some confound that would correlate with the same and inverse valence situations.

5.2.3.3 Prime stimulus perspective

Given these observations, a clearer pattern shows the valence of the prime stimuli. When there is an embedded evaluation of a negative stimulus (negative memory is recalled and rated), the valence of the target is intensified (more positive or more negative). On the other hand, when there is an embedded evaluation of a positive stimulus (positive memory is recalled and rated), the valence of the target is softened (less positive or less negative).

That could bring us to speculation that the possible constructive effect of the affective evaluation is more likely to be "introduced" by the embedded memory recall and rating (double condition) and diminished by the absence of such (single condition). Rather than caused by the direct impact of the prime on the target (single condition) and diminished by the embedded affective evaluation (double condition).

Even though the tendencies shown in this experiment are mostly weak, we can speculate that the measurement effect (the effect of participants' articulation of an affective judgment) works differently for positive and negative evaluations. Even though White et al. (2014) found that both NP and PN sequence intensifies the valence of the second stimuli in double condition, in their second study (2016), the intensifying effect for the PN sequence didn't turn out significant, which would support this thinking. If we took into account the tendencies shown in this experiment, we might therefore hypothesize that the affective evaluation of positive stimuli weakens the evaluation of the following stimuli and that the affective evaluation of negative stimuli intensifies the subsequent judgment.

This observation is interesting in the context of the NEVER model of emotional memory by Bowen et al. (2017). The model demonstrates how differently the human brain works with negatively valenced stimuli in comparison to the positive ones. The authors assert that encoding, retaining, and recalling negative memories enhance the recapitulation of sensory (especially visuo-sensory) circuits more than it is with positive memories, and so, negative events should be remembered in a greater sensory and emotional detail. Even though the authors identified memory valence to act as an independent factor, they don't exclude the possibility of other dimensions also playing a role in the observed differences in how the brain treats negative and positive information.

In this experiment, the constructive effect hasn't been observed after affective evaluation alone, as it was in the previous experiments, but also after an active recall of a memory with a specific emotional valence. So both, the affective evaluation and a memory recall could have played a role in impacting the subsequent affective judgment. In light of the NEVER model, we could speculate that the enhanced recapitulation of negative content could have – together with the negative affective evaluation – provoked an intensified rating of the subsequent stimuli. For example, the enhanced recapitulation alone could have transferred to the target memory recall and regardless of valence, the target memory could have been also recalled with an enhanced recapitulation fidelity, therefore with greater sensory and emotional detail and the affective evaluation could have been intensified. On the contrary, the recall of a positive memory with a weaker re-engagement of visuo-sensory neural activations could have – together with the positive affective evaluation – caused the next stimuli to be rated less intensively. In any case, further

research would be needed to establish that the principles described in the NEVER model also apply specifically to the autobiographical memory paradigm.

Another question, that would be interesting to explore further, is how does the affective evaluation alone relate to emotional memory recall. Both could provoke a similar process that might have the potential to interfere with the process of constructing the subsequent information. This could be discussed for example in the context of the theory of constructed emotions by Feldman-Barrett (2017). They assert that emotions aren't reactions, but predictions that our brain constructs from various external and internal sources to anticipate future circumstances. Given this perspective, the affective evaluation could be perhaps seen as a constructive process that could also work with information from memory. Feldman-Barrett (2019) even directly states that *"The neural representation of emotion, then, may be created from memory, rather than merely associated with or triggered by memory"* (p. 7). Theoretically, we may assume that an act of affective judgment could be based on memory and could be therefore subject to similar specifics of negative valence as the NEVER model describes in the context of emotional memory recall.

5.3 Other variables

With regards to other variables, it's important to mention that the design of this experiment measured a wide variety of them, which haven't been included in the analysis. For example, the participants' mood was measured as a control variable and didn't show any significant differences when included in the models used for analysis and was therefore omitted. The other dependent variables such as arousal, vividness, personal significance, and frequency of involuntary recall would be interesting to include in the analysis to observe the effects of cue valence on these variables and also to observe any potential effects the embedded memory recall and articulation of an affective evaluation may have on them. However, addressing all these topics would exceed the scope of this thesis and therefore, they were left out and kept for future research initiatives.

6 Conclusion

The experiment conducted for this thesis followed two main questions. First, whether the emotional valence of autobiographical memories can be manipulated using emotional cue words presented at retrieval, and second, whether the participants' affective evaluation alone can also have constructive effects on the valence of autobiographical memories. The valence congruency of the cue words and autobiographical memories was demonstrated. The efforts to explore the link between affective evaluation and the valence of autobiographical memories didn't lead to a solid effect, however, the analysis pointed out some tendencies. Specifically, a difference has been observed between the tendencies caused by the preceding evaluation of positive in contrast to the negative stimuli. In a pair of emotional cue words, when the first one (prime) was *negative*, an embedded evaluation (memory recall and rating) placed after the first *negative* cue word (prime) caused the subsequent word (target) to be evaluated more extremely than when participants just saw the *negative* cue word (prime) without evaluating it. So with embedded evaluations of *negative* primes, **negative** target words were rated **more negatively** and **positive more positively**.

In contrast, when the first word of the pair (prime) was *positive* and if there was an embedded evaluation after it (recall and rating of a memory) the subsequent evaluation of the target word was less extreme than if there was no embedded evaluation and participants just saw the *positive* prime word. So with embedded evaluations of *positive* primes, the **negative** target words were rated **less negatively** (higher numbers on the scale) and **positive less positively** (lower number on the scale).

These differences are discussed in the context of the NEVER model of emotional memory (Bowen et al., 2017), which suggests that negative stimuli provoke greater visuo-sensory recapitulation (the re-engagement of the same neural activations at recall that were active in the encoding situation) and thus, negative stimuli should be recalled with greater sensory and emotional details. The possibility, that the enhanced recapitulation elicited by the negative prime memory could transfer to the target recall and influence its sensory and emotional detail and so its valence intensity, is discussed.

As a concluding remark, some authors suggest that various psychiatric conditions such as depression, PTSD, anxiety disorder, obsessive-compulsive disorder, and eating disorders could be related to biases and abnormalities in memory processes, and negative alterations of memory content (Bowen et al., 2017). Hopefully, the understanding of the constructive effects of emotional cues and affective evaluations in laboratory conditions can be of some use in future research of the affective evaluations we address towards ourselves and our everyday lives.

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8 Appendixes

Appendix nr. 1: Experimental design diagram

Experimental design diagram
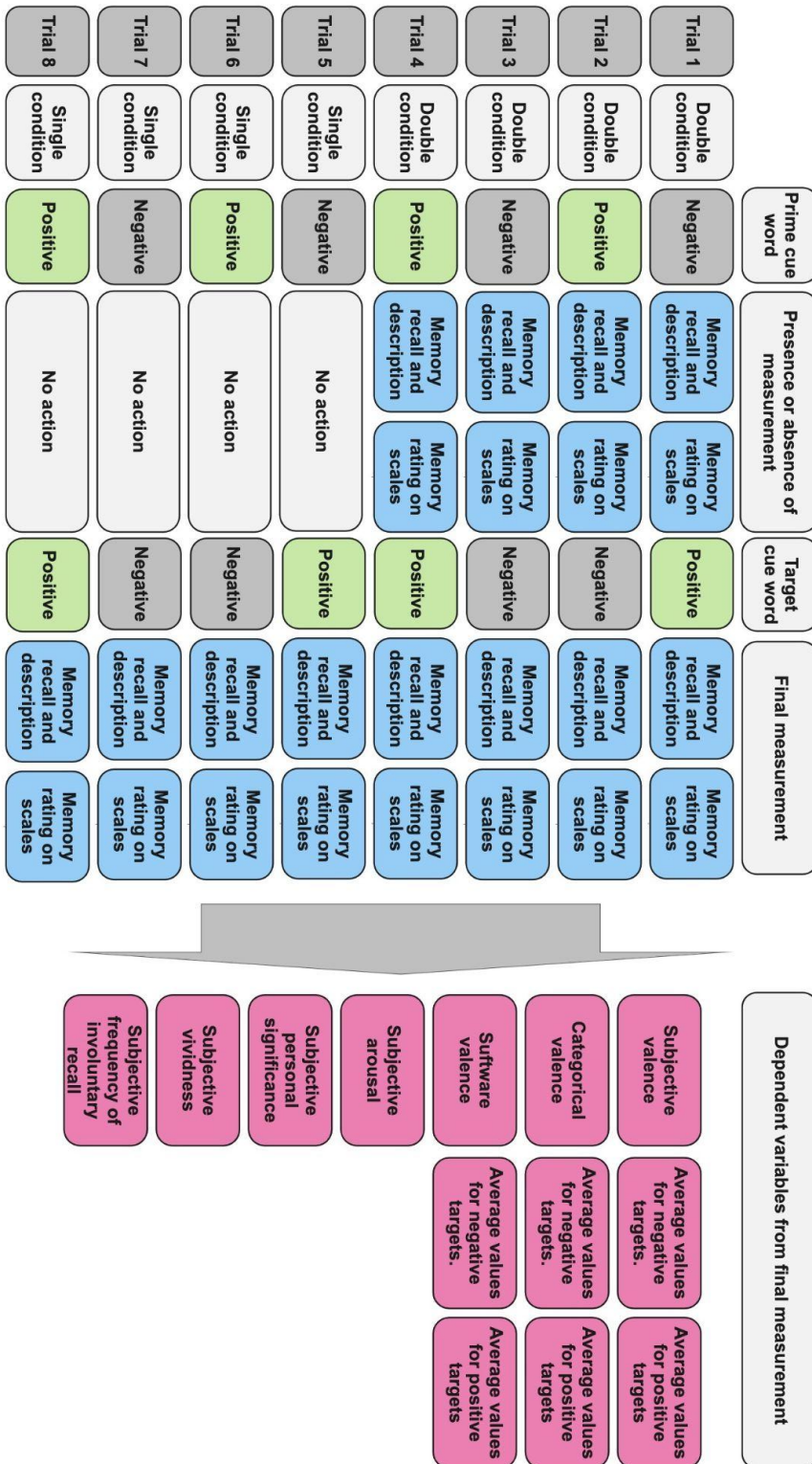
Appendix nr. 2: Result tables and graphs

<table>
<tr><td colspan="5">Table 1: Results for hypothesis 1</td></tr>
<tr><td>Valence type</td><td>Target stimulus</td><td>Condition</td><td>Median</td><td>95% PPI</td></tr>
<tr><td rowspan="4">Subjective*</td><td>negative</td><td>single</td><td>4.28</td><td>[3.77, 4.80]</td></tr>
<tr><td>negative</td><td>double</td><td>4.28</td><td>[3.74, 4.78]</td></tr>
<tr><td>positive</td><td>single</td><td>7.08</td><td>[6.65, 7.50]</td></tr>
<tr><td>positive</td><td>double</td><td>7.15</td><td>[6.71, 7.55]</td></tr>
<tr><td rowspan="4">Category**</td><td>negative</td><td>single</td><td>1.24</td><td>[1.12, 1.37]</td></tr>
<tr><td>negative</td><td>double</td><td>1.38</td><td>[1.23, 1.54]</td></tr>
<tr><td>positive</td><td>single</td><td>2.51</td><td>[2.32, 2.66]</td></tr>
<tr><td>positive</td><td>double</td><td>2.65</td><td>[2.51, 2.79]</td></tr>
<tr><td rowspan="4">Software**</td><td>negative</td><td>single</td><td>1.45</td><td>[1.33, 1.59}</td></tr>
<tr><td>negative</td><td>double</td><td>1.46</td><td>[1.34, 1.58]</td></tr>
<tr><td>positive</td><td>single</td><td>2.31</td><td>[2.16, 2.46]</td></tr>
<tr><td>positive</td><td>double</td><td>2.29</td><td>[2.13, 2.44]</td></tr>
<tr><td colspan="5">Note. Median = median of average ratings of target stimuli; PPI = posterior probability interval; * range 1–9; ** range 1–3.</td></tr>
</table>

Table 2: Results for hypothesis 2–5

Valence type	Order	Condition	Median	95% PPI	pd
	NN	Single-Double	0.29	[-0.72, 1.27]	72.05
	NP	Single-Double	-0.54	[-1.37, 0.26]	90.1
	PN	Single-Double	-0.3	[-1.22, 0.70]	71.55
Subjective*	PP	Single-Double	0.4	[-0.42, 1.24]	82.45
	NN	Single-Double	0.05	[-0.25, 0.33]	62.33
	NP	Single-Double	-0.18	[-0.50, 0.12]	88
	PN	**Single-Double**	**-0.3**	**[-0.56, -0.03]**	**98.8**
Categorical**	PP	Single-Double	-0.1	[-0.40, 0.23]	74.98
	NN	Single-Double	0.07	[-0.19, 0.30]	71.13
	NP	Single-Double	-0.1	[-0.37, 0.19]	75.13
	PN	Single-Double	-0.08	[-0.35, 0.17]	73.23
Software**	PP	Single-Double	0.17	[-0.11, 0.46]	86.45

Note. NN = negative-negative order condition; NP = negative-positive order condition; PN = positive-negative order condition; PP = positive-positive order condition; Median = median of the posterior distribution of the differences; PPI = posterior probability interval; pd = Probability of Direction; * range 1–9; ** range 1–3.
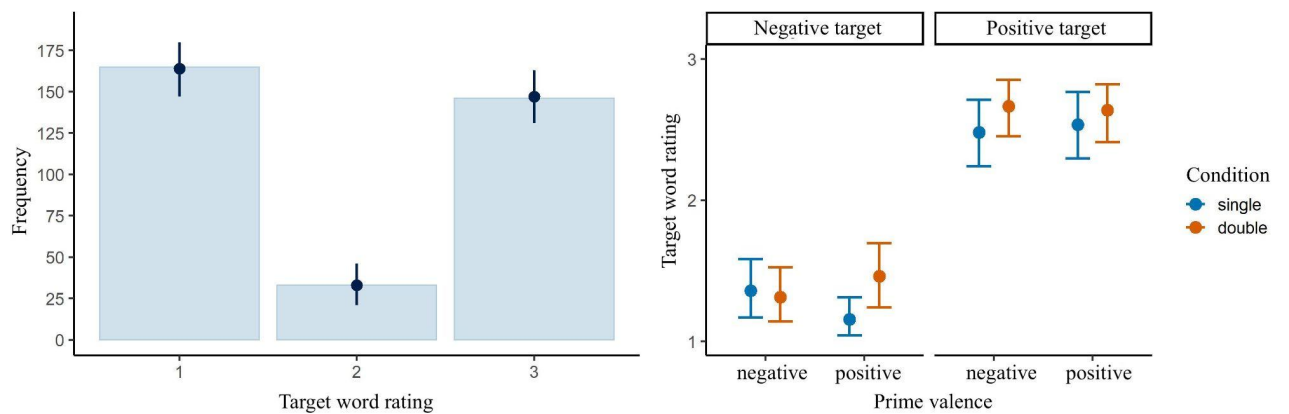
Graph 1: Subjective valence

Histogram of target stimuli ratings (on the left) and comparison of the single and double conditions for all sequences of prime and target valence (on the right).
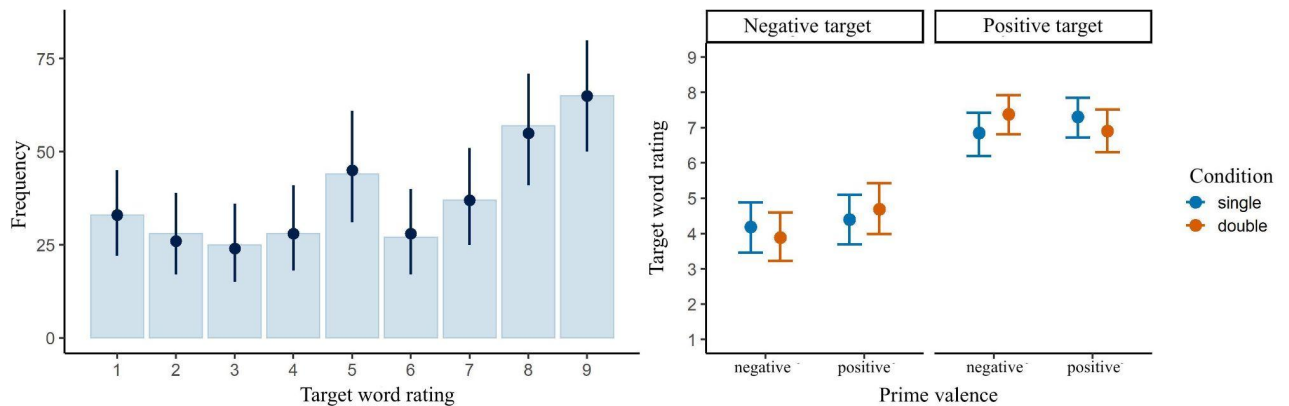
Graph 2: Categorical valence

Histogram of target stimuli ratings (on the left) and comparison of the single and double conditions for all sequences of prime and target valence (on the right).

Graph 3: Software valence

Histogram of target stimuli ratings (on the left) and comparison of the single and double conditions for all sequences of prime and target valence (on the right).
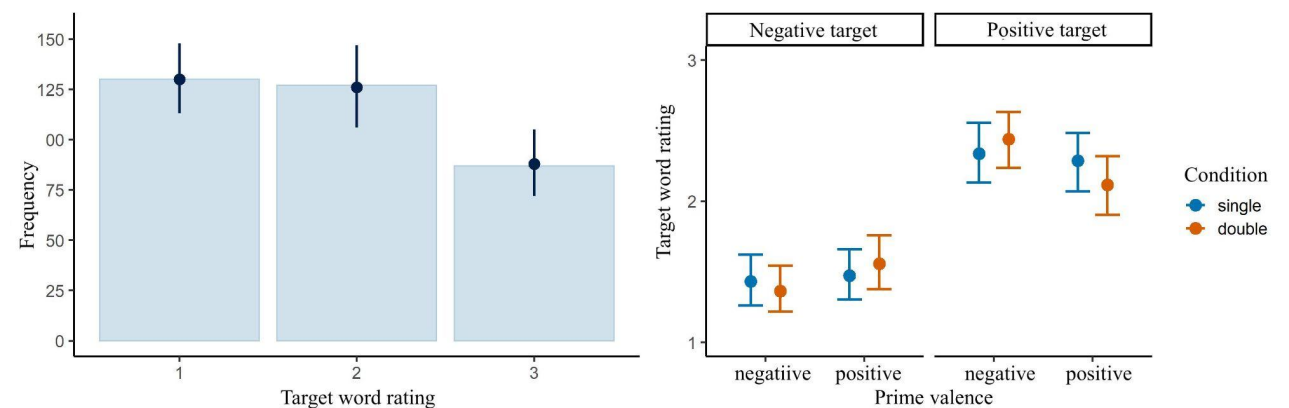
Appendix nr. 3: Lists of emotional cue words

Table 3: Two lists of emotional cue words used to elicit memories			
List 1		**List 2**	
Cue word	**Valence**	**Cue word**	**Valence**
boj	negative	bolest	negative
jistota	positive	dárek	positive
láska	positive	hrůza	negative
narozeniny	positive	krása	positive
nedůvěra	negative	nadšení	positive
nehoda	negative	nebezpečí	negative
oběť	negative	nenávist	negative
přepadení	negative	neštěstí	negative
problém	negative	pohroma	negative
smích	positive	polibek	positive
týrání	negative	prázdniny	positive
úspěch	positive	radost	positive
výhra	positive	šťastlivec	positive
zábava	positive	válka	negative
záchrana	positive	vtip	positive
zlo	negative	zbraň	negative
Note. Words were selected from sets used in previous experiments (Table 1; Scott et al., 2009) and translated to Czech.			

Appendix nr. 4: List of life events categories

Table 4: Categories used to assess categorical valence	
Upsetting news (neg)	Nice time with family (pos)
Success in sports or lottery (pos)	Misfortune at school or personal life (neg)
Success at work or in personal life (pos)	Illness or death of close person or pet (neg)
Social gatherings (pos)	Feared situations (neg)
Second-hand experiences (neu)	Conflicts with friends (neg)
Rude or violent encounters (neg)	Conflicts in romantic relationships (neg)
Romantic experiences (pos)	Conflicts in family (neg)
Pleasant social encounters (pos)	Other - positive (pos)
Pleasant leisure activities (pos)	Other - neutral (neu)
Physical discomfort (neg)	Other - negative (neg)
Note. The categories were inspired by existing systems used for assessing the pleasantness or unpleasantness of personal life events (Brantley et al., 1987; Cochrane & Robertson, 1973; Kanner et al., 1981; Kubany et al., 2000); Zautra et al., 1986).	

Bibliographic details

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Posudek vedoucího/~~oponenta~~ bakalářské/~~diplomové~~ práce
na Pražské vysoké škole psychosociálních studií

Jméno a příjmení studenta/-tky: Štěpán Mesany
Obor studia: Psychologie
Název práce: The Effect of Emotional Cue Words on Autobiographical Memory Recall
Vedoucí/~~oponent~~* práce: Radek Trnka, Ph.D.

Technické parametry práce:
Počet stránek textu (bez příloh):44 (i se seznamem literatury)
Počet stránek příloh:6
Počet titulů v seznamu literatury: 93

	0**	1	2	3	4

Výběr tématu

Závažnost tématu		1			
Oborová přiléhavost tématu		1			
Originalita tématu a jeho zpracování		1			

Formální zpracování

Jazykové vyjádření (respektování pravopisné normy, stylistické vyjadřování, zvládnutí odborné terminologie)		1			
Práce s odbornou literaturou a prameny (citace, parafráze, odkazy, dodržení norem pro citace, cizojazyčná literatura)		1			
Formální zpracování (jasnost tématu, rozčleněni textu, průvodní aparát, poznámky, přílohy, grafická úprava)		1			

Metody práce

Vhodnost a úroveň použitých metod		1			
Využití výzkumných empirických metod		1			
Využití praktických zkušeností	0				

Obsahová kritéria a přínos práce

Přístup autora k řešené problematice (samostatnost, iniciativa, spolupráce s vedoucím práce)		1			
Naplnění cílů práce		1			
Vyváženost teoretické a praktické části v daném tématu		1			
Návaznost kapitol a subkapitol		1			

_____

** 0 – nehodnoceno; 1 – výborně; 2 – velmi dobře; 3 – dobře; 4 – neprospěl/a

Dosažené výsledky, odborný vklad, použitelnost
výsledků v praxi

		2		

Vhodnost prezentace závěrů práce
(publikace, referáty, apod.)

	1			

Otázky a náměty k diskusi při obhajobě:

Nemám.

Celkové hodnocení práce (klady, nedostatky):

Práce je celkově výborná. Kvalita vychází zejména z široké teoretické základny - autor nastudoval velké množství literatury (odkazuji na jeho seznam citací) a dobrý teoretický background se pak odrazil i na zpracování a interpretaci získaných zjištění. Obzvláště vyzdvihuji interpretaci na straně 34, kde autor prokázal i schopnost propojit získaná zjištění s existující teorií. Drobnou výtkou je, že v abstraktu chybí stručný popis vzorku a metodiky.

Doporučení k obhajobě: doporučuji/~~nedoporučuji~~*

Navrhovaná klasifikace: výborně

Datum, podpis: 16.9.2021

_____

* nehodící se, škrtněte

Posudek oponenta bakalářské práce
na Pražské vysoké škole psychosociálních studií

Jméno a příjmení studenta: **Štěpán Mesany**
Obor studia: **Psychologie**
Název práce: **The effect of emotional cue words on autobiografical memory**
Oponent práce: **doc. PhDr. Karel Balcar, CSc.**

Technické parametry práce:
Počet stránek textu (bez příloh):
Počet stránek příloh:
Počet titulů v seznamu literatury:

	0**	1	2	3	4

Výběr tématu

	0	1	2	3	4
Závažnost tématu		1			
Oborová přiléhavost tématu		1			
Originalita tématu a jeho zpracování		1			

Formální zpracování

	0	1	2	3	4
Jazykové vyjádření (respektování pravopisné normy, stylistické vyjadřování, zvládnutí odborné terminologie)		1			
Práce s odbornou literaturou a prameny (citace, parafráze, odkazy, dodržení norem pro citace, cizojazyčná literatura)			2		
Formální zpracování (jasnost tématu, rozčleněni textu, průvodní aparát, poznámky, přílohy, grafická úprava)		1			

Metody práce

	0	1	2	3	4
Vhodnost a úroveň použitých metod		1			
Využití výzkumných empirických metod		1			
Využití praktických zkušeností	0				

Obsahová kritéria a přínos práce

	0	1	2	3	4
Přístup autora k řešené problematice (samostatnost, iniciativa, spolupráce s vedoucím práce)	0				
Naplnění cílů práce		1			
Vyváženost teoretické a praktické části v daném tématu		1			
Návaznost kapitol a subkapitol		1			

** 0 – nehodnoceno; 1 – výborně; 2 – velmi dobře; 3 – dobře; 4 – neprospěl/a

Dosažené výsledky, odborný vklad, použitelnost
výsledků v praxi

		1			

Vhodnost prezentace závěrů práce
(publikace, referáty, apod.)

		1			

Otázky a náměty k diskusi při obhajobě:

1) Shrňte pro komisi stručně česky, čím Vámi získané výsledky přispívají k současné debatě o psychologické povaze autobiografické paměti a s ní spjatých procesů – čemu v ní poskytují podporu, co zpochybňují, nač z nich lze uzavřít a nač ne.

2) Zkoumal jste, jak afektivní kvalita a čas či pořadí slovních podnětů ovlivňuje vybavení a reprodukci dřívějších události. Jeví se Vám přitom cit či emoce jako zvláštní, od jiných odlišitelný duševní jev či děj, který se může, ale také nemusí spojovat s jinými, nebo (jen) jako kvalitativní stránku jiných, svou povahou vydělitelných prožitkových pochodů či stavů, které cit ke svému výskytu a projevení nezbytně potřebuje? Jinak řečeno, je cit či emoce samostatnou složkou duševního dění, nebo jen nesamostatnou vlastností jiných složek (vlastností, dějů atp.) osobnosti?

Celkové hodnocení práce (klady, nedostatky):

Předložená, anglicky psaná, práce je vynikající experimentální studií, teoreticky i prakticky podloženou tak, že splňuje nároky i na práci vyššího stupně, než je bakalářský. Svou kvalitou a výsledky může promluvit do současné, v psychologii pamatování výzkumně vedené, debaty o povaze a podmínkách vtiskování, vybavování a re-konstruování autobiografických vzpomínek v závislosti na k tomu přidružených citových podnětech. Obsah a kvalita teoretického rozboru a uskutečněného výzkumu svědčí o metodologicky zdravém vedení a odpovědném provedení stanoveného úkolu. Žádné věcné nedostatky na reportované práci nenacházím.

Po formální stránce oceňuji jazykovou kvalitu anglicky sepsaného textu. Občas v něm nacházím obsahově nepodstatné písařské či stránkovací nepřesnosti či nedostatky – např. v seznamu literatury, v tiráži ap. (vyznačuji je tužkou v zapůjčeném exempláři práce). – Ač sepsání práce v angličtině bylo zřejmě schváleno pedagogickou poradou školy, pokládám v tomto případě za nezbytné připojit do práce, stejně jako tam jsou anglicky, tak i česky psané titulní listy, abstrakt a klíčová slova; je však možné, že na to dosud platné školní pokyny k psaní závěrečných prací v cizím jazyce nepamatují(? – měly by!).

Doporučení k obhajobě: **doporučuji** / ~~nedoporučuji~~[*]

Navrhovaná klasifikace: **výborně**

Datum, podpis: **13. srpna 2021**

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[*]   nehodící se, škrtněte