A Darkness Shining in Brightness.
The Role of Mixed Emotions in the Contexts of Consumer Psychology and Decision Making

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To Schecki, the courageous chicken of my niece, Marika.

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List of Abbreviations

CI	confidence interval
coef	coefficient
df	degrees of freedom
DV	dependent variable
e.g.	exempli gratia ('for example')
i.e.	id est ('that is')
M	mean value
ME	mixed emotions/mixed emotional impulses
mix	mixed emotional
N	observation size
neg	negative
n.s.	non-significant
pos	positive
RQ	research question
SD	standard deviation
SE	standard error

Chapter 1
Introduction

> *Finis, ut delectet, variosque in nobis moveat affectus. Fieri autem possunt cantilenae simul tristes et delectabiles, nec mirum tam diversae […]* [1] (Descartes, 2022, p. 58)

There are these songs that are sad and joyful at the same time. Moreover, there are these moments of melancholy, when choosing to commit to one thing entails relinquishing another – and these bittersweet sensations when something meaningful comes to an end. Encounters like these are characterized by *mixed emotions*: the "simultaneous or nearly simultaneous co-occurrence of relatively brief positive and negative affective states" (Larsen et al., 2017a, p. 72).

Such mixed emotions accompany individuals throughout their daily lives (Larsen et al., 2017a). Also, they are present in marketing communications: Mercedes Benz, for instance, focused its 2017 *Grow Up* campaign on the mixed emotional theme of "people caught between the coolness of adolescence and the squareness of adulthood" (Mercedes-Benz, n.d., para. 1) – while the Whisky brand Johnnie Walker gained considerable attention through the bittersweet short story *Dear Brother* ("Deutsche Studenten Sorgen Für Gänsehaut-Moment", 2015).

Due to their inherent ambiguity, mixed emotions can be associated with unique consumption experiences. The investigation of such consumption experiences constitutes the focus of this thesis: Across three projects, involving different research perspectives and methodological approaches, it sets out to contribute to the understanding of mixed emotions within consumer psychology and decision making.

As to be outlined in **Chapter 2**, there have been persistent debates amongst emotion theorists about the nature of mixed emotions and their role in the structure of affect. Alongside these discourses, an increasing body of *empirical* research has been investigating the antecedents and outcomes of mixed emotional phenomena in psychology and marketing. This research adds valuable insights to the understanding of mixed emotions in consumption contexts. On a methodological level, however, it faces the challenge of relying on a variety of different approaches to measuring mixed emotions. For researchers, this

[1] The aim [of sound] is ultimately to delight us and to evoke in us various emotions. But songs can be sad and joyful at the same time, and it is not surprising that they are so different […] (own translation)

diversity in measurements can complicate the comparison and synthesis of mixed emotion research, and the identification of the most suitable measurement approach for their own work.

To guide researchers along that way, Chapter 2 undertakes a systematic literature review of the field of quantitative mixed emotions research. This review is based on a theoretical overview, in which different constitutive elements of mixed emotions are outlined and discussed. Searches in bibliographic databases, reference lists, and citations, yielded more than 4000 articles, which are assessed along a set of inclusion criteria. On this basis, a taxonomy of mixed emotion measurement approaches is developed: This taxonomy organizes mixed emotion measurement approaches into three distinct levels that refer to the focal object of investigation (distinguishing between subjective assessment and emotion recognition), the conceptualization of mixed emotions (either in a valence-compositional or construct-specific form), and their quantification (through similarity and/or intensity). In a subsequent step, the two most frequently used measurement approaches are compared in a meta-analysis. This analysis investigates whether one of these approaches results in higher scores of measured mixed emotions – both on an absolute level and in relative comparison of a mixed emotional condition with other emotional reference conditions.

While Chapter 2 centers on the measurement of mixed emotions, **Chapter 3** takes one step back and poses the question of how mixed emotions can be experimentally induced. One stimulus medium that researchers can rely on for this purpose, is music (Joseph et al., 2020). This medium involves certain benefits for the study of mixed emotions: Not only do mixed emotions often arise from aesthetic encounters (e.g., in the form of being moved; Menninghaus et al., 2019); from a methodological perspective, music does not require participants' attentive focus to elicit emotional impulses and therefore can be played in the background and paired with other experimental stimuli (Lowe et al., 2019).

When using music to induce emotions, experimenters often rely on pre-existing musical pieces (Eerola & Vuoskoski, 2013). This seems reasonable in terms of external validity but bears disadvantages. For instance, emotion induction can be confounded if music is familiar to participants: listening to a sad piece of music that is linked to a beautiful memory might evoke non-target emotions of happiness in participants (Juslin & Västfjäll, 2008). Moreover, confounds can emerge if music is heterogeneous between experimental groups: if a positive

emotion condition is presented with music by Beethoven and a mixed emotion condition is presented with music by The Cure, it might not be clear whether group differences are to be attributed to emotional valence (i.e., positive versus mixed) or to anything else that differentiates Beethoven from The Cure (e.g., different cognitions, experiences, and preferences).

To mitigate these risks of confounds and enable researchers to harness the potential of music for emotion induction in experiments, this chapter develops music stimuli that are as homogeneous and controlled as possible. In doing so, a composition concept for a positive, a negative, and a mixed emotional music stimulus is created. This concept bases all stimuli conditions on the same underlying composition but varies each version on certain musical parameters to elicit the intended emotional impulses. These parameters are derived from music-theoretical and psychological research on the emotional effects of music. After presenting the development of the controlled music, this chapter validates the stimuli in their emotional effects: Two pre-registered experiments document that the controlled stimuli reliably evoke the intended emotional impulses, and are furthermore comparable to musical reference stimuli identified by past research.

Finally, **Chapter 4** unites the perspectives of the previous two chapters: Addressing the role of mixed emotions in (marketing) practice, it investigates consumer mixed emotions as input factors for personalization. In three pre-registered experiments, using the controlled music stimuli to elicit emotional impulses (see Chapter 3), it investigates distinct preference patterns that mixed emotions give rise to: Along different product categories, it documents that encountering mixed emotions entices consumers to seek out low-arousal products (such as a relaxing compared to an energizing tea flavor). This finding is likely to be explained by the inherent ambiguity in mixed emotional encounters: Consumption decisions (e.g., the preferences for products with certain arousal qualities) might constitute a means for consumers to resolve experienced states of tension. As a boundary condition of this effect, this chapter furthermore investigates an element of the recommendation-set architecture: Introducing the concept of *contrast framing*, it suggests that mixed-emotion evoked preferences for low-arousal products are particularly pronounced if recommendation sets include a contrasting high-arousal product highlighting the low-arousal quality of a focal product.

From a general perspective, this research sets out to be of relevance in an increasingly data-driven world, where technological advances are increasing the ease and efficiency of emotion recognition in consumption settings (Matz & Netzer, 2017). As a basis for a comprehensive, enforceable, and democratically legitimized regulation on the use of such emotion data, an understanding of the associated effects and underlying psychological mechanisms is needed.

The three chapters of this dissertation contribute to the field of mixed emotions research from the following perspectives: Through a systematic review and meta-analysis, Chapter 2 offers insights into approaches to measuring mixed emotions. Chapter 3 relies on an interdisciplinary approach and contributes controlled music stimuli to the methodological body of emotion induction procedures. Chapter 4 applies this developed stimulus material and empirically investigates the role of mixed emotions for emotion-based personalization in product recommendation settings. In sum, this dissertation offers conceptual and methodological contributions to the field of mixed emotion research and contributes a small glimpse to the understanding of how our perception, thinking, and decision making are shaped by mixed emotional encounters.

Chapter 2
Measuring Mixedness. Systematic Review, Taxonomy, and Meta-Analytic Comparison of Mixed Emotion Measurement Approaches in Quantitative Empirical Research

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Abstract

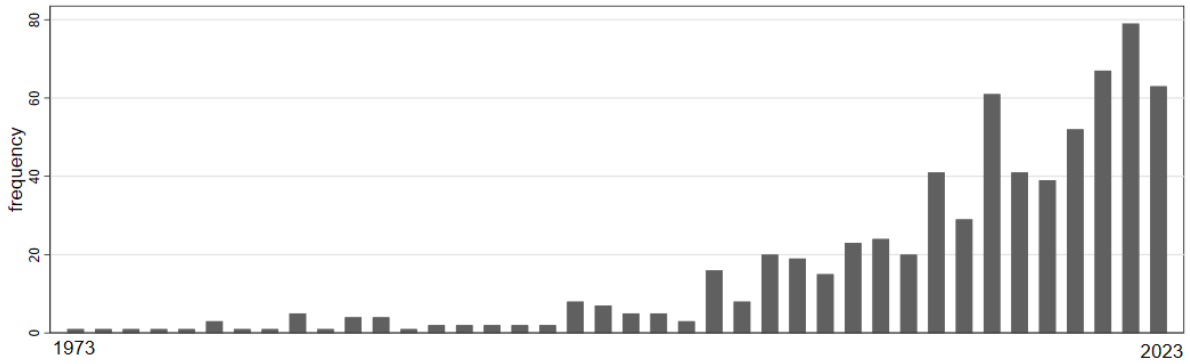
Mixed emotions have received increasing attention in the study of emotions in consumer behavior. However, existing research evinces a diversity of approaches to mixed emotion measurement, which presents a challenge for cross-study comparisons and research synthesis. In response to this challenge, this chapter undertakes a systematic literature review, on the basis of which it develops a taxonomy of mixed emotion measurements: It organizes measurement approaches into three levels that refer to the object of investigation (distinguishing between subjective assessment and emotion recognition), the conceptualization of mixed emotions (either in a valence-compositional or construct-specific form), and their quantification (based on a similarity and/or intensity perspective). To enable insights into the discriminatory efficacy of these approaches, this chapter furthermore presents a meta-analysis of 99 articles, comparing the two most frequently used measurement approaches. This analysis documents that construct-specific approaches tend to result in higher scores of measured mixed emotion compared with valence-compositional approaches – both on an absolute level and in relative comparison of a mixed emotional condition with other emotional reference conditions. In sum, this chapter sets out to provide a comprehensive reference guide for emotion researchers, enabling more informed methodological decisions on how to measure mixed emotions.

2.1 Introduction

Mixed emotions describe emotional encounters in which states of positive and negative valence co-occur (Larsen et al., 2001). They can constitute a considerable portion of individuals' emotional experiences, having been observed in their daily lives with incidences of "as low as 5% […] to as high as 50%" (Larsen et al., 2017a, p. 73). In consumption contexts, mixed emotions can be evoked by marketing appeals (Goenka & Van Osselaer, 2019; Williams & Aaker, 2002), or give rise to distinct consumer preferences (e.g., Hamby & Russell, 2022).

Given this eminence, consumer research shows a rising interest in the study of mixed emotions: A keyword search of the term "mixed emotions" in the *Web of Science* database documents a strong (possibly even exponential) increase in search results in the last two decades (see Figure 2-1).

Figure 2-1. Search results for "mixed emotions" in the Web of Science database[3]



However, upon closer examination of how existing research *quantifies* the experience of mixed emotions, there seems to be a "disparate array of approaches to measuring mixed emotions" (Hershfield & Larsen, 2012, p. 2). This heterogeneity poses a challenge when researchers set out to synthesize or compare mixed emotion studies: It introduces the risk of juxtaposing dissimilar entities. Indeed, the substantial variation in reported mixed emotional experiences noted earlier (i.e., from 5% to 50%) could originate in part from different approaches to mixed emotion measurement. Beyond challenges of research synthesis or

[3] In detail, the "topic" category was searched for the term "mixed emotion", with a wildcard allowing for various endings of the term "emotion".

comparison, this heterogeneity also prompts researchers to consider which measurement approach is most appropriate for their own work.

In response to these challenges, this chapter undertakes a systematic literature review of empirical studies that quantitatively measure mixed emotions. On this basis, it develops an integrative conceptual framework that organizes these measurement approaches alongside three levels: referring to the focal object of investigation (i.e., subjective emotion assessment versus emotion recognition), the conceptualization of mixed emotions (i.e., valence-compositionally versus construct-specifically), and their quantification (i.e., similarity- and/or intensity-based).

Moreover, this chapter presents a meta-analysis to provide insights into the discriminatory efficiency of the two most frequently used measurement approaches. This meta-analysis investigates whether there are differences in valence-compositional and construct-specific approaches – either with regards to the absolute levels of measured mixed emotions, or in relative comparison of a mixed emotional condition with other emotional reference conditions.

In sum, this chapter contributes to consumer emotion research from three perspectives: First, it provides conceptual insights into the field of mixed emotions research through an extensive systematic literature review that covers more than 4000 screened articles, including, for example, the systematic representation of mixed emotion research fields, population characteristics, or experimental induction media. Second, it provides a reference guide to the quantification of mixed emotions through developing a taxonomy of measurement approaches. Third, it provides statistical conclusions about the discriminatory efficacy of different mixed emotions measures through a meta-analysis comparing the two most frequently used approaches.

Concluding, this chapter addresses Larsen et al.'s (2017a, p. 72) remark that it „remains to be seen which [measurement approach] is most valid in different contexts". As a practical reference guide, it strives to be of value to consumer emotion researchers in the process of research comparison and synthesis, or in the face of the conceptual decision of how to measure mixed emotions in their own research. Ideally, such methodological decisions are based on an informed, comprehensive, and data-driven overview of the range of possibilities. To avoid the need for researchers to establish such an overview on their own –

an obligation that seems as inefficient as it is often practically unfeasible – this chapter offers a guide for researchers navigating the field of quantitative mixed emotion measurement.

2.2 Conceptual Background

The following section addresses mixed emotions on a conceptual basis: It outlines mixed emotions in the broader structure of affect and addresses the concept of emotional valence as a constitutive factor of mixed emotions. Furthermore, it provides a reflection on secondary mixed emotions, as well as further emotional concepts that may be considered comparable analogs or independent concepts to mixed emotions. Finally, these insights are synthesized into an initial structural framework for mixed emotion measurement that constitutes the basis of the systematic literature review and meta-analysis.

2.2.1 Mixed Emotions in the Structure of Affect

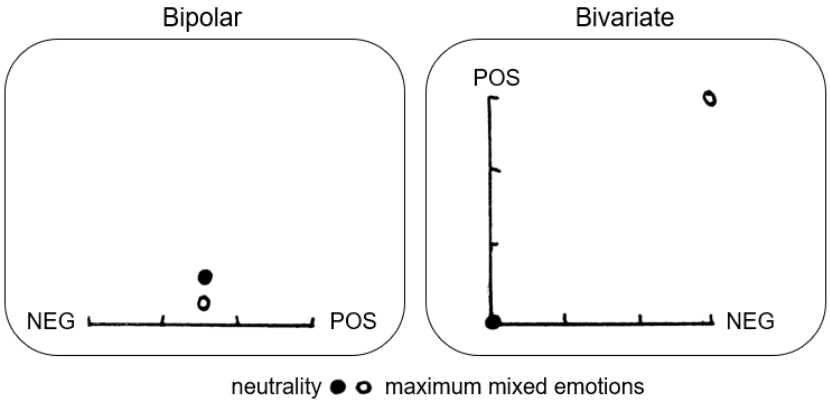
Mixed emotions are defined as "the simultaneous or nearly simultaneous co-occurrence of relatively brief positive and negative affective states" (Larsen et al., 2017a, p. 72).[4] Their characteristic of co-occurrence implies that positivity and negativity are not necessarily negatively correlated (or even mutually exclusive). Thus, mixed emotions can be represented in *bivariate models of affect* (such as the Evaluative Space Model, Cacioppo & Berntson, 1994; Larsen et al., 2009). Such bivariate models represent positive and negative valence as two separable dimensions that can, in principle, vary independently. On this basis, they disentangle the strength of an emotional experience from its valence quality (Olsen, 1999). In contrast, *bipolar models of affect*[5] do not entail such a differentiation. To illustrate this difference, Figure 2-2 documents two states, in which positive and negative emotions are of identical valence quality, but respectively differ in intensity. In a bipolar model (left figure), these two emotional states both coincide in the scale midpoint; in a bivariate model (right

[4] Terminologically, *affect* can be considered a generic concept of evaluative and emotional phenomena, while *emotion* refers to a "complex assortment of affects, beyond merely good feelings and bad, to include delight, serenity, anger, sadness, fear and more" (Fiske & Taylor, 2017, p. 368). Emotion can be distinguished from the less specific, diffuse emotional phenomenon of *moods* (see also Russell & Barrett, 1999).

[5] Such bipolar models of affect conceptualize positivity and negativity as endpoints of a bipolar continuum (Kreibig et al., 2015; Larsen & Green, 2013; Larsen & McGraw, 2011, 2014). A prominent bipolar model is the Circumplex Model (Russell, 1980).

figure), they constitute different qualities of mixed emotional experience. Empirical evidence suggests that such a differentiation (as documented in the right figure) is important to be made, as states of emotional neutrality and mixed emotions, represented by the black and white markers in Figure 2-2, constitute distinct emotional phenomena (Schneider et al., 2016; Tang et al., 2014).

Figure 2-2. Bipolar versus bivariate models of affect



This differentiation between the strength and valence quality of an emotional experience addresses a constitutive facet of assessing ambivalence. In the context of attitudinal research, Thompson and Zanna (1995, p. 263) document "two necessary and sufficient conditions for ambivalence": From the perspective of *intensity,* co-occurring attitude components should involve a certain level of magnitude to be perceived as ambiguous. From the perspective of *similarity*, co-occurring attitude components should be comparatively similar in magnitude to be perceived as ambiguous; in other words, ambivalence is lower if co-occurring attitude components strongly deviate in their levels of intensity (see also Katz & Hass, 1988). In the context of mixed emotions research, this notion is reflected by researchers setting out to capture "how alike opposing [emotional] responses are and how strong they are" (Fong & Tiedens, 2002, p. 108).

While such mixed emotions research provides compelling evidence for the existence of mixed emotions on a phenomenological basis, there is less unanimous agreement among emotion *theorists* on the place of mixed emotions in the structure of affect. The concept of *core affect* (i.e., the most basic feelings of good/bad, energized/enervated that an individual

constantly experiences, but must not necessarily attend to) presumes two bipolar dimensions of "consciously accessible elemental processes of pleasure and activation" (Russell & Barrett, 1999, p. 805; see also Barrett & Bliss-Moreau, 2009; Russell & Carroll, 1999). Based on this concept, Russell (2003, 2017) challenges the notion that positive and negative *core affect* could be simultaneously experienced. Instead, he suggests that mixed emotions result from either sequential oscillation of core affects, perceptual qualities, or emotional meta-experiences.

This former concept, affective oscillation, implies that positive and negative emotional states fluctuate "with sufficient speed to produce a sustained activation of both" (Norris et al., 2010, p. 425; see also Kellogg, 1915). In mixed emotions research, such patterns of co-occurrence have been described and investigated as *sequentially experienced mixed emotions* (Carrera & Oceja, 2007; Oceja & Carrera, 2009). From another perspective, however, researchers set out to capture *simultaneously experienced mixed emotions:* Studies involving procedures such as the Button Press measure (Larsen et al., 2004), the Continuous Evaluative Space Grid (Larsen & McGraw, 2011), or the Analogical Emotional Scale (Carrera & Oceja, 2007) suggest that it may indeed be possible to experience positive and negative emotions simultaneously. While this perspective might align with neuroscientific research suggesting that positivity and negativity are represented in "separable and overlapping brain systems" (Man et al., 2017, p. 124), it challenges the premises of core affect. Resonating with Larsen's (2017, p. 120) remark that "the bipolarity hypothesis may ultimately prove unfalsifiable", the place of mixed emotions in the structure of affect may not be conclusively resolved (and perhaps need not be).

2.2.2 Emotional Valence

Positivity and negativity, the two co-occurring constituencies of mixed emotions, pertain to the concept of emotional valence. Emotional valence "generally refers to the 'positive' or 'negative' character of an emotion" (Colombetti, 2005, p. 103). This character can be manifested on the basis of different conceptualizations, such as behavioral tendencies of approach and withdrawal (Davidson, 1993), intrinsic attractiveness or aversiveness (Frijda, 1986), good versus bad evaluations (Ortony et al., 1988), or the appraisal of the resulting social consequences as beneficial versus harmful (Lazarus, 1991). While these different

conceptualizations often lead to similar classifications of a given emotion (i.e., as of positive or negative valence), there are instances, in which these classifications can differ: for instance, “anger” can be classified as a positive-valence (i.e., “approach”) emotion from a behavioral tendency perspective, but as a negative-valence emotion from an intrinsic attractiveness perspective (Colombetti, 2005; Harmon-Jones et al., 2009; Paulus & Wentura, 2016). Similarly, “surprise” has been classified as either of positive or negative valence (Podoynitsyna et al., 2012; Schniter et al., 2015).

In this regard, reference shall be made to a framework by Oh and Tong (2022) that offers a dynamic interpretation of an emotion’s valence quality: The authors conceptualize mixed emotions as involving conflicting appraisals between or within appraisal dimensions (e.g., goal-congruence, self-control, certainty). For instance, an employee learning about a new colleague in the office might experience surprise and joy in co-occurrence. This emotional experience would be conceptualized as of *higher* mixed emotional quality if it involved *conflicting appraisal dimensions*, such as a high other-evaluation (i.e., looking forward to the new colleague) and low control (i.e., feeling powerless in the face of a top-down decision). In contrast, it would be conceptualized as of *lower* mixed emotional quality if it involved *harmonious appraisal dimensions*, such as a high other evaluation and high pleasantness.

In summary, the concept of emotional valence is multifaceted and may merit special consideration for emotions whose valence classification changes with different conceptual perspectives. In this regard, it might be fruitful to approach this concept also based on underlying appraisals.

2.2.3 Secondary Mixed Emotions

In certain emotional encounters, states of positive and negative valence might “co-occur so succinctly that they blend into a feeling with a distinctive quality [that] might be considered as a specific type of mixed emotions” (Braniecka et al., 2014, p. 2). Such types of mixed emotions are referred to as *unique patterns* (Oh & Tong, 2022) or *secondary mixed emotions* (Braniecka et al., 2014; Russell, 2017). They include *nostalgia* (where a sense of loss underlies a positive feeling about the past; Batcho, 2020; Newman et al., 2020) or *poignancy* (where something meaningful comes to an end; Ersner-Hershfield et al., 2008). Moreover,

experiences of *empathy* (Carrera et al., 2013), *tenderness* (Kalawski, 2010), *sentimentalism* (Metzer, 2016; Yang & Galak, 2015), or *awe* (Keltner & Haidt, 2003; Shiota et al., 2007) have been described as secondary mixed emotions.[6] On a broader level, affective encounters such as feeling *torn* or *mixed* can also be considered secondary mixed emotions (e.g., Gasper & Danube, 2016).

Concerning the appraisal framework of mixed emotions, Oh and Tong (2022) argue that secondary mixed emotions are likely to be elicited by unusual events and are characterized by lower levels of appraisal conflict compared to co-existing patterns of mixed emotions (as the co-occurrence of two different emotional valence states is less salient).

In general, secondary mixed emotions often constitute distinctive emotional phenomena themselves, around which separate fields of research have formed. For instance, *nostalgia* has been described as "sentimental affection for the past" (Baldwin et al., 2015, p. 128), and has been analyzed in its affective qualities in contexts such as social relationships (Abeyta et al., 2015; Wildschut et al., 2006), connectedness (Wildschut et al., 2010), or meaning in life (Routledge et al., 2011). Given the high specificity of secondary mixed emotions like nostalgia, the question arises as to what extent they can be *unified* in their attribute of constituting mixed emotions and to what extent they might constitute *idiosyncratic concepts*.

2.2.4 Mixed Emotions Analogs and Independent Concepts

Sometimes, mixed emotional phenomena are investigated under different labels. In the following, such related concepts are outlined and evaluated as to whether they can be considered analogs to mixed emotions or constitute independent concepts. An overview of these concepts is provided in Table 2-1. They are outlined in further detail in the following.

[6] In a linguistic context, such secondary mixed emotions are often encountered in the lexical analysis of "untranslatable words" in different languages (Lomas, 2017, 2021).

Table 2-1. Concepts related to mixed emotions

Analogs to Mixed Emotions	Independent Concepts
• Dialectical emotions • Emotional ambivalence • Emotional complexity • Emotional co-occurrence • Emotional dissonance • Mixed affect • Mixed feelings	• Attitudinal ambivalence • Cognitive dissonance • Correlation of positive and negative emotions • Evaluative ambivalence • Emodiversity • Emotional conflict • Emotional differentiation • Emotional granularity • Expressed ambivalence • Group-level mixed emotions • Trait mixed emotions • Same-valence emotional blends

Analogs to mixed emotions. The following section addresses emotional concepts that share constitutive elements of mixed emotions (i.e., co-occurring emotional states of positivity and negativity) and therefore could be considered as analogs. In this regard, *dialectical emotions* (defined as the "propensity to experience both positive and negative over time", Miyamoto & Ryff, 2011, p. 22) and *emotional complexity* (defined as the "concurrence of positive and negative emotions", Lu et al., 2017, p. 150) could be considered such analogs to mixed emotions. Similarly, *mixed affect* or *mixed feelings* often serve as alternative expressions for the concept of mixed emotions (see, for instance, Hunter et al., 2008). Moreover, some researchers addressed mixed emotional phenomena under the explicit label of *emotional co-occurrence* (e.g., Miyamoto et al., 2010), while others linked them to the concept of *emotional dissonance* (Williams & Aaker, 2002). Finally, *emotional ambivalence* (defined as "dual-valenced affective reactions", Oh & Tong, 2022, p. 284) constitutes an analog to mixed emotions, which is prominent in the disciplines of attitudes and organizational research.

Independent concepts. On the other hand, there are emotional concepts to be demarcated from mixed emotions. For instance, *same-valence emotional blends* (such as co-occurring states of joy and gratitude; Tong & Jia, 2017) do not meet the definitional criterion of involving co-occurring states of positive and negative valence. Moreover, research has been investigating an individual's propensity to experience and differentiate co-occurring emotions in precise and specific nuances: This research (often conducted under the labels of *emotional differentiation, emotional granularity,* or *emodiversity*; Quoidbach et al., 2014;

Tugade et al., 2004) focuses on the number of experienced emotions. As it does not necessarily involve co-occurring states of both positive and negative valence, it should not be considered as involving mixed emotions, per se (for a systematic differentiation, see Grossmann & Ellsworth, 2017).

On a cognitive level, the co-occurrence and processing of inconsistent (emotional) information can instill *cognitive dissonance* or *emotional conflict* in individuals (Hock & Krohne, 2004; Olsen, 1999; Plambeck & Weber, 2009; van Harreveld et al., 2009b). Likewise, individuals might hold both positive and negative opinions about an object (often referred to as evaluative or attitudinal ambivalence; Thompson et al., 1995). According to the definition of mixed emotions, phenomena like these would be only considered as mixed emotions if they involved affective reactions (Larsen et al., 2017a). In research practice, however, a clear distinction between cognitive and affective components of ambivalence is not always made (see for instance the definition of attitudinal ambivalence as "simultaneously holding conflicting feelings or beliefs"; Wheeler & Jones, 2006, p. 251).

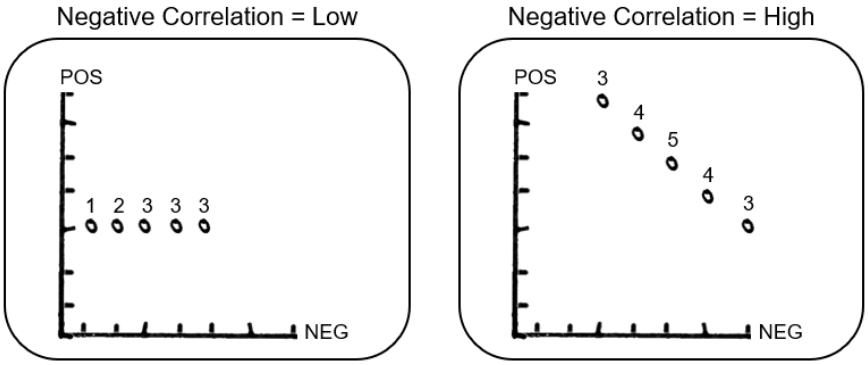
Furthermore, certain concepts address co-occurring states of positivity and negativity but do not take into account an individual's momentary emotional experience: For instance, *expressed ambivalence* centers on observed mixed emotions in other individuals (Barlow et al., 2019; Denison et al., 1995; Kim et al., 2015; Lim et al., 2021; Rothman, 2011). *Trait mixed emotions* describe an individual's propensity to experience mixed emotions as a dispositional personality trait (Barford & Smillie, 2016; Hohnsbehn et al., 2022; Kang & Shaver, 2004; Oh, 2022; Rafaeli et al., 2007; Schneider et al., 2021; Tze et al., 2022). Moreover, *group-level mixed emotions* center on the collective experience of mixed emotions (e.g., Pelled et al., 1999; Walter et al., 2013).

Finally, a weaker negative (or even positive) *correlation of positivity and negativity* is not necessarily indicative of a higher level of experienced mixed emotions:[7] Regarding the initial discussion of mixed emotions in the structure of affect (e.g., positive and negative emotions not being mutually exclusive), such an association seems intuitive at first sight. However, empirical research documents that this connection cannot be reliably drawn (Larsen et al.,

[7] Such correlational inference can be based on repeated emotion measures on an *individual level* (i.e., intraindividual correlation), for instance, in the context of experience sampling data (Barford et al., 2020). Moreover, it can be based on *cross-sectional data*, for instance, of different populations (Ahn et al., 2021).

2017b; Scott et al., 2014). An underlying reason is that while the correlation between positive and negative emotions is more sensitive to the *variance* of these two valence states, mixed emotions are more sensitive to the valence state that is *weaker in intensity*. To visualize this notion, the left pattern in Figure 2-3 depicts an intraindividual correlation of zero, with the respective conflicting emotional valence state (i.e., the emotion lower in intensity) ranging from values one to three (as indicated by the numbers above each marker). The right pattern in Figure 2-3 depicts an intraindividual correlation of -1, with the respective conflicting emotional valence state ranging from values three to five. As the intensity of mixed emotions rises with the intensity of the conflicting valence state (see Chapter 2.4.3) the right figure (i.e., the one with a *higher* negative correlation of positivity and negativity) would be associated with a higher intensity of mixed emotions.[8]

Figure 2-3. Patterns of correlation between positive and negative emotions



NOTE. — Markers represent simulated data of (repeated or cross-sectional) measurements of positive and negative emotional experience. The number above each marker indicates the intensity of the conflicting emotional valence state.

Despite the conceptual and empirical evidence that "the correlation between positive and negative affect tells us little about their co-occurrence" (Larsen et al., 2017b, p. 334), some research has operationalized mixed emotions as the correlation of positive and negative emotions (see Appendix 2.1). As outlined above, this research might deserve special

[8] Moreover, research indicates that the relationship between co-occurrence and correlation of positive and negative emotions itself is moderated by external factors (e.g., arousal, Reich & Zautra, 2002).

attention: Ideally, correlational inferences would be complemented with established measures of mixed emotions to assess whether results can be generalized.

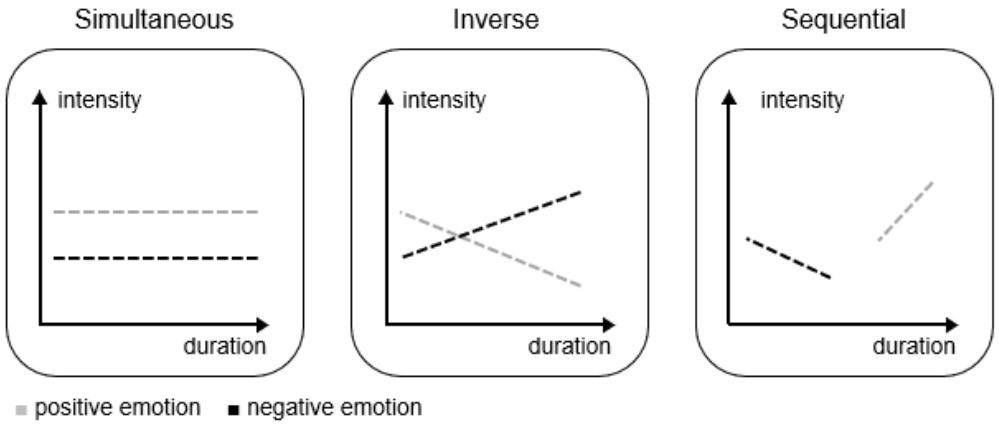
2.2.5 Measurement of Mixed Emotions

When it comes to measuring mixed emotions, "[m]ost research on mixed emotions involves the subjective experience of affect" (Hershfield & Larsen, 2012, p. 5) and asks participants to assess their emotional experience. While some research has used open questions for this purpose (Larsen & McGraw, 2011), most research relies on closed-ended agreement scales for assessing subjectively experienced emotions.

In this regard, two types of measures can be discerned: On the one hand, referring to the concept of co-occurring valence states, researchers can measure positive and negative emotions and use "mathematical models of ambivalence to combine [obtained] positive and negative reactions into an ambivalence index" (Priester & Petty, 1996, p. 431). On the other hand, referring to the concept of secondary mixed emotions, researchers can measure "specific emotion labels that do not involve explicit pairings of discrete opposite-valence emotions" (Oh & Tong, 2022, p. 283).

Regarding the former co-occurrence-based approach, some approaches set out to measure positive and negative emotional valence simultaneously (Berrios et al., 2015a). For instance, the *Button Press* procedure (Larsen et al., 2004) asks participants to press one button when experiencing positive and a second button when experiencing negative emotions, with mixed emotions resulting from both buttons being pressed simultaneously. Furthermore, the *Analogue Emotion Scale* (Carrera & Oceja, 2007) asks participants to draw lines of experienced positive and negative emotions on a two-dimensional graph. In this graph, the y-axis captures the intensity, and the x-axis captures the duration of the experienced emotion (for different variants of mixed emotional experience, see Figure 2-4). Finally, the *Evaluative Space Grid* (Larsen et al., 2009) asks participants to move a cursor in a two-dimensional grid, in which one axis represents the intensity of positive emotional experience, while the other axis represents the intensity of negative emotional experience.

Figure 2-4. Patterns of mixed emotional experience captured by the Analogue Emotion Scale



NOTE. — Own representations, based on the work by Oceja and Carrera (2009)

Table 2-2. Simultaneous measurement approaches of mixed emotions

Measure	Advantages	Disadvantages	Use in research
Button Press	• easy to perform • measures emotion in the moment	• no inferences about emotional intensity	Hunter et al. (2008) Larsen et al. (2004) Larsen and McGraw (2011) Larsen and Stastny (2011) Larsen and Green (2013) Wassiliwizky et al. (2017)
Analogue Emotion Scale (AES)	• captures variants of ME experience	• usually recall-based • complex to execute	Carrera and Oceja (2007) Carrera et al. (2013) Oceja and Carrera (2009)
Evaluative Space Grid (ESG)	• enables a granular emotion assessment • measures emotion in the moment	• no consideration of the dimension of time if measured on a single occasion	Audrezet and Parguel (2018) Larsen et al. (2009) Larsen et al., (2017b) Norris et al. (2019) Norris and Larsen (2020) Norris and Wu (2021) Schneider et al. (2015) Veilleux et al. (2013)

While these measurement approaches allow for the simultaneous assessment of co-occurring emotional valence states obtained through subjective emotion assessment, they also involve complexities in understanding and execution with the risk of distracting participants from their emotional experience (Andrade & Cohen, 2007). Table 2-2 provides

an overview of the advantages and disadvantages of the three approaches and documents their use in existing research.

While most research measures mixed emotions through participants' subjective experience, there are also alternative measurement approaches: For instance, mixed emotions have been inferred from participants' *affective reactions* (e.g., Griffin & Sayette, 2008) or the analysis of *event descriptions* (e.g., Amabile et al., 2005). With regards to the former, also technological advances "can help inform some of the more psychological aspects of consumer behavior that is aimed at understanding – rather than merely predicting – consumer attitudes and emotions" (Matz & Netzer, 2017, p. 7).

Given these different approaches to measuring mixed emotions, the next part of this chapter sets out to provide a systematic overview of mixed emotion measurements. In detail, it addresses the following research question:

> *Research Question 1:* What is an effective taxonomy for systematizing mixed emotion measurement approaches?

Based on this taxonomy, the discriminatory efficacy of different measurement approaches is investigated. With this aim in mind, this section compares the two most frequently employed measurement approaches (i.e., valence-compositional and construct-specific subjective emotion assessment). In detail, it compares the two most frequently used measurement approaches to determine whether one of them yields higher absolute scores of measured mixed emotions. In a subsequent step, this section focuses on studies that involve different emotional conditions (i.e., a mixed emotional condition that is compared to a positive and/or negative and/or neutral condition). For these studies, the difference in measured mixed emotions between a (focal) mixed emotional condition and the respective emotional reference conditions is investigated. In sum, this section addresses the following research questions:

> *Research question 2a:* Do the two most frequently used approaches differ in their absolute levels of measured mixed emotions?
>
> *Research question 2b:* Does one of these approaches yield higher differences in measured mixed emotions between a mixed emotional condition and respective emotional reference conditions?

A systematic literature review on quantitative studies measuring mixed emotions serves as the foundation to create a taxonomy of measurement approaches. In a subsequent step, the two most frequently used measurement approaches are meta-analytically compared.

2.3 Systematic Literature Review

The pre-registered goal of the systematic literature review was to identify *empirical, peer-reviewed journal articles in English that quantitatively measured mixed emotions and did not involve non-adult or clinical samples*.[9] Preregistration is available at https://aspredicted.org/L4S_SC4.

Literature of the systematic review was retrieved between May and August 2023 based on bibliographic keyword searches in three databases, and the screening of reference lists and forward citations of relevant mixed emotion literature (for an overview, see Table 2-3). In detail, this screening involved reference lists of seven mixed emotions review articles, as well as Google Scholar forward citations of the three original articles introducing the simultaneous measurement approaches (for related procedures of previous meta-analyses, see Eisend, 2009; White, 2009).

Table 2-3. Sources of the systematic literature review

Database Search		**Backward Citations** (reference lists)		**Forward Citations** (Google Scholar)	
Source	N	Source	N	Source	N
Web of Science	2485	*Analogue Emotion Scale*: Carrera and Oceja (2007)	170	Berrios et al. (2015a)	99
Scopus	2159			Hershfield and Larsen (2012)	86
APA PsychInfo	1577	*Evaluative Space Grid*: Larsen et al. (2009)	260	Kreibig and Gross (2017)	121
		Button Press: Larsen et al. (2004)	389	Larsen et al. (2017a)	65
				Larsen (2017)	44
				Oh and Tong (2022)	261
				Rothman et al. (2017)	205

NOTE. — N = number of retrieved articles

[9] In the process of the review, it became evident that some identified studies investigated *pre-existing datasets*, which bear the risk of overlapping samples. Therefore, it was ex-post decided to include only datasets with primary data.

The bibliographic keyword searches encompassed the databases *Web of Science* and *Scopus* (i.e., searching in keywords, titles, and abstracts), as well as the database *APA PsychInfo* (i.e., searching in keywords, titles, and first pages). The search criteria included composite terms of the words "mixed" (as well as synonyms) and "emotion" (as well as synonyms), occurring together within a range of three words (as specified by a proximity operator).[10] It also included terms related to the concept of mixed emotions, referring to the previous discussion of analogs and independent concepts (see Chapter 2.2.4).[11] Finally, the conceptual domains of children and patients were *excluded* from the search through six exclusionary terms for reasons of comparability and relevance to the field of consumer research.[12] The complete database search query is documented in Appendix 2.2.

An overview of the systematic literature review process is provided in Figure 2-5. In sum, the systematic literature search yielded 4322 results (excluding articles removed before screening, see Figure 2-5). These results were assessed according to the inclusion criteria (i.e., whether they constituted empirical, peer-reviewed journal articles in English with primary data that quantitatively measured mixed emotions and did not involve non-adult or clinical samples). As a first step, all 4322 results were assessed through title-abstract screening. In a second step, a remaining subset of 483 results was assessed via full-text screening.

In this process, excluded articles were assigned to one of four overarching categories: (a) non-quantitative articles (e.g., theoretical, conceptual, or qualitative works), (b) articles not meeting the definition of mixed emotions[13], (c) articles not combining measured co-

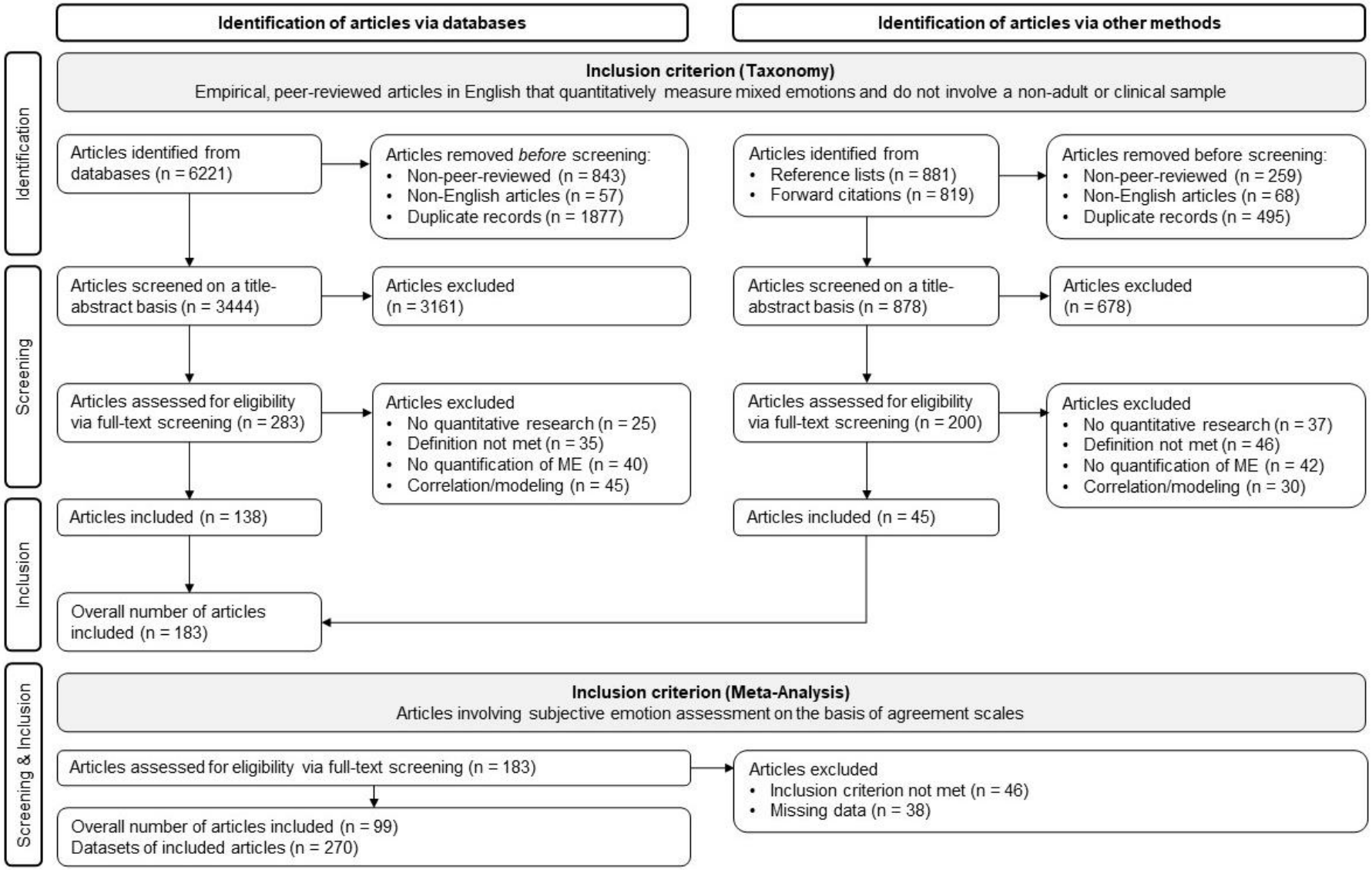
[10] This proximity specification was applied to filter out unrelated results (e.g., mixed-methods, mixed design, mixed reality).

[11] Given the iterative nature of this work, some of the discussed concepts were identified in the course of the literature review and have therefore not been part of the search query.

[12] For research addressing children's experience of mixed emotions, reference shall be made to Peng et al. (1992), Denham et al. (2002), Lagattuta (2005), Larsen et al. (2007), Dunn (1995), and the work of Burkitt et al. (2018, 2019).

[13] This category included articles on the *independent concepts* of mixed emotions discussed above. Moreover, it included articles on *highly specific secondary mixed emotions* if they did not seem comparable with more general mixed emotions or if they were ambiguous in their emotional character (e.g., awe is considered as predominantly positive emotion by some [Pan & Jiang, 2023] and as a mixed emotion by others [Braniecka et al., 2014b]).

Figure 2-5. Process flow of the systematic literature search



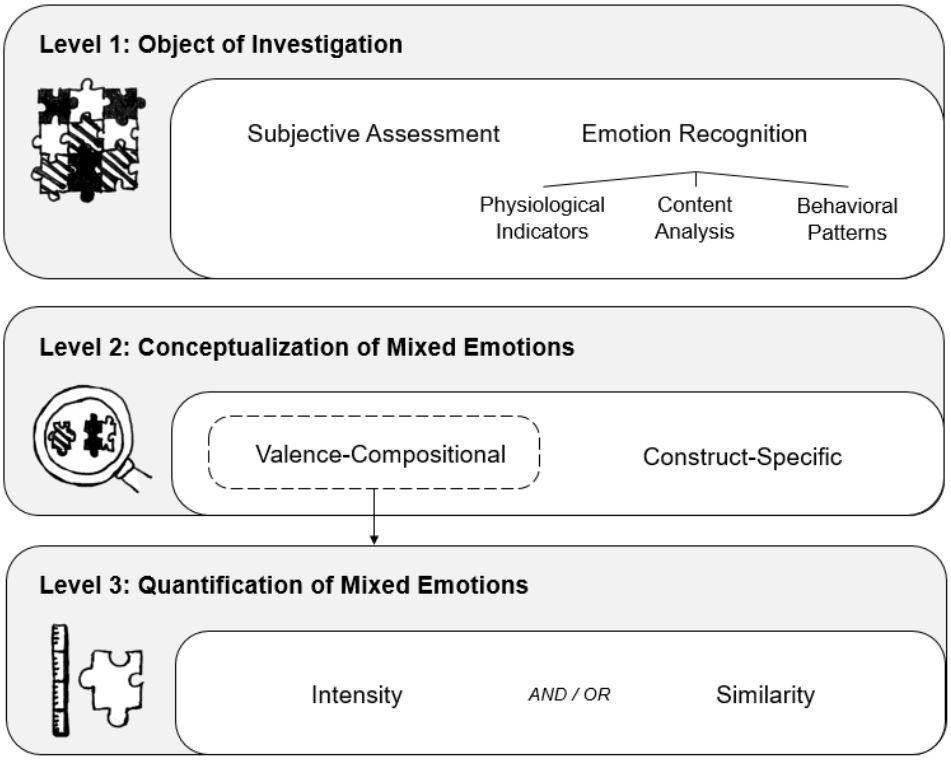
occurring valence states into a score of mixed emotions, and (d) articles operationalizing mixed emotions through correlational or variance-analytical approaches.[14] An overview of articles excluded on the basis of the last two categories is provided in Appendix 2.1.

In total, the systematic literature review yielded a final set of 183 articles that met the inclusion criteria. This dataset is documented in Appendix 2.3.

2.4 Taxonomy of Mixed Emotion Measurement Approaches

In the following, a taxonomy of mixed emotion measurement approaches is derived from the results of the systematic literature review (RQ 1). In detail, these results were analyzed and clustered based on common similarities in their approach to measuring mixed emotions and then organized into a structural framework that allows the categorization of measurement approaches. This process resulted in a three-level taxonomy (see Figure 2-6).

Figure 2-6. Taxonomy of mixed emotion measurement approaches



[14] In the category of variance-analytical approaches, mixed emotions were operationalized through estimates of positive and negative emotions as predictors of a dependent variable. While this perspective quantifies the *effect* of mixed emotions on that respective variable, it does not allow inferences on the level of individually experienced mixed emotions.

2.4.1 Level 1: Object of Investigation

On the first level, mixed emotion measurement approaches can be categorized according to the *object of investigation* from which mixed emotions are derived. Aligning with the discussion in Chapter 2.2.5, two broad categories can be distinguished: On the one hand, researchers can infer mixed emotions from subjective assessment (e.g., asking participants to what extent they experience certain emotions). On the other hand, they can infer mixed emotions from implicit emotion recognition approaches.

Most results of the systematic literature review involved participants' subjective emotion assessments as the object of investigation (i.e., 168 of the overall 183 articles; see Appendix 2.3).[15] This preponderance might be attributed to the notion that "the essence of an emotion" could only be reliably inferred from subjective assessment, while alternative approaches allowed only indirect inference (LeDoux & Hofmann, 2018, p. 67). However, subjective emotion assessment is not without its drawbacks: It requires the cognitive translation of an emotion into a verbal representation by participants and therefore depends on individual abilities (e.g., introspection, verbal competence; Locke, 2005). In addition, *assessing* an emotional encounter might shift the focus away from the experience or even alter the experience itself.

Alternatively (or complementarily) to subjective emotion assessment, research can involve emotion recognition approaches as the object of investigation. Such approaches set out to implicitly infer emotion from observed entities. With regard to the systematic literature review, 24 results involved emotion recognition approaches. These results, in turn, could be aligned to three sub-categories: physiological indicators, content analysis, and behavioral patterns, which are outlined in the following.

Physiological Indicators. On the one hand, researchers have inferred mixed emotions from physiological indicators. In detail, 16 results of the systematic review involved this object of investigation, which can be further subdivided into three categories (see Table 2-4). For instance, emotion has been inferred from participants' *facial action.* This approach is based on the notion that certain facial movements are indicative of positive and negative affect (Griffin & Sayette, 2008; Harris & Alvarado, 2005; Weth et al., 2015). Often, facial electromyographic activity (EMG) has been used to investigate mixed emotions-related facial

[15] Note that an article could also involve multiple objects of investigation.

expressions (Kreibig et al., 2013; Larsen et al., 2009; Larsen & Norris, 2009; Nohlen et al., 2016; Sharman & Clark, 2016). Moreover, emotion has been inferred from participants' *autonomic nervous system activity.* Here, mixed emotions have been analyzed in their association with electrodermal (Maio et al., 2001; Sharman & Clark, 2016) or adrenergic activity (Segal & Cahill, 2009). A distinct manifestation of mixed emotional encounters has been observed in the experiences of "chills and tears" (Wassiliwizky et al., 2015, 2017), which resulted, for instance, from intense emotional states of being moved. Finally, emotion has been inferred from participants' *neural activity* (for reviews, see Hoemann et al., 2017; Man et al., 2017): Here, distinct neural patterns of perceived or experienced mixed emotions could be observed in electroencephalography (EEG; Kaminska et al., 2020; Plourde-Kelly et al., 2021), event related potentials (ERPs; Luo et al., 2010; Norris & Wu, 2021), and functional magnetic resonance imaging (fMRI; Henderson & Norris, 2013; Talmi et al., 2009).

While physiological indices provide compelling insights into the correlates of emotional experiences, it appears challenging to infer a comprehensive assessment of experienced mixed emotions from a single physiological indicator. In this regard, the *combined consideration* of multiple physiological indicators might constitute a promising avenue for future emotion research (see, for instance, Kreibig et al., 2013).

Table 2-4. Research involving physiological indicators of mixed emotions

Facial Action	**Autonomic Nervous System Activity**	**Neural Activity**
Griffin and Sayette (2008) Harris and Alvarado (2005) Kreibig et al. (2013) Larsen and Norris (2009) Larsen et al. (2009) Nohlen et al. (2016) Sharman and Clark (2016) Weth et al. (2015)	Kreibig et al. (2013) Maio et al. (2001) Segal and Cahill (2009) Sharman and Clark (2016)	Henderson and Norris (2013) Kaminska et al. (2020) Luo et al. (2010) Norris and Wu (2021) Plourde-Kelly et al. (2021) Talmi et al. (2009)

Content Analysis. On the other hand, researchers have inferred mixed emotions from the analysis of semantic content. In detail, five results of the systematic review involved this object of investigation. These articles investigated contents of textual nature, comprising Tweets (Alowibdi et al., 2022; Daniel et al., 2021; Stella et al., 2020), textual databases

(Grossmann et al., 2016), and narrative descriptions (Miyamoto et al., 2010). In general, such emotional content is often quantitatively analyzed through *keyword-based* linguistic networks (e.g., Lin et al., 2021) or *learning-based* machine learning approaches (e.g., Daniel et al., 2021). In this context, mixed emotions have been operationalized on the basis of collocates (i.e., positive emotion words near negative emotion words; Grossmann et al., 2016) or co-occurrence networks (Stella et al., 2020).

Beyond quantitative research, content analysis is frequently part of *qualitative* studies: Such studies have investigated, for instance, answers to open-ended questions (Scott & Sutton, 2009; Wood & Greenfeld, 1979), essays (Amabile et al., 2005; Moeller et al., 2018a), autobiographical narratives (Wildschut et al., 2006), memories (Goldner & Scharf, 2017; von Sadovszky et al., 2006), interviews (Harikkala-Laihinen, 2022; Hassett et al., 2018; Lunardo & Saintives, 2018; O'Brien & Linehan, 2019; Price et al., 2000) or descriptive experience sampling (Heavey et al., 2017). In addition to textual content, oral narratives (Adler & Hershfield, 2012; Goldner & Scharf, 2017) and even drawings (Lin, 2022; Löfström & Nevgi, 2014) have been objects of investigation in (qualitative) mixed emotions research.

Behavioral Patterns. Finally, research has inferred mixed emotions from behavioral patterns. In detail, three results of the systematic review involved this object of investigation and analyzed inferences on mixed emotions in the context of mouse tracking (Schneider et al., 2015; Schneider & Mattes, 2021) and eye tracking approaches (Ersner-Hershfield et al., 2009). Future avenues for behavioral inference of mixed emotions could involve speech emotion recognition (Khalil et al., 2019) or emotion inference from videographic imagery (den Uyl & van Kuilenburg, 2015).

2.4.2 Level 2: Conceptualization of Mixed Emotions

On a second level, measurement approaches can be categorized according to their *conceptualization of mixed emotions*. As previously outlined, mixed emotions are defined as co-occurring positive and negative emotional states, but can also take the form of secondary mixed emotions. Existing research has captured these different perspectives in emotion labels such as "'opposite-valenced emotions' versus 'specific types of mixed emotions'" (Oh & Tong, 2022), or "'direct measures of emotions' versus the 'coactivation of positive and negative affect'" (Hershfield & Larsen, 2012). This principle is reflected in the second

taxonomy level, which categorizes mixed emotion measurements into valence-compositional and construct-specific approaches.

Most results of the systematic literature review involved valence-compositional approaches: In sum, 127 articles were categorized into (purely) valence-compositional approaches, while 60 were categorized into (purely) construct-specific approaches, and 19 articles involved both approaches to conceptualizing mixed emotions (see Appendix 2.3).[16]

In detail, *valence-compositional approaches* conceptualize mixed emotions by measuring positive and negative valence and combining these measures into a score of mixed emotions (e.g., through a mathematical function; see Chapter 2.2.5). In the case of *subjective emotion assessment* as the object of investigation, such valence-compositional approaches involve participants' assessed experience of positive and negative emotions (e.g., through indicating how happy and how sad they are feeling). In the case of *emotion recognition*, they might involve the co-occurrence of positively and negatively valenced indicators (e.g., facial muscle activity indicative of both smiling and frowning).

On the other hand, *construct-specific approaches* conceptualize mixed emotions as distinct emotional phenomena (see Chapter 2.2.3). In the case of *subjective emotion assessment* as the object of investigation, such construct-specific approaches involve the assessed experience of secondary mixed emotions. With regards to the systematic review, many articles explicitly or implicitly referred to the work by Priester and Petty (1996) and measured mixed emotions by asking participants to what extent their emotions were, for instance, "conflicted", "mixed", "indecisive", "ambivalent", "uneasy", or "torn". Other works referred to the approach by Berrios et al. (2015b), and measured mixed emotions by asking participants to what extent they felt, for instance, "contrasting emotions", "a mixture of emotions", or "a combination of different emotions at the same time". While most research relied on agreement scales (e.g., anchored in experiencing the described emotional phenomenon from "not at all" to "very much"), some research employed semantic differentials (e.g., anchored in having "completely one-sided reactions" versus "completely mixed reactions"; Durso et al., 2021). An overview of these articles is provided in Appendix

[16] Note that the focus is placed on the 168 articles that involved subjective emotion assessment as the object of investigation to assure comparability. However, as to be outlined in the following, the two conceptualizations of mixed emotions can in principle also be applied to approaches to emotion recognition.

2.4. In the case of *emotion recognition*, construct-specific approaches might involve indicators idiosyncratic to mixed emotions (e.g., chill experiences).

Comparison of the two conceptualization approaches. It seems possible that valence-compositional approaches might lead to lower scores of mixed emotion measurements in tendency, compared with construct-specific approaches: Research suggests in their lay theories of the structure of affect, participants often regard positive and negative emotions as opposites that exclude each other (Fong, 2006; Larsen & McGraw, 2011). These participants may perceive cognitive dissonance when reporting co-occurring high levels of positive and negative emotions, even when they are actually experiencing such emotional states. Construct-specific approaches, on the other hand, may circumvent such perceptions by not directly involving the simultaneous co-occurrence of two seemingly opposing valence states. However, construct-specific measurement approaches are not without their drawbacks: Often involving abstract and non-commonplace vocabulary (e.g., "bittersweet"; Larsen et al., 2001), they require researchers to ensure that participants are familiar with and "have the same understanding of the given experience as [themselves]" (Hershfield & Larsen, 2012, p. 14).

2.4.3 Level 3: Quantification of Mixed Emotions

In the case of a valence-compositional conceptualization of mixed emotions, a third taxonomy level can be applied: This third level categorizes measurement approaches according to the approach that is used to *quantify mixed emotions*. In other words, this level centers on the approach (e.g., the mathematical formula) that is used to combine measures of positivity and negativity, on the basis of a conflicting and dominant emotion, into a score of mixed emotions.

In the course of the taxonomy development, each dataset that involved a valence-compositional conceptualization of mixed emotions and subjective emotion assessment as the object of investigation was analyzed in terms of its underlying quantification approach. An overview of these approaches is provided in Table 2-5.[17] With reference to the two

[17] For reasons of comparability, focus is placed on subjective emotion assessment. However, different quantification approaches of valence-compositionally conceptualized mixed emotion might also be observed for emotion recognition approaches (e.g., regarding the combination of positive and negative valence scores inferred from textual content analysis).

components of ambiguity outlined in Chapter 2.2.1, these approaches can quantify mixed emotions on the basis of *similarity* and/or *intensity*. As result, the quantification of mixed emotions can be categorized into intensity-based, similarity-based, and intensity-similarity-based approaches, which are outlined in the following.

Table 2-5. Quantification approaches of mixed emotions

	Approach	Formula	Source	N
Intensity-based	Minimum Score	MIN[C; D]	Schimmack (2001)	64
Similarity-based	Absolute Difference Score	| D – C |	n/a	2
Similarity-intensity-based	Similarity-Intensity Model (SIM; "Griffin Formula")	(C + D) / 2 – | D – C |; (C + D) / 2 – | D – C | + 1.5	Thompson et al. (1995)	51
	Simplified Similarity-Intensity Model (SIM)	5C – D; 3C – D	Williams and Aaker (2002)	12
	Negative Acceleration Model (NAM)	([2 × C] + 1) / (C + D + 2)	Scott et al. (1966)	10
	Conflicting Reactions Model (CRM; "Kaplan Formula")	C + D – | D – C |	Kaplan (1972)	9
	Gradual Threshold Model (GTM)	$5*C^{P} – D^{1/C}$; with P < 1	Priester and Petty (1996)	3

NOTE. — C = conflicting emotion (minor); D = dominant emotion (major); N indicates the frequency of datasets with the respective quantification approach (16 out of the 167 datasets using "other" approaches are not considered in this overview)

Intensity-based quantification takes into account the emotional magnitude. In detail, it centers on the intensity of the conflicting (minor) emotional valence state. Depending on the underlying definition, this conflicting emotion refers to the emotion lower in intensity or the non-target emotion (i.e., negative emotion for a positive-valenced stimulus; Kafetsios & Hess, 2019; Ruth et al., 2002). Most results of the systematic review relied on an intensity-based quantification approach by using the *minimum score* (see Table 2-5). This approach quantifies mixed emotions as the minimum value of measured positive and negative valence (Schimmack, 2001) and is based on the rationale that "the higher the lowest rating, the greater the amount of co-activation across both feelings" (Hunter et al., 2008, p. 331).

Similarity-based quantification takes into account the similarity in magnitude of co-occurring valence states. In the systematic review, two datasets relied on similarity-based quantification by using the absolute difference of positive and negative emotions to quantify mixed emotions (see Table 2-5). This approach is based on the rationale that there is *less* emotional ambivalence if the co-occurring emotional valence states strongly deviate in their levels of intensity (Hamamura et al., 2008; Katz & Hass, 1988; Thompson et al., 1995).

Similarity-intensity-based quantification combines these two perspectives in capturing "how alike opposing [emotional] responses are and how strong they are" (Fong & Tiedens, 2002, p. 108). In the systematic review, five major formulas of similarity-intensity-based approaches were observed (see Table 2-5). These formulas imply different procedures and weightings through which the co-occurring valence states are combined into a score of mixed emotions. In detail, the *Similarity-Intensity Model* captures *similarity* through the absolute difference of the two valence states and *intensity* through their combined average (Thompson et al., 1995). A similar process underlies the *Conflicting Reactions Model* (Kaplan, 1972), which differs in its weight of the similarity component from the previous approach. In a simplified form, the *Simplified Similarity-Intensity Model* subtracts the dominant emotion from a multiple of the conflicting emotion (Williams & Aaker, 2002). The *Negative Acceleration Model*, in turn, is based on the relation of the intensity of the conflicting emotion to the intensity of both emotional valence states (Scott, 1966). In a more complex manner, the *Gradual Threshold Model* implements the three mechanisms that "(a) ambivalence increases in a negatively accelerating manner as the number of conflicting reactions increases; (b) ambivalence is a negative function of the extent of dominant reactions when there are no conflicting reactions; and (c) as the number of conflicting reactions increases, the impact of dominant reactions on ambivalence gradually decreases" (Priester & Petty, 1996, p. 447).

On a final note, some research investigated mixed emotions as being present or absent. For instance, it assessed whether participants rated both positive and negative emotions greater than the scale midpoint (e.g., Fong, 2006; Miyamoto et al., 2010) or responded to dichotomous measures of positive and negative emotions with "yes" (e.g., McGraw & Warren, 2010). While providing relevant insights to mixed emotion research, these approaches are not considered in this framework, as they provide no continuous quantification of mixed emotions on an individual level.

2.4.4 Discussion

In sum, the developed taxonomy provides a conceptual framework that allows the classification of quantitative mixed emotion measurement approaches according to three levels. These levels refer to the object of investigation (distinguishing between subjective assessment and emotion recognition), the conceptualization of mixed emotions (either in a valence-compositional or construct-specific form), and their quantification (based on similarity and/or intensity).

With regards to the first taxonomy level (i.e., the object of investigation), most articles involved subjective emotion assessment. While this approach might be best suited to infer "the essence of an emotion" (LeDoux & Hofmann, 2018, p. 67), it also bears disadvantages (e.g., intrusiveness) and might be complemented and/or substituted with emotion recognition procedures (e.g., in the form of physiological indicators, content analysis, or behavioral patterns).

With regards to the second taxonomy level (i.e., conceptualization of mixed emotions), measurement approaches can be categorized into valence-compositional and construct-specific approaches. These approaches mirror the theoretical conceptualization of mixed emotions as (a) involving the co-occurrence of positive and negative emotional valence states and (b) occurring also in the form of secondary mixed emotions.

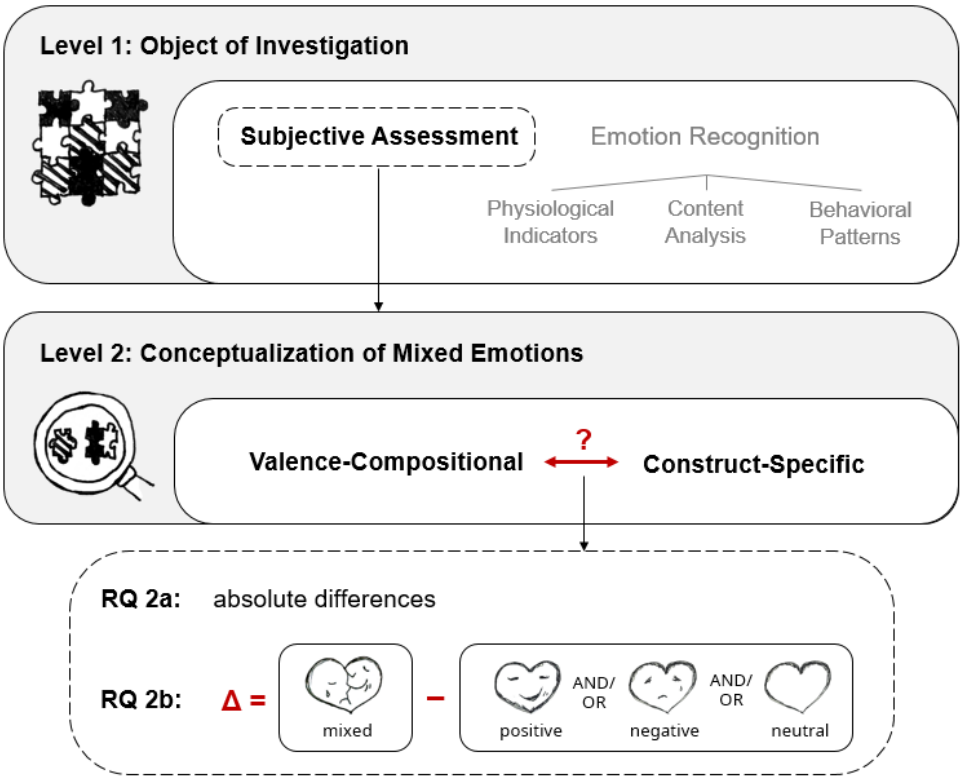
With regards to the third taxonomy level (i.e., quantification of mixed emotions), there are three different approaches to mathematically combining valence-compositionally measured states of positive and negative emotions into a score of mixed emotions. These quantification approaches involve either a similarity-, an intensity-, or a similarity-intensity-based perspective. Strikingly, most results of the systematic review involved intensity-based quantification through the Minimum Score (Schimmack, 2001), which only accounts for *one* of the two components that researchers (e.g., Thompson & Zanna, 1995) consider necessary to describe ambiguity.

2.5 Meta-Analysis

The following part describes a meta-analysis conducted to enable insights into the discriminatory efficacy of the two most frequently used mixed emotion measurement

approaches. For reasons of comparability, this meta-analysis focuses on a subset of the results identified in the systematic literature review: It centers on articles that involve subjective emotion assessment and, within this subset, compares valence-compositional and content-specific conceptualizations of mixed emotions (see Appendix 2.3). In integration of this analysis into the overall framework is provided in Figure 2-7.

Figure 2-7. Research questions in the context of the overall framework



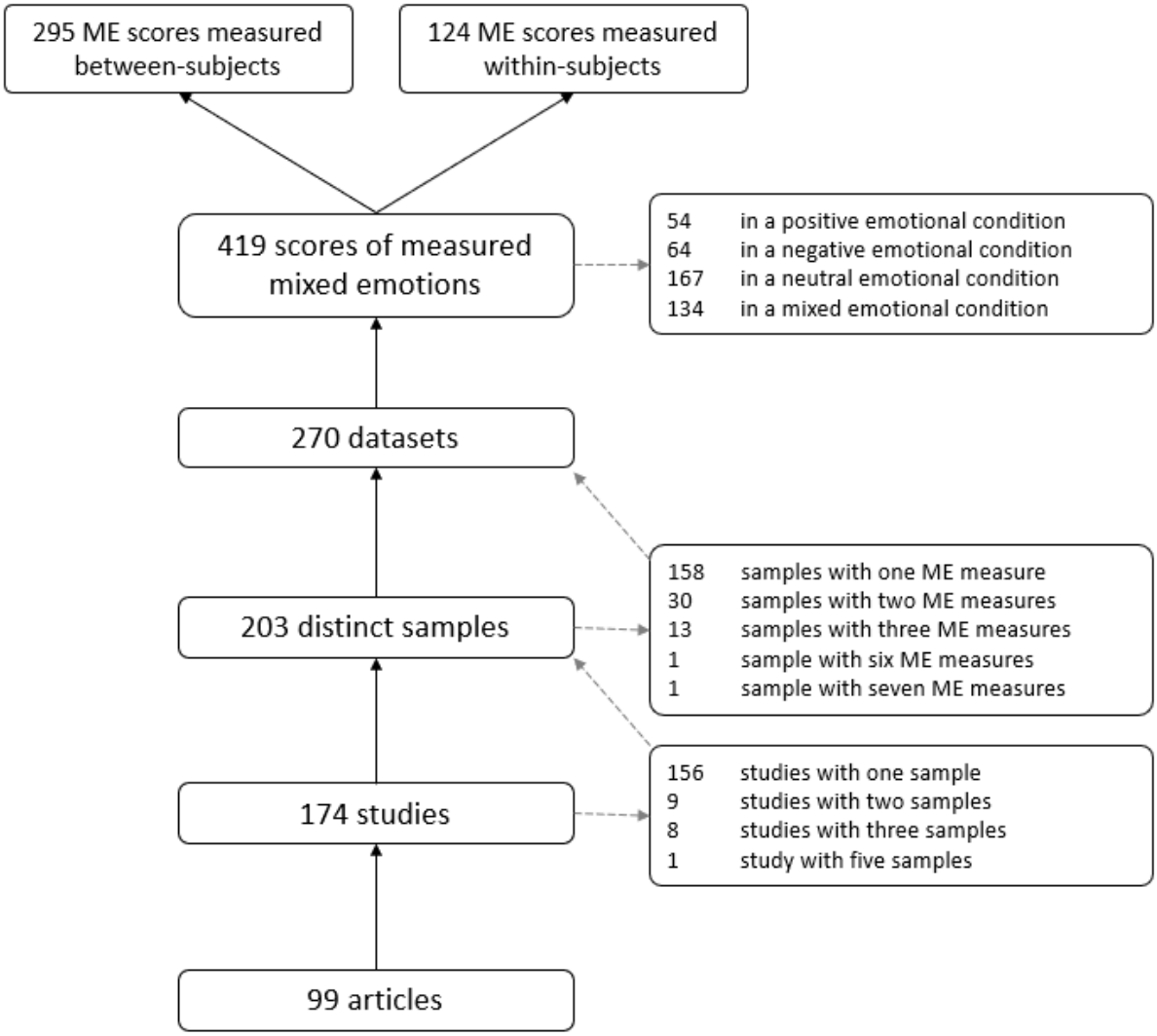
In detail, the meta-analysis addresses the following (conditionally) pre-registered research questions: Do valence-compositional and construct-specific approaches differ in their absolute levels of measured mixed emotions (RQ 2a)? Does one of the approaches yield higher differences in measured mixed emotions between a mixed emotional condition and respective emotional reference conditions (RQ 2b)?

2.5.1 Method

Results of the systematic review were included if they involved subjective emotion assessment and contained at least one study that measured and reported the mean value and standard deviation of mixed emotions, along with the corresponding sample size. If an

article did not provide sufficient data this data was attempted to be retrieved from the authors.[18]

Figure 2-8. Overview of the data structure



The final dataset comprised 99 articles with 174 studies, which involved 203 distinct samples, 270 datasets, and 419 single mixed emotion scores. This data structure is documented in Figure 2-8. In detail, this structure accounts for the fact that some articles measured mixed emotions in several *studies* (i.e., level = study), some studies comprised more than one *sample* (i.e., level = sample) and some samples comprised more than one

[18] Overall, 49 authors were approached, out of which eleven thankfully provided the required data, eleven were not able to provide the data, and 27 did not respond.

measure of mixed emotions (i.e., level = dataset). Moreover, some datasets involved experimental designs, in which mixed emotions were measured in different emotional conditions (i.e., positive and/or negative and/or mixed emotional and/or neutral conditions). Thus, different datasets comprised more than one *score of measured mixed emotions* (i.e., level = measurement scores). These measurement scores, in turn, could either originate from a within-subject or a between-subjects design.

For each of these 419 measured mixed emotions scores, the author coded the mean value, standard deviation, and underlying sample size. Mean values and standard deviations were standardized (i.e., normalized as a continuous uniform distribution) with a range of from 0 (minimum value) to 1 (maximum value). Details on this process are documented in Appendix 2.5.

Table 2-6. Variable overview

Variable	Description and coding	Function/rationale for inclusion	Mean	SD	N
		Primary dependent *and independent variable*			
Measured mixed emotions	Mean value of measured mixed emotions, standardized to a range of from 0 to 1.	Dependent variable	.35	.21	51197
Measurement approach	Dummy-coded variable that indicates whether mixed emotions are measured through a valence-compositional [0] or a construct-specific measurement approach [1].	Tests potential differences in measured mixed emotions between these approaches.	.37	.48	51197
		Population characteristics			
Average age	Continuous variable that indicates average age of sample.	Test whether population characteristics influence a potential effect of measurement approach.	29.9	11.7	27726
Proportion of females	Continuous variable that indicates proportion of females in sample.		.57	.15	35456
Type	Categorical variable that indicates whether sample consisted of students (151), an online panel (82), employees (13), or other (21). *Aggregated into dummy-coded variable "online sample" [0 = students, employees, other; 1 = online panel]*		n/a	n/a	37030
Culture	Categorical variable that indicates whether sample was based in North America (118), Europe (72), Asia (47), or other places (7). *Aggregated into dummy-coded variable "North American" [0 = Europe, Asia, other; 1 = North America]*		n/a	n/a	33555
		Research design variables			
Research perspective	Categorical variable that categorizes articles into centering on the outcomes (214) of mixed emotions (e.g., effects on perceptions or preferences) or the antecedents (162) giving rise to them (e.g., contextual factors).	Test whether research design variables influence a potential effect of measurement approach.	n/a	n/a	46457
Research context [19]	Categorical variable that categorizes articles into the areas of complex life events (33), conflict and coping (94), information selection and processing (49), phenomenon of mixed emotions (89), social contexts (79), and difference variables (75). *Aggregated into dummy-coded variable "Phenomenon [versus Correlates]" [0 = complex life events, conflict and coping, information selection and processing, social contexts; 1 = phenomenon of mixed emotions, difference variables]*		n/a	n/a	51197

[19] For related approaches on categorizing research contexts, see Larsen et al. (2017a) and Oh and Tong (2022).

Origin of occurrence[20]	Categorical variable that categorizes datasets into originating from deliberate induction (e.g., through experimental procedures; 318), having been given rise to by a natural encounter (e.g., the experience of a meaningful ending; 22), or having been measured in individuals' daily lives without an anteceding evocative impulse (79). *Aggregated into dummy-coded variable "Mixed emotional impulse" [0 = status quo; 1 = natural encounter, induction]*		n/a	n/a	51197
Measurement type	Categorical variable that categorizes datasets into mixed emotions measured as dependent variable (264), predicting variable (77), or manipulation check (78). *Aggregated into dummy-coded variable "Dependent measure" [0 = predicting variable; 1 = manipulation check, dependent variable]*		n/a	n/a	51197
Induction medium[21]	Categorical variable that categorizes datasets of induced mixed emotions into underlying induction media of imagery (67), text (69), recall (41), video (45), situational procedures (46), image-based (27), multi-media (21), or music (2). *Aggregated into dummy-coded variable "Introspective [versus external]" [0 = music, picture, text, video, multi-media, situational procedures; 1 = imagery, recall]*		n/a	n/a	27909
		Control variables			
Within-subjects measure	Dummy-coded variable that indicates whether studies that measured mixed emotions in different emotional conditions are based on a within-subject design.	Test whether a potential effect of measurement approach is robust if control variables are considered.	.30	n/a	51197
Emotional condition	Categorical variable that categorizes scores of measured mixed emotions into the condition of positive (54), negative (64), neutral (167), or mixed emotions (134).		n/a	n/a	51197

NOTE. — For categorical variables, numbers in round brackets indicate absolute frequencies for each category. For population characteristics, underlying observation sizes refer to *unique participants*; for all other variables, underlying sample sizes refer to *all observed measured mixed emotions scores* for which the respective variable could be retrieved.

[20] This variable is documented for descriptive purposes and is not included as a predictor in the analyzed models due to reasons of collinearity (for instance, in relation to *induction medium*, which is contingent on emotion induction), with the exception of an exploratory analysis (documented in Appendix 2.8).

[21] Further details on the eight different medium categories are provided in Appendix 2.6.

Apart from these measures, the author coded a set of independent variables if they were provided or inferable from the data. In detail, these independent variables included *population characteristics* (i.e., the type, culture, average age, and percentage of females in the investigated population), *research design variables* (i.e., research perspective, context, measurement type, origin of occurrence of mixed emotions, and induction medium), as well as *control variables* (i.e., within-subjects-design, emotional condition). An overview and further description of these variables are provided in Table 2-6.

2.5.2 Descriptive Overview

The sample size of all coded mixed emotion scores totaled 51197 observations that could be attributed to 38380 unique participants.[22] On average, participants were 29.9 years old, part of an online sample (31 percent), predominantly female (57 percent), and North American (48 percent). The average score of measured mixed emotions across all coded means was .35 (SD = 21), on a range from 0 to 1 (see Table 2-6). With regards to the two measurement approaches, most of the 419 mixed emotions scores originated from valence-compositional approaches (see Table 2-7).

Table 2-7. Distribution of measurement approaches (absolute frequencies)

Perspective	Articles	Studies	Distinct Samples	Datasets	Scores
overall	99	174	203	270	419
valence-compositional (VC)	66	108	133	167	264
construct-specific (CS)	50	86	90	103	155
both VC and CS	17	20	20	n/a	n/a

With regards to the *research design*, most mixed emotion scores could be attributed to studies investigating the outcomes (n = 136), as compared to the antecedents of mixed emotions (n = 104). *Context-wise*, most mixed emotion scores pertained to studies investigating mixed emotions in the context of conflict and coping (n = 62), followed by social contexts (n = 61), the phenomenon of mixed emotions, as well as difference variables (both n = 46), information selection and processing (n = 37), and complex life events (n = 22).

[22] In the case of unique participants, a population was counted only once if mixed emotions were obtained through different measures for the same population and/or if multiple mixed emotion scores were obtained through a within-subjects design.

With regards to the *origin of occurrence*, most mixed emotion scores originated from an induction procedure (n = 193), compared to the status quo (n = 79) and natural encounters (n = 22). With regards to *measurement type,* they most often constituted dependent variables (n = 264), compared to manipulation check measures (n = 78) and predicting variables (n = 77). Datasets involving the induction of mixed emotions most often relied on text-based procedures (n = 69) and imagery (n = 67) as *emotion induction media*, followed by situational procedures (n = 46), video (n = 45), recall (n = 41), image-based (n = 27), multi-media (n = 21), and music (n = 2; for details, see Appendix 2.6).

With regards to additional *control variables*, 124 of the 419 mixed emotion scores originated from within-subject designs, whereas the remaining 295 scores originated from between-subject designs. Finally, *emotional conditions* were most often neutral in valence (n = 167), compared to mixed emotional (n = 134), negative (n = 64), or positive (n = 54). A visualized overview of these variables in relation to the two different measurement approaches, as well as of the distribution of the experimental conditions is provided in Appendix 2.7.

2.5.3 Results

On the basis of this dataset, the two most frequently used mixed emotion measurement approaches (i.e., valence-compositional and construct-specific measurement) are meta-analytically compared. These analyses are outlined in the following, structured according to the two research questions (see Figure 2-7).

RQ 2a: Absolute differences. To investigate whether valence-compositional and construct-specific approaches differ in their absolute levels of measured mixed emotions, the standardized scores of measured mixed emotions are regressed on the dummy-coded measurement approach variable (0 = valence-compositional; 1 = construct-specific), relying on the robumeta module in Stata with hierarchical effect weights on the article-level (Fisher et al., 2017). As documented in Table 2-8 (Model 1), construct-specific measurement approaches yielded higher scores of measured mixed emotions (β_{CS} = .10, SE = .04, p = .006).

To investigate the robustness of this finding, covariates were included in this base model. To ensure sufficient degrees of freedom for variance estimation, separate models were analyzed for each category of covariates, and some categorical variables were grouped into larger categories (for an overview of these covariates, see Table 2.6). First, *population*

characteristics were included in the base model (i.e., percentage of females, as well as two dummy-coded variables categorizing a sample as North American [i.e., Culture] or online [i.e., Type]).[23] Second, *research design variables* were included in the base model (i.e., dummy-coded variables for different research contexts, measurement types, and research perspectives, as well as a dummy-coded variable that aggregated induction media into external or introspective media.) Third, *control variables* were included in the base model (i.e., dummy-coded variables categorizing a score as originating from a within-subjects design, as well as from a positive, negative, or neutral emotional condition). Results of the models are documented in Table 2-8 and consistently indicate the tendency that construct-specific measurement approaches yield higher levels of measured mixed emotions: when controlling for population characteristics, this effect was marginally significant (β_{CS} = .08, SE = .04, p = .054), while it was significant when controlling for research design variables (β_{CS} = .12, SE = .04, p = .013) and control variables (β_{CS} = .08, SE = .04, p = .043).

[23] Population age was not included in the analysis due to insufficient degrees of freedom.

Table 2-8. Regression analyses investigating the effect of measurement approach on absolute differences in measured mixed emotions

	Model 1 Base model	**Model 2** Population characteristics	**Model 3** Research design variables	**Model 4** Control variables
Primary independent variable (baseline = Valence-compositional measurement)				
Construct-specific measurement	.10***	.08†	.12*	.08*
	(.04)	(.04)	(.04)	(.04)
Research design variables				
Context (baseline = Phenomenon of mixed emotions)				
Complex life events			-.08	
			(.11)	
Conflict and coping			.05	
			(.08)	
Information selection & processing			.03	
			(.10)	
Social contexts			.02	
			(.07)	
Difference variables			.07	
			(.11)	
Measurement type (baseline = Dependent variable)				
Manipulation check			.04	
			(.05)	
Predictor			-.09†	
			(.05)	
Research perspective (baseline = Antecedent)				
Outcome			.03	
			(.05)	
Medium (baseline = External induction media)				
Introspective			.06	
			(.05)	
Population characteristics				
Percentage of females		-.19†		
		(.09)		
Online sample (baseline = other)		-.03		
		(.05)		
North American (baseline = other)		.11**		
		(.03)		
Control variables				
Within-subjects design				-.10*
				(.04)
Emotional condition (baseline = mixed emotional condition)				
Positive condition				-.12**
				(.04)
Negative condition				-.07
				(.05)
Neutral condition				-.07†
				(.04)
Constant	.31***	.38***	.20†	.40***
	(.03)	(.07)	(.11)	(.04)
Observations	419	332	296	419

NOTE. — Standard errors in parentheses. *** p < .001, ** p < .01, * p < .05, † p < .10

RQ 2b: Differences between mixed and emotional reference conditions. The next section investigates whether the two measurement approaches can be distinguished in their differences in measured mixed emotions between mixed and other emotional reference conditions. For this purpose, a difference variable between these emotional conditions is calculated. For each dataset j, this variable captures the difference between measured mixed emotions in a *mixed emotional* condition and the average of measured mixed emotions in the respective *reference condition(s)* (i.e., a positive and/or negative and/or neutral condition). Formally, this difference score can be represented as:

$$MEscore[mixed]_j - avg(MEscore[pos]_j, MEscore[neg]_j, MEscore[neu]_j)$$

Per definition, this score requires datasets that involve a mixed emotional condition and at least one other emotional reference condition. This requirement is met by 90 of the overall 270 datasets (for an overview, see Figure A2-7 in Appendix 2.7).

In addressing RQ 2b, this score (mean = .15, SD = .14, [min = -.13; max = .63]) is regressed on the dummy-coded measurement approach variable (0 = valence-compositional; 1 = construct-specific), relying on the robumeta module in STATA with hierarchical effect weights on the article-level. As documented in Table 2-9, construct-specific measurement approaches yielded higher difference scores between mixed and emotional reference conditions (β_{CS} = .11, SE = .04, p = .014).

To investigate the robustness of this finding, covariates were included in this base model. First, *population characteristics* were included in the same manner as in the previous part. Second, *research design variables* were included in the base model (i.e., a dummy-coded variable categorizing research contexts into phenomenon-based versus correlate-based contexts, as well as the variables of induction medium and research perspectives outlined in the previous part).[24] Third, *control variables* were included in the base model (i.e., two dummy-coded variables indicating the presence of a positive and respectively negative reference condition, as well as the within-subjects variable outlined in the previous part).[25]

[24] A variable of research perspective was omitted due to a lack of degrees of freedom.
[25] A dummy-coded variable for a neutral emotional reference condition was omitted due to collinearity.

Results of the models are documented in Table 2-9 and consistently indicate the tendency for construct-specific measurement approaches to yield higher difference scores between mixed and emotional reference conditions: when controlling for population characteristics, this effect was marginally significant (β_{CS} = .09, SE = .04, p = .053), while it was significant when controlling for research design variables (β_{CS} = .08, SE = .03, p = .039) and control variables (β_{CS} = .11, SE = .03, p = .003).

Table 2-9. Regression analyses investigating the effect of measurement approach on differences between mixed and emotional reference conditions

	Model 1 Base model	**Model 2** Population characteristics	**Model 3** Research design variables	**Model 4** Control variables
Primary independent variable (baseline = Valence-compositional measurement)				
Construct-specific measurement	.11*	.09†	.08*	.11**
	(.04)	(.04)	(.03)	(.03)
Research design variables				
Context (baseline = External correlates of mixed emotions)				
Phenomenological context			.01	
			(.04)	
Medium (baseline = External induction media)				
Introspective medium			.00	
			(.04)	
Measurement type (baseline = Dependent variable)				
Manipulation check			.11†	
			(.05)	
Predictor			.00	
			(.03)	
Population characteristics				
Percentage of females		.09		
		(.14)		
Online sample (baseline = other)		.01		
		(.05)		
North American (baseline = other)		-.05		
		(.04)		
Control variables				
Within-subjects design				-.01
				(.06)
Presence of positive condition				.08
				(.05)
Presence of negative condition				-.03
				(.04)
Constant	.11**	.10	.08*	.09
	(.03)	(.08)	(.04)	(.06)
Observations	90	73	87	90

NOTE. — Standard errors in parentheses. *** p < .001, ** p < .01, * p < .05, † p < .10

Exploratory analyses. Beyond the two research questions, the coded dataset enabled a set of exploratory analyses, which are documented in Appendix 2.8. On the one hand, these analyses investigate whether certain population characteristics and research design variables moderated the differences in measured mixed emotions between the two measurement approaches. On the other hand, they investigate whether these sample or research characteristics themselves affected measured mixed emotions.

2.5.4 Discussion

In comparing the two most frequently used measurement approaches – subjectively assessed mixed emotions in a valence-compositional or construct-specific conceptualization – this part documented that construct-specific approaches yielded higher scores of measured mixed emotions in tendency (RQ 2a). Theoretically, this observation might align with the notion that positive and negative emotions are often regarded as opposites that exclude each other. As discussed in Chapter 2.4.2, participants might experience cognitive dissonance in indicating higher levels of both positive and negative emotions, even if these levels actually occur. However, the finding of the presented meta-analysis does not necessarily imply that construct-specific measurement approaches lead to *objectively* higher levels of measured mixed emotions: the observed differences might also constitute an artifact of the measurement procedures themselves.

Of practical relevance, construct-specific measurement approaches were associated with higher (positive) differences in measured mixed emotions between mixed and other emotional reference conditions (RQ 2b). This observation might imply that construct-specific measures more successfully predict induced mixed emotions between different (experimental) emotion conditions.

2.6 Conclusion

2.6.1 Theoretical and Methodological Contributions

In light of a growing interest in the study of mixed emotions, this chapter strives to equip researchers with a conceptual framework of mixed emotion measurement that encourages evidence-based rather than convenience-driven selection of measurement procedures. To

this end, a systematic literature review of studies that quantitatively measured mixed emotions was conducted. This review covered more than 4000 screened articles and led to a set of 183 studies, which served as a basis for developing a taxonomy of mixed emotion measurement approaches. This taxonomy organizes measurement approaches into three levels that refer to the object of investigation (distinguishing between subjective assessment and emotion recognition), the conceptualization of mixed emotions (either in a valence-compositional or construct-specific form), and their quantification (based on similarity and/or intensity).

To provide insights into the discriminatory efficacy of the two most frequently used measurement approaches, a meta-analysis was conducted: Centering on subjective emotion assessment as the object of investigation, this analysis compared valence-compositional with construct-specific conceptualizations. As a first step, it documented that construct-specific approaches yielded higher absolute scores of measured mixed emotions – a finding that might be explained through individuals' lay theories regarding the mutual opposite character of positive and negative emotions. In a second step, it was shown in a second step that construct-specific measurement approaches yielded higher (positive) differences in measured mixed emotions between mixed and other emotional reference conditions. This finding might provide an indication that construct-specific measures more successfully predict induced mixed emotions between different (experimental) emotion conditions. For research practice, it might be of particular relevance if only small levels or differences of mixed emotions are expected in investigated phenomena.

Beyond the taxonomy of mixed emotion measurement approaches, this chapter provides conceptual insights into the field of mixed emotions research: In categorizing the results of the systematic literature on a set of identified covariates, it offers an overview of different characteristics of underlying populations and research designs.

2.6.2 Limitations and Future Research Directions

This chapter is not without limitations. In terms of its scope of observation, the focus has been placed on quantitative research. Therefore, it is only to a marginal extent able to account for the insights that *qualitative research* has contributed to mixed emotion scholarship (e.g., Liyanagamage et al., 2019; Schneider et al., 2015).

With regard to the systematic literature review, only peer-reviewed articles in English were considered. While this inclusion criterion was applied to ensure a comparable level of quality across the considered articles, it poses the risk of increasing publication bias. However, given the nature of the phenomenon under investigation, this risk seems comparably less pertinent: It seems likely that publication bias might affect more strongly secondary aspects (e.g., certain induction media that systematically differed in their success of eliciting mixed emotions) than the comparison of measurement approaches. Nonetheless, an extension of the literature review (e.g., to unpublished research and book chapters), while including indicators of their methodological quality, seems worthwhile.

Regarding the coding of the identified review results, this process was conducted by the researcher alone. However, as it occasionally required high-inference decisions that entailed a certain degree of subjective judgment and interpretation (e.g., regarding the categorization of articles to certain contexts of investigation), future research should assure the inclusion of a second coder for validation purposes.

With regard to the meta-analytical comparison of differences in measured mixed emotions between mixed and other emotional reference conditions, these latter reference conditions were aggregated (see chapter 2.5.3). In other words, no distinction was made between reference conditions that were of positive and/or negative and/or neutral valence. While this aggregation assured a sufficient number of observations, this procedure does not take into account potential heterogeneity between these reference conditions. For instance, negative emotional reference conditions might elicit a considerable degree of mixed emotions themselves, as individuals' emotional baseline experience tends to be slightly positive (also referred to as "positivity offset"; Ito & Cacioppo, 2005).

With regard to the different conceptualizations of valence-compositional and construct-specific measurement approaches, studies were analyzed in an aggregated form to ensure a sufficient number of observations. In consequence, this procedure does not account for potential differences *within* these two approaches. For instance, in the context of valence-compositional approaches, "emotional valence" can be conceptualized from different perspectives (e.g., on the basis of intrinsic attractiveness/aversiveness or underlying appraisals; see chapter 2.2.2). Moreover, the two emotional valence states can be assessed in different levels of granularity (e.g., through broad emotion categories, such as "positive"

and “negative” or through distinct emotional phenomena, such as “amusing” and “repulsive”) or number (e.g., single-item versus multi-item scales). Future research might address these differences.

Finally, the distinction between valence-compositional and construct-specific conceptualizations might merit further conceptual and empirical investigation: As they might involve different characteristics of appraisal (see chapter 2.2.2), the question arises as to what extent they measure a shared, *idiosyncratic concept of mixed emotions* or capture different forms of mixed emotional phenomena.

Appendix 2.1: Excluded Articles (Correlation/Modeling or Lack of Quantification)

Table A2-1. Excluded articles on the basis of correlation/modeling and lack of quantification

Article	Exclusion	Source
Ahn et al. (2021)	correlation/modeling	Dat
Albrecht et al. (2005)	no quantification	Dat
Algoe et al. (2010)	correlation/modeling	Dat
An et al. (2017)	correlation/modeling	Cit
Andersen et al. (2020)	correlation/modeling	Cit
Aragón (2017)	correlation/modeling	Dat
Armitage (2003)	no quantification	Cit
Audrezet et al. (2016)	correlation/modeling	Dat
Aumer et al. (2016)	no quantification	Cit
Aydin (2020)	no quantification	Dat
Baas et al. (2012)	no quantification	Cit
Bae (2021)	no quantification	Cit
Bae (2023)	no quantification	Cit
Bagozzi et al. (1999)	correlation/modeling	Cit
Balzarini et al. (2021)	correlation/modeling	Dat
Bannister (2020)	no quantification	Dat
Batcho (2020)	no quantification	Cit
Blaxton et al. (2021)	correlation/modeling	Dat
Bodner and Bensimon (2016)	correlation/modeling	Dat
Bodner et al. (2015)	correlation/modeling	Dat
Bonanno and Keltner (1997)	no quantification	Cit
Breaden Madden and Jabusch (2021)	correlation/modeling	Cit
Briesemeister et al. (2012)	no quantification	Cit
Brose et al. (2015)	correlation/modeling	Dat
Carstensen et al. (2000)	correlation/modeling	Cit
Chancellor et al. (2018)	no quantification	Dat
Chang and Inoue (2021)	no quantification	Dat
Chen and Treviño (2022)	correlation/modeling	Dat
Choraria (2013)	no quantification	Cit
Coats and Blanchard-Fields (2008)	correlation/modeling	Dat
Cohen et al. (2016a)	no quantification	Dat

Coifman et al. (2007)	correlation/modeling	Cit
Condon and Feldman Barrett (2013)	correlation/modeling	Cit
D'Cruz and Noronha (2015)	no quantification	Cit
De Jong et al. (2018)	correlation/modeling	Dat
Defrin et al. (2015)	no quantification	Cit
Delton et al. (2022)	no quantification	Cit
Dickens and Chavez (2018)	no quantification	Dat
Diener and Iran-Nejad (1986)	correlation/modeling	Dat
Fang and Zhang (2021)	no quantification	Dat
Fayn and Kuppens (2017)	no quantification	Dat
Franklin et al. (2013)	no quantification	Cit
Fredrickson and Levenson (1998)	no quantification	Cit
Fredrickson et al. (2003)	no quantification	Cit
Fugate et al. (2008)	correlation/modeling	Cit
Gadosey et al. (2021)	correlation/modeling	Dat
Gordon et al. (2017)	no quantification	Cit
Grühn et al. (2013)	correlation/modeling	Dat
Herrald and Tomaka (2002)	no quantification	Cit
Hershfield et al. (2013)	correlation/modeling	Dat
Holt-Lunstad et al. (2007)	no quantification	Cit
Hosoya et al. (2017)	no quantification	Dat
Huang (2020)	no quantification	Dat
Hung and Lu (2018)	correlation/modeling	Cit
Kaleńska-Rodzaj (2018)	no quantification	Cit
Kassam et al. (2011)	no quantification	Cit
Kawakami et al. (2013)	no quantification	Dat
Kessous et al. (2017)	no quantification	Dat
Khalmetski et al. (2015)	no quantification	Cit
Ki et al. (2017)	correlation/modeling	Dat
Kivikangas and Ravaja (2013)	no quantification	Cit
Klibert et al. (2022)	correlation/modeling	Cit
Koenigstorfer et al. (2010)	no quantification	Dat
Kööts et al. (2012)	correlation/modeling	Dat
Kööts-Ausmees et al. (2013)	correlation/modeling	Dat
Kuijer and Boyce (2014)	no quantification	Dat

Labroo and Ramanathan (2007)	no quantification	Dat
Lau-Gesk and Mukherjee (2017)	no quantification	Dat
Leu et al. (2011)	correlation/modeling	Cit
Li (2015)	correlation/modeling	Dat
Lomas (2017)	no quantification	Cit
Lunardo and Saintives (2018)	correlation/modeling	Dat
Luong et al. (2016)	no quantification	Cit
Maguire and Geiger (2015)	no quantification	Cit
Malooly et al. (2013)	no quantification	Cit
Mavrou and Dewaele (2020)	no quantification	Dat
Mellers et al. (1997)	no quantification	Cit
Meyerson and Scully (1995)	no quantification	Cit
Mileti et al. (2013)	correlation/modeling	Dat
Moeller et al. (2018b)	correlation/modeling	Dat
Moldjord et al. (2022)	no quantification	Cit
Moulard et al. (2012)	correlation/modeling	Cit
Nasso et al. (2022)	no quantification	Cit
Nelissen and van Selm (2008)	correlation/modeling	Dat
Newman and Sachs (2020)	no quantification	Dat
Newman et al. (2020)	correlation/modeling	Dat
Norberg et al. (2020)	no quantification	Dat
O'Brien and Linehan (2019)	no quantification	Dat
Ong and Bergeman (2004)	correlation/modeling	Cit
Ong et al. (2006)	correlation/modeling	Cit
Oppliger and Zillmann (1997)	correlation/modeling	Cit
Ozawa (2021)	correlation/modeling	Dat
Palgi et al. (2014)	correlation/modeling	Dat
Pappas et al. (2017)	correlation/modeling	Dat
Parkins (2023)	no quantification	Dat
Paulus and Wentura (2016)	correlation/modeling	Dat
Peng and Nisbett (1999)	no quantification	Cit
Phan and Beck (2020)	no quantification	Cit
Plourde-Kelly et al. (2021)	no quantification	Dat
Polivy (1981)	no quantification	Cit
Prati and Giner-Sorolla (2018)	no quantification	Dat

Prayag and Soscia (2016)	no quantification	Cit
Primoceri and Ullrich (2023)	correlation/modeling	Cit
Quirin et al. (2009)	correlation/modeling	Cit
Radu-Lefebvre and Randerson (2020)	no quantification	Dat
Rafaeli and Revelle (2006)	correlation/modeling	Cit
Rafaeli et al. (2007)	correlation/modeling	Dat
Ramsey et al. (2016)	correlation/modeling	Cit
Ready et al. (2008)	correlation/modeling	Dat
Reich and Zautra (2002)	correlation/modeling	Dat
Reisenzein and Hofmann (1990)	no quantification	Cit
Rozin et al. (2013)	no quantification	Cit
Russell and Carroll (1999)	correlation/modeling	Cit
Ruth et al. (2002)	correlation/modeling	Dat
Sawaoka and Monin (2020)	no quantification	Dat
Scherer and Ceschi (1997)	no quantification	Cit
Scherer and Meuleman (2013)	no quantification	Cit
Schimmack (2009)	correlation/modeling	Cit
Schimmack et al. (2002)	correlation/modeling	Cit
Seah et al. (2022)	correlation/modeling	Dat
Septianto et al. (2022)	no quantification	Dat
Shiota et al. (2010)	correlation/modeling	Dat
Shrira et al. (2015)	correlation/modeling	Dat
Shrira et al. (2020)	correlation/modeling	Dat
Sims et al. (2015)	correlation/modeling	Dat
Song et al. (2021)	no quantification	Cit
Stein et al. (1997)	no quantification	Cit
Stein et al. (2015)	no quantification	Dat
Tang et al. (2020)	correlation/modeling	Dat
Thagard et al. (2023)	no quantification	Dat
Tian et al. (2021)	correlation/modeling	Dat
Tillman and Louwerse (2018)	no quantification	Dat
Tong and Jia (2017)	correlation/modeling	Dat
Tweed and Tweed (2011)	correlation/modeling	Cit
Uchino et al. (2012)	no quantification	Cit
Uchino et al. (2013)	correlation/modeling	Cit

Ursavas and Hesapci-Sanaktekin (2013)	no quantification	Dat
Vansteelandt et al. (2005)	correlation/modeling	Dat
Vince and Broussine (1996)	no quantification	Cit
Vinney and Dill-Shackleford (2018)	no quantification	Dat
Vroegh (2019)	no quantification	Dat
Vroegh (2021)	no quantification	Dat
Walsh et al. (2022)	correlation/modeling	Dat
Ward et al. (2000)	no quantification	Dat
Warren and McGraw (2016)	correlation/modeling	Cit
Watson et al. (1999)	correlation/modeling	Cit
Weber et al. (2020)	correlation/modeling	Cit
Weissman (1970)	no quantification	Dat
Wen et al. (2018)	no quantification	Dat
Willroth et al. (2020)	correlation/modeling	Dat
Wilt et al. (2016)	no quantification	Dat
Xiao et al. (2018)	no quantification	Dat
Yik (2007)	correlation/modeling	Dat
Zablocki et al. (2019)	no quantification	Dat
Zautra et al. (2000)	correlation/modeling	Cit
Zautra et al. (2002)	correlation/modeling	Cit
Zelenski and Larsen (2000)	correlation/modeling	Cit

NOTE. — Dat = identification via databases; Cit = identification via other methods (i.e., backward or forward citations)

Appendix 2.2: Database Search Criteria

Searches in the three bibliographic databases were based on the structure of the following search prompt:

```
(
    (
        (
            ("mixed" OR "conflicting" OR "ambivalent" OR "contrasting" OR "co-occur*")
            NEAR/3
            ("feeling*" OR "emotion*" OR “mood” OR moods)
        )
        OR
        ("emotional blend*" OR "emotional ambivalence" OR "emotional conflict*” OR
        "emotional complex*" OR “emodiversity”)
    )
    NOT (children OR patients OR depression OR disorder OR clinical OR therapy)
)
```

Appendix 2.3: Dataset of Taxonomy Development

Table A2-2. Dataset of taxonomy development

Article	Object of investigation	Conceptualization of ME	Research Context[1]	Source
Aaker et al. (2008)	Sub	CS	.	Dat
Alowibdi et al. (2022)	Con	.	.	Dat
Armitage and Conner (2000)	Sub	VC	Information selection and processing	Cit
Audrezet and Parguel (2018)	Sub	VC	.	Cit
Barford et al. (2018)	Sub	VC	Difference variables	Dat
Barford et al. (2020)	Sub	VC	Difference variables	Dat
Barrett et al. (2010)	Sub	VC	.	Dat
Bartsch et al. (2010)	Sub	CS	Difference variables	Dat
Bee and Madrigal (2013)	Sub	VC	Conflict and coping	Dat
Berrios et al. (2015b)	Sub	CS, VC	Conflict and coping	Dat
Berrios et al. (2017)	Sub	CS	Difference variables	Dat
Berrios et al. (2018a)	Sub	CS	Complex life events	Dat
Berrios et al. (2018b)	Sub	CS, VC	Complex life events	Dat
Bi et al. (2020)	Sub	VC	Complex life events	Dat
Braniecka et al. (2014)	Sub	CS	Conflict and coping	Dat
Caballero et al. (2007)	Sub	CS, VC	Complex life events	Dat
Carrera and Oceja (2007)	Sub	VC	.	Dat
Carrera et al. (2008)	Sub	VC	.	Cit
Carrera et al. (2013)	Sub	VC	.	Cit
Chang and Raver (2020)	Sub	VC	Social contexts	Dat
Chang (2019)	Sub	VC	.	Dat
Chang (2013)	Sub	CS	Difference variables	Dat
Chaudhury et al. (2022)	Sub	CS, VC	Phenomenon of ME	Dat
Clark et al. (2008)	Sub	CS	Information selection and processing	Cit
Commodari and Sole (2020)	Sub	VC	.	Dat
Costarelli and Gerłowska (2015a)	Sub	CS	Social contexts	Dat
Costarelli and Gerłowska (2015b)	Sub	CS	Social contexts	Dat
Daniel et al. (2021)	Con	.	.	Dat
De Vos et al. (2021)	Sub	VC	.	Dat
Deckman and Skolnick (2020)	Sub	VC	.	Dat

Deng et al. (2016)	Sub	VC	Difference variables	Dat
Diestel and Schmidt (2011)	Sub	CS	.	Cit
Dong and Xu (2022)	Sub	VC	.	Dat
Durso et al. (2021)	Sub	CS	Information selection and processing	Cit
Ersner-Hershfield et al. (2008)	Sub	VC	.	Dat
Ersner-Hershfield et al. (2009)	Sub, Beh	VC	.	Dat
Fingerman et al. (2008)	Sub	VC	Social contexts	Cit
Fong and Tiedens (2002)	Sub	VC	.	Dat
Fong (2006)	Sub	CS, VC	Information selection and processing	Dat
Frank et al. (2022)	Sub	CS	Conflict and coping	Dat
Gasper and Danube (2016)	Sub	CS, VC	Phenomenon of ME	Cit
Gasper et al. (2021)	Sub	VC	Phenomenon of ME	Cit
Griffin and Sayette (2008)	Phy	.	.	Cit
Grossmann et al. (2016)	Con	.	.	Dat
Guarana et al. (2022)	Sub	CS	Social contexts	Dat
Haddock et al. (2017)	Sub	CS	.	Dat
Hamby and Russell (2022)	Sub	CS	Conflict and coping	Dat
Hamilton and Allard (2022)	Sub	VC	Difference variables	Dat
Harris and Alvarado (2005)	Sub, Phy	VC	.	Cit
Hemenover and Schimmack (2007)	Sub	VC	Phenomenon of ME	Dat
Henderson and Norris (2013)	Phy	.	.	Dat
Homer (2021)	Sub	VC	Social contexts	Dat
Hong and Lee (2010)	Sub	VC	.	Dat
Hostler and Berrios (2021)	Sub	VC	Complex life events	Dat
Hu and Gasper (2022)	Sub	CS	Phenomenon of ME	Cit
Hu and Sung (2022)	Sub	CS	Conflict and coping	Dat
Huang et al. (2018)	Sub	VC	Conflict and coping	Dat
Hui et al. (2009)	Sub	VC	Difference variables	Dat
Hunter et al. (2008)	Sub	VC	.	Dat
Hunter et al. (2010)	Sub	VC	.	Dat
Hyde and Masser (2021)	Sub	CS	Conflict and coping	Dat
Itkes et al. (2019)	Sub	VC	.	Dat
Jonas et al. (1997)	Sub	CS, VC	.	Cit
Jost and Burgess (2000)	Sub	VC	Social contexts	Cit
Juslin et al. (2021)	Sub	VC	.	Dat

Kaminska et al. (2020)	Phy	.	.	Dat
Kim et al. (2017)	Sub	VC	.	Dat
Kreibig et al. (2015)	Sub, Phy	VC	Phenomenon of ME	Dat
Kung and Chao (2019)	Sub	VC	Information selection and processing	Dat
Kwak et al. (2013)	Sub	VC	.	Cit
Ladinig and Schellenberg (2012)	Sub	VC	.	Dat
Larsen and Green (2013)	Sub	VC	.	Dat
Larsen and McGraw (2011)	Sub	VC	.	Dat
Larsen and Norris (2009)	Phy	.	.	Cit
Larsen and Stastny (2011)	Sub	VC	.	Dat
Larsen et al. (2001)	Sub	CS	Phenomenon of ME	Dat
Larsen et al. (2003)	Sub	VC	.	Cit
Larsen et al. (2004)	Sub	VC	.	Dat
Larsen et al. (2009)	Sub, Phy	VC	Phenomenon of ME	Dat
Larsen et al. (2021)	Sub	VC	Complex life events	Dat
Larsen et al. (2017b)	Sub	VC	Phenomenon of ME	Dat
Lin and Utz (2015)	Sub	CS	.	Cit
Liu et al. (2021)	Sub	VC	Conflict and coping	Dat
Lu et al. (2017)	Sub	VC	Difference variables	Dat
Luo et al. (2010)	Phy	.	.	Dat
MacDonald and Zanna (1998)	Sub	VC	.	Cit
Madrigal et al. (2022)	Sub	VC	.	Dat
Maio et al. (2001)	Sub, Phy	VC	Information selection and processing	Cit
Mather and Ready (2021)	Sub	VC	.	Dat
Mayser et al. (2008)	Sub	CS	Complex life events	Dat
McGraw and Warren (2010)	Sub	VC	.	Dat
Melwani and Rothman (2022)	Sub	VC	Social contexts	Dat
Menninga et al. (2011)	Sub	CS	Conflict and coping	Dat
Menninghaus et al. (2015)	Sub	VC	.	Dat
Miao (2011)	Sub	VC	.	Dat
Mill et al. (2018)	Sub	VC	.	Dat
Miyamoto and Ryff (2011)	Sub	VC	.	Cit
Miyamoto et al. (2010)	Sub, Con	VC	Difference variables	Dat
Mori (2022)	Sub	VC	.	Dat
Napa Scollon et al. (2005)	Sub	VC	.	Cit

Newby-Clark et al. (2002)	Sub	CS, VC	.	Cit
Newman et al. (2022)	Sub	CS	.	Dat
Nohlen et al. (2016)	Phy	.	.	Cit
Nordgren et al. (2006)	Sub	CS	.	Cit
Norris and Larsen (2020)	Sub	VC	Complex life events	Dat
Norris and Wu (2021)	Sub, Phy	VC	Conflict and coping	Dat
Norris et al. (2019)	Sub	CS, VC	Conflict and coping	Cit
Nowlis et al. (2002)	Sub	CS	.	Cit
Oceja and Carrera (2009)	Sub	VC	.	Dat
Oh and Tong (2021)	Sub	CS	Conflict and coping	Cit
Oh (2022)	Sub	CS, VC	Conflict and coping	Dat
Orth et al. (2010)	Sub	VC	Conflict and coping	Dat
Pe and Kuppens (2012)	Sub	VC	.	Cit
Peng and Chen (2021)	Sub	CS	Conflict and coping	Dat
Penz and Hogg (2011)	Sub	VC	.	Dat
Peterson and Janssen (2007)	Sub	VC	.	Dat
Pillaud et al. (2013)	Sub	CS, VC	Social contexts	Cit
Plambeck and Weber (2009)	Sub	VC	Complex life events	Dat
Plourde-Kelly et al. (2021)	Phy	.	.	Dat
Podoynitsyna et al. (2012)	Sub	VC	Information selection and processing	Dat
Priester and Petty (1996)	Sub	CS, VC	.	Cit
Raza-Ullah (2020)	Sub	CS	Conflict and coping	Dat
Rees et al. (2013)	Sub	CS	Information selection and processing	Dat
Reich and Wheeler (2016)	Sub	VC	Conflict and coping	Cit
Reinders et al. (2020)	Sub	CS	Conflict and coping	Dat
Riediger et al. (2009)	Sub	VC	.	Cit
Riediger et al. (2014)	Sub	VC	.	Cit
Righetti et al. (2020)	Sub	CS	Social contexts	Dat
Ritchie et al. (2006)	Sub	VC	.	Dat
Rothman and Northcraft (2015)	Sub	CS	Social contexts	Dat
Rothman et al. (2022)	Sub	VC	Social contexts	Dat
Samson et al. (2016)	Sub	VC	Phenomenon of ME	Dat
Santos et al. (2021)	Sub	VC	Information selection and processing	Dat
Sawicki et al. (2013)	Sub	VC	Information selection and processing	Cit
Scheibe et al. (2007)	Sub	CS	Difference variables	Dat

Schimmack and Colcombe (2007)	Sub	VC	.	Dat
Schimmack (2001)	Sub	VC	.	Dat
Schimmack (2005)	Sub	VC	.	Dat
Schmalz and Orth (2012)	Sub	VC	Social contexts	Dat
Schmukle and Egloff (2009)	Sub	VC	Phenomenon of ME	Dat
Schneider and Mattes (2021)	Sub, Beh	CS, VC	Phenomenon of ME	Dat
Schneider and Stone (2015)	Sub	VC	.	Dat
Schneider et al. (2015)	Sub, Beh	CS, VC	Phenomenon of ME	Cit
Schneider et al. (2016)	Sub	CS, VC	Phenomenon of ME	Dat
Schneider et al. (2019)	Sub	CS, VC	.	Cit
Schneider et al. (2020)	Sub	VC	Phenomenon of ME	Dat
Schuh et al. (2016)	Sub	CS, VC	Social contexts	Dat
Scott et al. (2014)	Sub	VC	.	Dat
See and Luttrell (2021)	Sub	CS, VC	Phenomenon of ME	Dat
Segal and Cahill (2009)	Phy	.	.	Dat
Septianto (2021)	Sub	VC	Information selection and processing	Dat
Sharman and Clark (2016)	Phy	.	.	Dat
Shirai and Kimura (2022)	Sub	VC	Complex life events	Dat
Sincoff (1992)	Sub	CS	.	Dat
Sinha and Sinha (2012)	Sub	CS	.	Cit
Smith and Ellsworth (1987)	Sub	VC	.	Dat
Spencer-Rodgers et al. (2004)	Sub	VC	Difference variables	Cit
Spencer-Rodgers et al. (2010)	Sub	VC	Difference variables	Dat
Stella et al. (2020)	Con	.	.	Dat
Stephens et al. (2023)	Sub	VC	Information selection and processing	Dat
Sun et al. (2021)	Sub	CS	Conflict and coping	Dat
Talmi et al. (2009)	Phy	.	.	Cit
Tarlow Friedman et al. (2002)	Sub	VC	Phenomenon of ME	Cit
Trampe et al. (2015)	Sub	VC	.	Cit
Vakola et al. (2021)	Sub	CS	Complex life events	Dat
van den Broek and Westerink (2009)	Sub	VC	.	Dat
van Harreveld et al. (2014)	Sub	CS	Social contexts	Cit
van Harreveld et al. (2009a)	Sub	CS, VC	Conflict and coping	Dat
Veilleux et al. (2013)	Sub	VC	Conflict and coping	Dat

H.-J. Wang et al. (2022a)	Sub	VC	Social contexts	Dat
S. Wang et al. (2022b)	Sub	CS	.	Dat
Wassiliwizky et al. (2017)	Sub	VC	.	Dat
Watson and Stanton (2017)	Sub	VC	.	Dat
Weth et al. (2015)	Phy	.	.	Dat
Wildschut et al. (2006)	Sub	VC	Phenomenon of ME	Cit
Williams and Aaker (2002)	Sub	VC	.	Dat
Xia et al. (2016)	Sub	VC	Complex life events	Dat
Zampetakis et al. (2016)	Sub	VC	Complex life events	Dat
Zhang and Fung (2009)	Sub	VC	Complex life events	Dat
Zhang et al. (2010)	Sub	VC	Difference variables	Dat
Zhang et al. (2022)	Sub	CS	Information selection and processing	Dat
Zheng et al. (2021)	Sub	VC	Difference variables	Dat
Zoppolat et al. (2022)	Sub	CS	Social contexts	Dat

NOTE. — *Object of investigation:* Sub = Subjective assessment, Con = Content analysis, Beh = Behavioral patterns, Phy = Physiological indicators; *Conceptualization of mixed emotions:* VC = valence-compositional; CS = construct-specific*; Source:* Dat = identification via databases; Cit = identification via backward or forward citations; [1]assigned articles constitute the meta-analysis dataset

Appendix 2.4: Overview of Construct-Specific Measurement Approaches

Table A2-3. Overview of construct-specific measurement approaches

Approach	Study
Approaches aligned at Priester and Petty (1996) (e.g., "conflicted", "mixed", "torn")	Bee and Madrigal (2013) Berrios et al. (2018a) Clark et al. (2008) Costarelli and Gerłowska (2015a) De Vos et al. (2021) Fong (2006) Frank et al. (2022) Gasper and Danube (2016) Guarana et al. (2022) Hamby and Russell (2022) van Harreveld et al. (2009a; 2014) Hemenover and Schimmack (2007) Hostler and Berrios (2021) Larsen et al. (2001) Menninga et al. (2011) Norris et al. (2019) Peng and Chen (2021) Pillaud et al. (2013) Sawicki et al. (2013) Schneider et al. (2015, 2016) Schneider and Mattes (2021) Schuh et al. (2016) See and Luttrell (2021) Reinders et al. (2020) Righetti et al. (2020) Rothman and Northcraft (2015) Wang et al. (2022b) Zhang et al. (2022) Zoppolat et al. (2022)
Approaches aligned at Berrios et al. (2015b) (e.g., "experiencing a mixture of emotions")	Berrios et al. (2017, 2018b) Caballero et al. (2022) Fong (2006) Hu and Sung (2022) Hyde and Masser (2021) Oh and Tong (2021) Rees et al. (2013) Sun et al. (2021) Vakola et al. (2021)
Combining co-occurring valence states (e.g., "both painful and pleasurable", "a mix of pride and guilt")	Chang (2013) Costarelli and Gerłowska (2015a) Liu et al. (2021) Mayser et al. (2008) Oh (2022)

Distinct mixed emotional phenomena (e.g., being moved, feeling bittersweet, experiencing a sentimental longing)	Braniecka et al. (2014) Bartsch et al. (2010) Caballero et al. (2007) Larsen et al. (2001) Scheibe et al. (2007)

NOTE. — This overview pertains to articles involving subjective emotion assessment as object of investigation.

Appendix 2.5: Normalization Procedure

For mean values, normalization involved the following formula:

$$\frac{|\ measured\ mean - global\ minimum\ |}{|\ global\ maximum - global\ minimum\ |}$$

For standard deviations, normalization involved the following formula:

$$measured\ SD\ \times \frac{1}{global\ maximum - global\ minimum}$$

For construct-specific measurement approaches, the global minimum and maximum corresponded to the scale minimum and maximum. For valence-compositional approaches, the global minimum and maximum were inferred from the underlying formulas of mixed emotion quantification in the following ways (see also Table 2-5):[26]

Minimum Score/Non-target emotion

$$Score = \mathrm{Min}[\mathrm{C}, \mathrm{D}]$$

Global minimum	Global maximum
$ScaleMin$	$\mathrm{ScaleMax}$

Minimum Score (adapted)

$$Score = \ 2 * \mathrm{Min}[\mathrm{C}, \mathrm{D}]$$

Global minimum	Global maximum
$2 * ScaleMin$	$2 * \mathrm{ScaleMax}$

Absolute Difference Score

$$Score = |\ D - C\ |$$

Global minimum	Global maximum
$\lvert\ \mathrm{ScaleMax} - \mathrm{ScaleMax}\rvert$	$\lvert\mathrm{ScaleMax} - \mathrm{ScaleMin}\rvert$

Similarity-Intensity Model

[26] In these formulas, D corresponds to the dominant (major) emotion, and C corresponds to the conflicting (minor) emotion (see Chapter 2.4.3), with $D \geq C$.

$$Score = \left(\frac{\mathrm{C} + \mathrm{D}}{2}\right) - |\,\mathrm{D} - \mathrm{C}\,|$$

Global minimum	Global maximum
$\left(\frac{\mathrm{ScaleMax} + \mathrm{ScaleMin}}{2}\right) - \lvert\,\mathrm{ScaleMax} - \mathrm{ScaleMin}\,\rvert$	$\left(\frac{\mathrm{ScaleMax} + \mathrm{ScaleMax}}{2}\right) - \lvert\,\mathrm{ScaleMax} - \mathrm{ScaleMax}\,\rvert$

Similarity-Intensity Model (adapted)

$$Score = \left(\frac{\mathrm{C} + \mathrm{D}}{2}\right) - |\,\mathrm{D} - \mathrm{C}\,| + 1.5$$

Global minimum	Global maximum
$\left(\frac{\mathrm{ScaleMax} + \mathrm{ScaleMin}}{2}\right) - \lvert\,\mathrm{ScaleMax} - \mathrm{ScaleMin}\,\rvert + 1.5$	$\left(\frac{\mathrm{ScaleMax} + \mathrm{ScaleMax}}{2}\right) - \lvert\,\mathrm{ScaleMax} - \mathrm{ScaleMax}\,\rvert + 1.5$

Simplified Similarity-Intensity Model

$$Score = 5 * \mathrm{C} - \mathrm{D}$$

Global minimum	Global maximum
$5 * \mathrm{ScaleMin} - \mathrm{ScaleMax}$	$5 * \mathrm{ScaleMax} - \mathrm{ScaleMax}$

Simplified Similarity-Intensity Model (adapted)

$$Score = 3 * \mathrm{C} - \mathrm{D}$$

Global minimum	Global maximum
$3 * \mathrm{ScaleMin} - \mathrm{ScaleMax}$	$3 * \mathrm{ScaleMax} - \mathrm{ScaleMax}$

Negative Acceleration Model

$$Score = \frac{(2 * \mathrm{C} + 1)}{(\mathrm{C} + \mathrm{D} + 2)}$$

Global minimum	Global maximum
$\frac{(2 * \mathrm{ScaleMin} + 1)}{(\mathrm{ScaleMin} + \mathrm{ScaleMax} + 2)}$	$\frac{(2 * \mathrm{ScaleMax} + 1)}{(\mathrm{ScaleMax} + \mathrm{ScaleMax} + 2)}$

Conflicting Reactions Model

$$Score = D + C - |\,\mathrm{D} - \mathrm{C}\,|$$

Global minimum	Global maximum
$2 * \mathrm{ScaleMin}$	$2 * \mathrm{ScaleMax}$

Gradual Threshold Model

$$Score = 5 * \mathrm{C}^{\frac{1}{2}} - D^{\frac{1}{C}}$$

Global minimum	Global maximum
$5 * \mathrm{ScaleMin}^{\frac{1}{2}} - ScaleMax^{\frac{1}{ScaleMin}}$	$5 * \mathrm{ScaleMax}^{\frac{1}{2}} - ScaleMax^{\frac{1}{ScaleMax}}$

Gradual Threshold Model (adapted)

$$Score = 5 * (\mathrm{C} + 1)^{\frac{1}{2}} - (D + 1)^{\frac{1}{C}}$$

Global minimum	Global maximum
$5 * (\mathrm{ScaleMin} + 1)^{\frac{1}{2}} - (ScaleMax + 1)^{(\frac{1}{ScaleMin+1})}$	$5 * (\mathrm{ScaleMax} + 1)^{\frac{1}{2}} - (ScaleMax + 1)^{\frac{1}{(ScaleMax+1)}}$

Further formulae:

$$Score = -\,(\mathrm{D} - \mathrm{C})$$

Global minimum	Global maximum
$-\,(\mathrm{ScaleMax} - \mathrm{ScaleMin})$	$-\,(\mathrm{ScaleMax} - \mathrm{ScaleMax})$

$$Score = \frac{D}{(D + C)}$$

Global minimum	Global maximum
$\frac{ScaleMin}{(ScaleMin + ScaleMax)}$	$\frac{ScaleMax}{(ScaleMin + ScaleMax)}$

$$Score = \frac{(D + C)}{2}$$

Global minimum	Global maximum
$\frac{(ScaleMin + ScaleMin)}{2}$	$\frac{(ScaleMax + ScaleMax)}{2}$

Appendix 2.6: Mixed Emotion Induction Media

This section provides details on the eight different induction media, according to which review results were categorized (see Chapter 2.5.1).

Generally, emotion induction media can differ in characteristics such as standardization and ability to be implemented in the laboratory, as well as their complexity or ecological validity (Salas et al., 2012). With regard to their application, certain media necessarily require participants' active attention (Lowe et al., 2019) and/or place strong demands on their willingness to engage in a fictional reality (Lench et al., 2011) or the recollection of personal memories (Siedlecka & Denson, 2019).

To account for these differences in the meta-analytic comparison of mixed emotion measurement approaches, emotion induction media were grouped into eight different categories (for related approaches, see Berrios et al., 2015a; Siedlecka & Denson, 2019). These categories are outlined in the following.

Video-based stimuli are considered the most popular and effective media for evoking emotion (Joseph et al., 2020; Westermann et al., 1996). Mixed emotion researchers often used sequences from the film 'Life is Beautiful' (Cohen et al., 2016b; Itkes et al., 2019; Larsen et al., 2001; Larsen & Green, 2013; Larsen & McGraw, 2011) and moreover created film libraries of (mixed) emotional video stimuli (Samson et al., 2016).

Mixed emotional impulses can be furthermore evoked through *image-based stimuli* (e.g., Lang et al., 1999), such as pictures of powerful natural phenomena (Chaudhury et al., 2022).

Moreover, mixed emotional impulses can be evoked through *aural stimuli*, such as music with conflicting cues (e.g., major mode paired with slow tempo; Hunter et al., 2008; Larsen & Stastny, 2011). For further details on this emotion induction medium, see Chapter 3.

Mixed emotional impulses can be furthermore evoked through *text-based stimuli*, such as company websites (Bee & Madrigal, 2007) or stories (Lagattuta, 2005).

Moreover, mixed emotional impulses can be evoked through *mental imagery*, which constitutes a "quasi-perceptual experience that involves the generation of picture-like representations in the mind" (Jiang et al., 2014). For instance, mixed emotion researchers have instructed participants to mentally engage in depicted scenarios of life transitions (Williams & Aaker, 2002).

While mental imagery pertains to future or hypothetical experiences, mixed emotional impulses can also be evoked through *autobiographical recall* (i.e., "summoning personal emotional memories to reactivate emotions from the original emotional experience"; Siedlecka & Denson, 2019, p. 87), such as recalling and vividly describing an emotionally ambivalent event (Fong, 2006).

Moreover, *situational procedures* allow to create "a social situation that elicits the target emotion" (Siedlecka & Denson, 2019, p. 87). In mixed emotions research, such approaches have been employed for instance, in the form of role plays and negotiations (Fong & Tiedens, 2002; Kung & Chao, 2019), as well as game settings, in which participants achieved good outcomes that yet could have been better (Henderson & Norris, 2013; Larsen et al., 2004, 2009; Norris & Larsen, 2020).

Finally, two or more induction media can be combined into *multi-media approaches.* For instance, mixed emotion researchers have paired a video clip addressing a meaningful ending with mixed emotional music (Berrios et al., 2018b).

Appendix 2.7: Descriptive Statistics (Meta-Analysis)

Figure A2-1. Distribution of mixed emotion scores by measurement approach and research perspective (absolute frequencies)

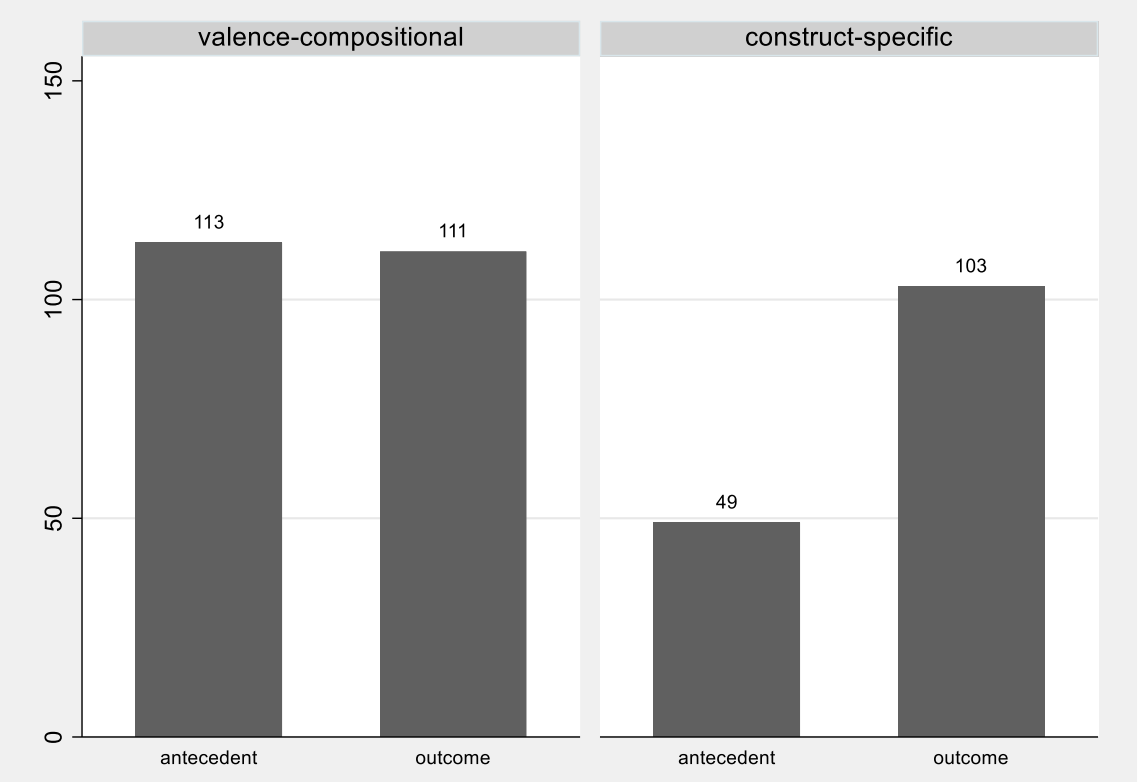


Figure A2-2. Distribution of mixed emotion scores by measurement approach and research context (absolute frequencies)

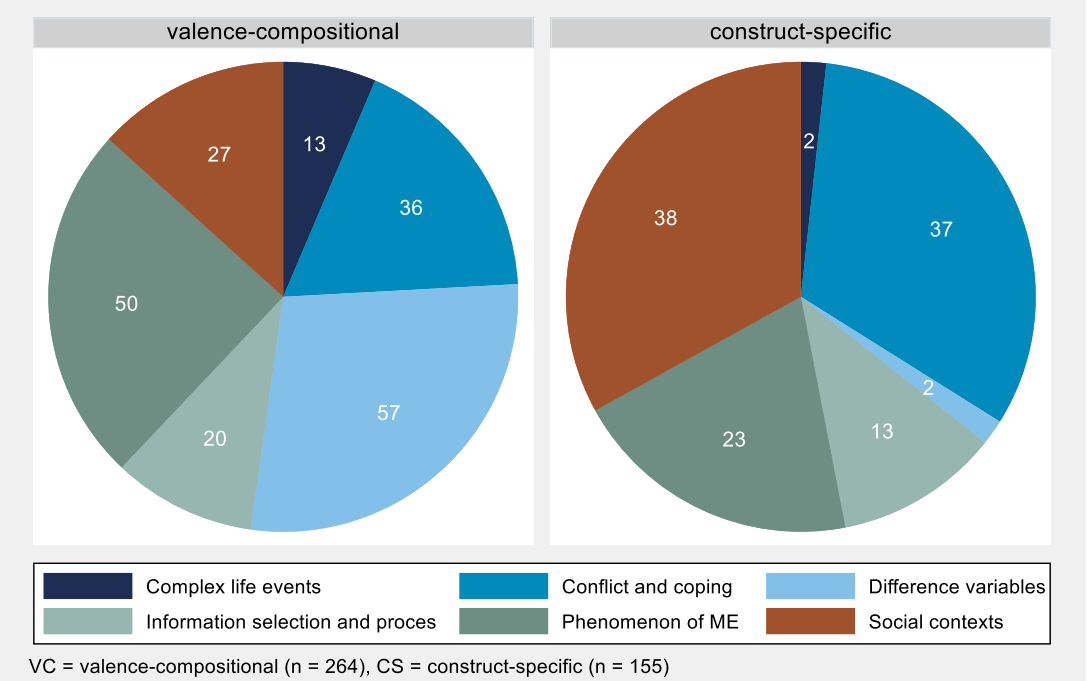


Figure A2-3. Distribution of mixed emotion scores by measurement approach and origin of occurrence (absolute frequencies)

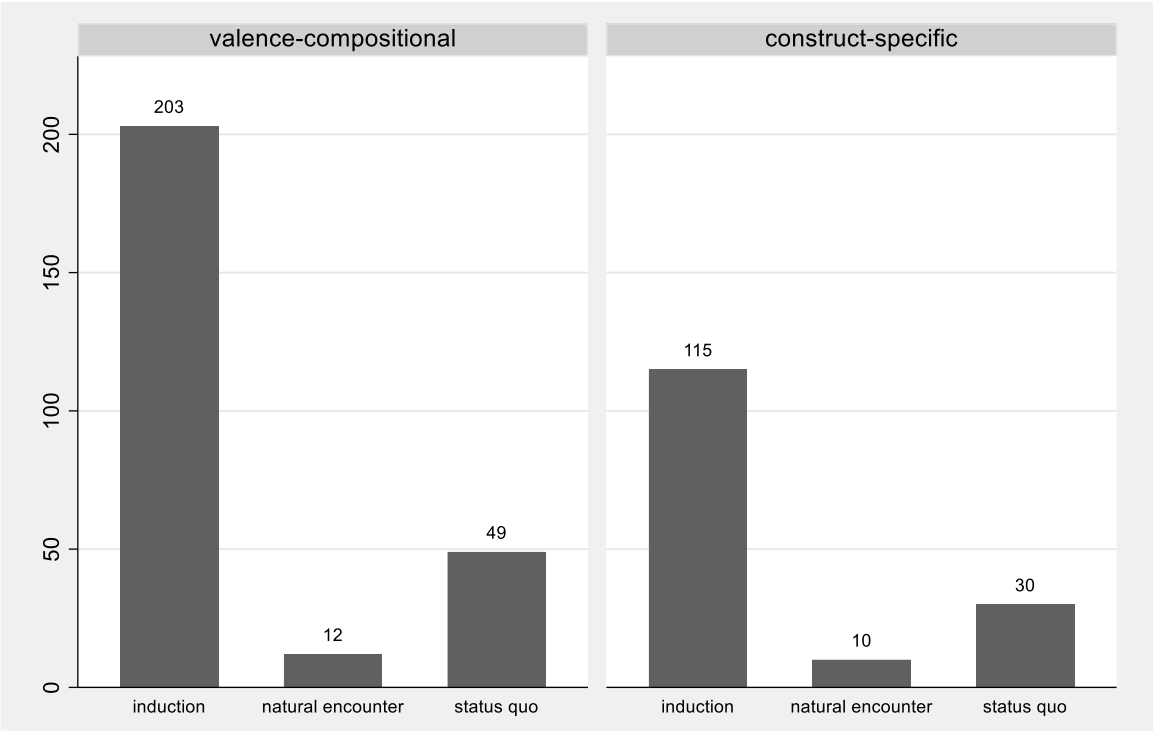


Figure A2-4. Distribution of mixed emotion scores by measurement approach and measurement type (absolute frequencies)

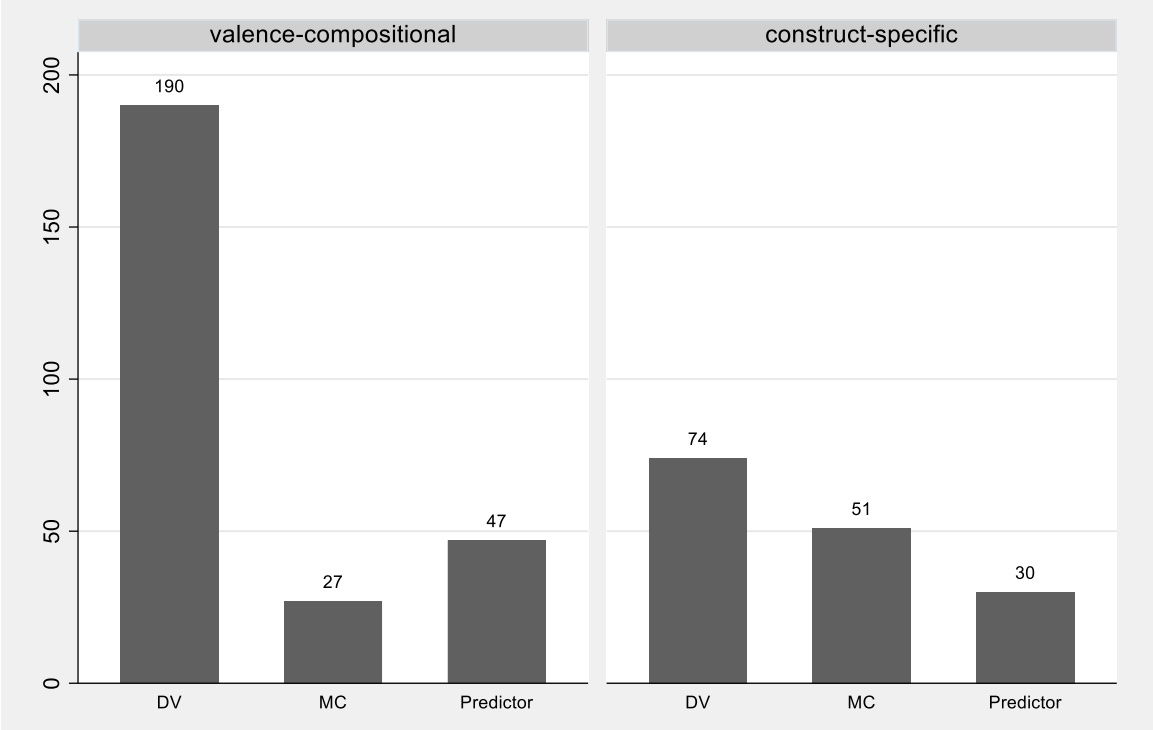
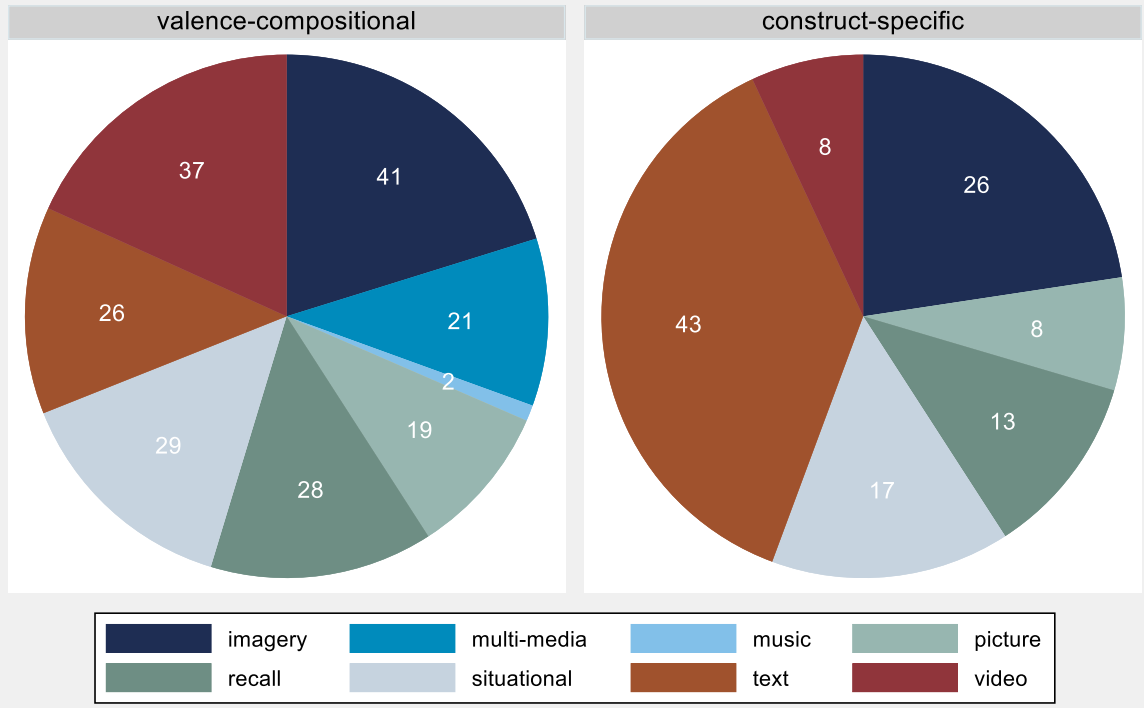


Figure A2-5. Distribution of mixed emotion scores by measurement approach and emotion induction medium (absolute frequencies)



VC = Valence Compositional (n = 203), CS = Construct Specific (n = 115)

Figure A2-6. Distribution of mixed emotion scores by measurement approach and research design (absolute frequencies)

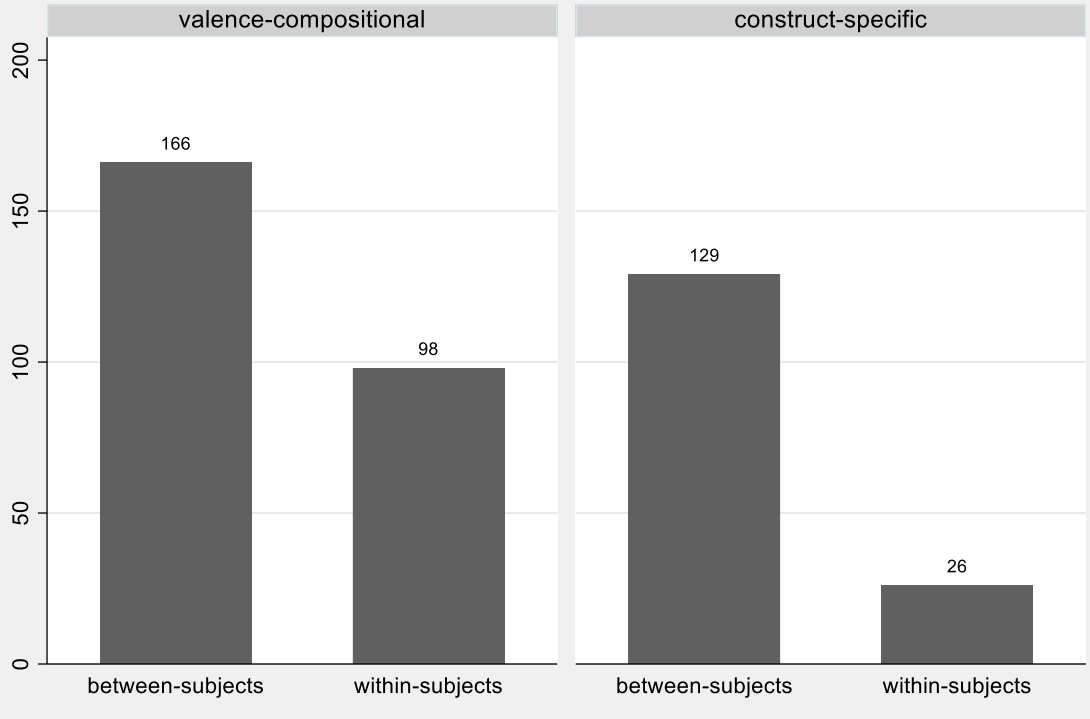
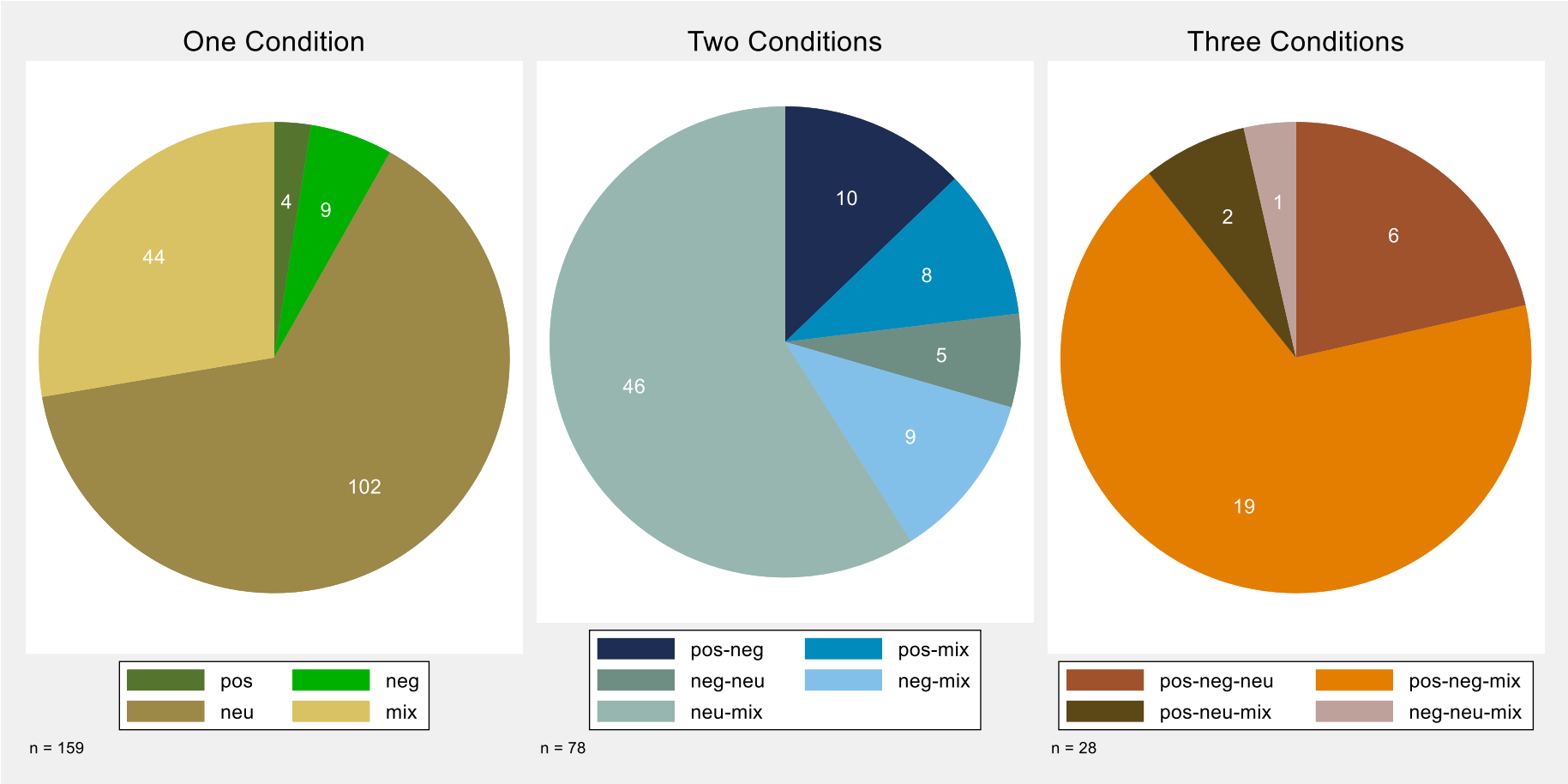


Figure A2-7. Distribution of mixed emotion scores by emotional condition (absolute frequencies)



NOTE. — pos = positive, neg = negative, neu = neutral, mix = mixed emotional condition; five datasets, in which all four conditions were investigated are not represented here

Appendix 2.8: Exploratory Analyses

In the following, two sets of exploratory analyses are documented that investigate the coded independent variables in their effect on measured mixed emotions.

Exploratory analyses (Set 1). A first set of exploratory analyses investigates whether certain population characteristics and research design variables moderate the differences in measured mixed emotions between the two measurement approaches (i.e., valence-compositional versus construct-specific approaches). These analyses included the dummy-coded measurement approach variable (0 = valence-compositional; 1 = construct-specific), the respective characteristics variable (described in the following), and the interaction term of these two variables as predictors. In detail, the characteristics variables comprised population age and percentage of females, as well as seven dummy-coded variables indicating: the sample being an online panel (0 = no; 1 = yes), the sample being North American (0 = no; 1 = yes), the research context (0 = correlates of mixed emotions; 1 = phenomenon of mixed emotions), the induction medium (0 = external; 1 = introspective), the type of the mixed emotions measure (0 = predicting variable; 1 = dependent variable), and the research perspective of mixed emotions (0 = antecedent, 1 = outcome). On these independent variables, the absolute scores of measured mixed, as well as the difference scores between mixed and emotional reference conditions were regressed as dependent variables. Models relied on the robumeta module in STATA with hierarchical effect weights on the article-level.

In the following, the focus is placed on analyses that indicated (tendencies) moderation effects. In detail, such tendencies are found for three characteristics variables on absolute scores of mixed emotions. As documented in the following, higher levels of mixed emotions measured through construct-specific approaches tended to further increase if emotion was induced through introspective (versus external) approaches (see Table A2-4). Moreover, a negative interaction effect was observed in tendency between measurement approaches and research context (see Table A2-5), while a positive interaction effect was observed (in tendency) between measurement approaches and origins of occurrence (see Table A2-6).

Table A2-4. Interaction of measurement approach with emotion induction medium on absolute scores of measured mixed emotions

	Model 1 Base model	**Model 2** Population characteristics	**Model 3** Research design variables	**Model 4** Control variables
Primary independent variables				
Measurement approach (MeasA)	.20**	.15*	.18**	.18**
(baseline = valence-compositional)	(.05)	(.05)	(.05)	(.05)
Induction medium (IndMed)	.14*	.06	.13*	.12†
(baseline = external)	(.05)	(.07)	(.06)	(.06)
Interaction: MeasA * IndMed	-.16*	-.04	-.16†	-.15*
	(.08)	(.09)	(.09)	(.07)
Population characteristics				
Percentage of females		-.21†		
		(.12)		
Online sample (baseline = other)		-.01		
		(.06)		
North American (baseline = other)		.09*		
		(.04)		
Research design variables				
Research context			.01	
(baseline = correlates of mixed emo.)			(.05)	
Measurement type			.09*	
(baseline = predicting variable)			(.04)	
Research perspective			.07	
(baseline = antecedent)			(.04)	
Control variables				
Within-subjects design				-.09*
				(.04)
Positive condition present				.05
				(.05)
Negative condition present22F[27]				-.07
				(.05)
Constant	.23***	.36***	.04	.30***
	(.03)	(.09)	(.10)	(.05)
Observations	318	253	296	318

NOTE. — Induction media are combined into a dummy-coded variable that is 0 for external emotion induction media (i.e., music, picture, text, video, multi-media, situational procedures) and 1 for introspective emotion induction media (i.e., imagery, recall). Standard errors in parentheses. *** p < .001, ** p < .01, * p < .05, † p < .10

[27] Note that a dummy-coded predictor of "Presence of neutral condition" was omitted due to collinearity.

Table A2-5. Interaction of measurement approach with research context on absolute scores of measured mixed emotions

	Model 1 Base model	**Model 2** Population characteristics	**Model 3** Research design variables	**Model 4** Control variables
Primary independent variables				
Measurement approach (MeasA)	.14**	.13**	.16**	.13**
(baseline = valence-compositional)	(.04)	(.04)	(.05)	(.04)
Research context (ResCon)	.02	.08	.04	.04
(baseline = correlates of mixed emo.)	(.06)	(.06)	(.05)	(.06)
Interaction: MeasA * ResCon	-.13†	-.15†	-.11	-.14†
	(.07)	(.07)	(.09)	(.07)
Population characteristics				
Percentage of females		-.22*		
		(.09)		
Online sample (baseline = other)		-.03		
		(.04)		
North American (baseline = other)		.11*		
		(.04)		
Research design variables				
Emotion induction medium			.06	
(baseline = external)			(.04)	
Measurement type			.09†	
(baseline = predicting variable)			(.05)	
Research perspective			.05	
(baseline = antecedent)			(.04)	
Control variables				
Within-subjects design				-.10*
				(.05)
Positive condition present				.05
				(.04)
Negative condition present				-.09*
				(.04)
Constant	.30***	.36***	.08	.34***
	(.03)	(.07)	(.09)	(.04)
Observations	419	332	296	419

NOTE. — Research contexts are combined into a dummy-coded variable that is 0 for contexts centering on correlates of mixed emotions (i.e., complex life events, conflict and coping, information selection and processing, social contexts) and 1 for contexts centering on the phenomenon of mixed emotions (i.e., phenomenon of mixed emotions, difference variables). Standard errors in parentheses. *** p < .001, ** p < .01, * p < .05, † p < .10

Table A2-6. Interaction of measurement approach with origin of occurrence of mixed emotions on absolute scores of measured mixed emotions

	Model 1 Base model	**Model 2** Population characteristics	**Model 3** Research design variables	**Model 4** Control variables
Primary independent variables				
Measurement approach (MeasA)	-.02	-.09	-.06	-.01
(baseline = valence-compositional)	(.07)	(.07)	(.05)	(.07)
Origin of occurrence (OrigOcc)	-.10	-.09	-.16*	-.05
(baseline = status quo)	(.06)	(.06)	(.07)	(.07)
Interaction: MeasA * OrigOcc	.15†	.20*	.19**	.13†
	(.07)	(.08)	(.06)	(.07)
Population characteristics				
Percentage of females		-.21*		
		(.09)		
Online sample (baseline = other)		-.03		
		(.05)		
North American (baseline = other)		.11**		
		(.03)		
*Research design variables*23F[28]				
Research context			-.00	
(baseline = correlates of mixed emo.)			(.04)	
Measurement type			.05	
(baseline = predicting variable)			(.04)	
Research perspective			.02	
(baseline = antecedent)			(.04)	
Control variables				
Within-subjects design				-.10*
				(.04)
Positive condition present				.05
				(.04)
Negative condition present				-.08†
				(.04)
Constant	.39***	.47***	.38***	.40***
	(.06)	(.09)	(.08)	(.06)
Observations	419	332	376	419

NOTE. — Origins of occurrence of mixed emotions are combined into a dummy-coded variable that is 0 if mixed emotions originated in the status quo, and 1 if mixed emotions originated in some form of mixed emotional impulses (i.e., experimental induction, natural encounter); Standard errors in parentheses. *** p < .001, ** p < .01, * p < .05, † p < .10

Exploratory analyses (Set 2). A second set of exploratory analyses investigated whether these sample or research characteristics themselves affected measured mixed emotions – without taking account of the underlying measurement approach. On these characteristic

[28] Note that a predictor variable of "Induction Medium" was omitted due to collinearity.

variables (both in their granular and aggregated form; see Table 2-7), the absolute scores of measured mixed and the difference scores between mixed and emotional reference conditions were regressed as dependent variables in different models, relying on the robumeta module in STATA with hierarchical effect weights on the article-level.

In the following, the focus is placed on analyses indicating (tendencies of) influences. In detail, such tendencies are found for three variables on the level of absolute scores of mixed emotions: As documented in the following, introspective (versus external) emotion induction media tended to positively predict absolute scores of measured mixed emotions (see Table A2-7, and Figure A2-8 for a granular descriptive overview of the average scores per induction media). On the dimension of population characteristics, a North American (versus a non-North American) sample tended to positively predict absolute scores of measured mixed emotions (see Table A2-8). Moreover, the average age of a sample tended to *negatively* predict absolute scores of measured mixed emotions (see Table A2-9) – a relationship that appeared to be linear (as an included quadratic term of age failed to reach significance).

Figure A2-8. Means of absolute scores of measured mixed emotions per different emotion induction media

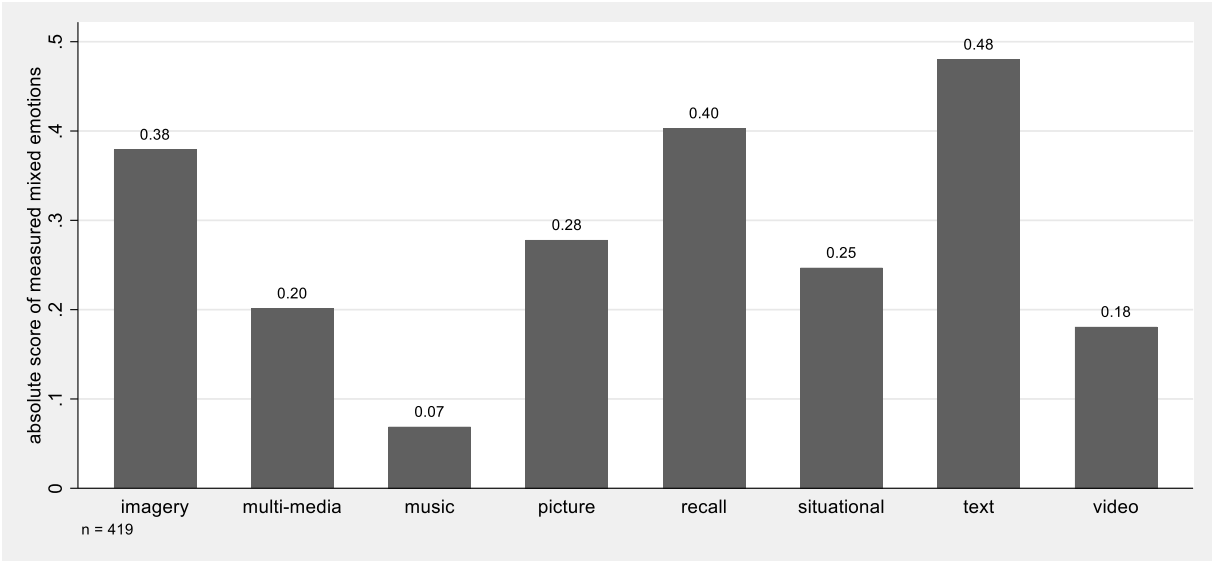


Table A2-7. Regression analyses investigating the effect of induction medium on absolute differences in measured mixed emotions

	Model 1 Base model	**Model 2** Population characteristics	**Model 3** Research design variables	**Model 4** Control variables
Emotion induction medium	.09*	.04	.06	.06
(baseline = external)	(.04)	(.05)	(.05)	(.04)
Population characteristics				
Percentage of females		-.21		
		(.15)		
Online sample (baseline = other)		-.03		
		(.06)		
North American (baseline = other)		.11*		
		(.04)		
Research design variables				
Research context			-.04	
(baseline = correlates of mixed emo.)			(.07)	
Measurement type			.15*	
(baseline = predicting variable)			(.06)	
Research perspective			.08	
(baseline = antecedent)			(.05)	
Control variables				
Measurement approach				.12**
(baseline = valence-compositional)				(.04)
Within-subjects design				-.10*
				(.04)
Positive condition present				.03
				(.05)
Negative condition present				-.07
				(.05)
Constant	.30***	.40**	.07	.32***
	(.03)	(.11)	(.11)	(.05)
Observations	318	253	296	318

NOTE. — Standard errors in parentheses. *** p < .001, ** p < .01, * p < .05, † p < .10

Table A2-8. Regression analyses investigating the effect of population culture on absolute differences in measured mixed emotions

	Model 1 Base model	**Model 2** Population characteristics	**Model 3** Research design variables	**Model 4** Control variables
Population culture: North American	.09*	.12**	.06	.08*
(baseline = other)	(.04)	(.04)	(.05)	(.03)
Research design variables				
Research context			-.03	
(baseline = correlates of mixed emo.)			(.06)	
Emotion induction medium			.06	
(baseline = external)			(.05)	
Measurement type			.14*	
(baseline = predicting variable)			(.06)	
Research perspective			.09	
(baseline = antecedent)			(.05)	
Population characteristics				
Percentage of females		-.18†		
		(.11)		
Online sample		-.03		
(baseline = other)		(.05)		
Control variables				
Measurement approach				.08*
(baseline = valence-compositional)				(.04)
Within-subjects design				-.09*
				(.04)
Positive condition present				.08†
				(.04)
Negative condition present				-.09*
				(.04)
Constant	.31***	.40***	.03	.32***
	(.03)	(.08)	(.12)	(.04)
Observations	374	332	276	374

NOTE. — Standard errors in parentheses. *** p < .001, ** p < .01, * p < .05, † p < .10

Table A2-9. Regression analyses investigating the effect of population age on absolute differences in measured mixed emotions

	Model 1 Base model	**Model 2** Population characteristics	**Model 3** Research design variables	**Model 4** Control variables
Population Age	-.001*	-.004†	-.002	-.004**
	(.001)	(.002)	(.002)	(.001)
Research design variables				
Research context			-.01	
(baseline = correlates of mixed emo.)			(.07)	
Emotion induction medium			.09†	
(baseline = external)			(.05)	
Measurement type			.12†	
(baseline = predicting variable)			(.06)	
Research perspective			.05	
(baseline = antecedent)			(.06)	
Population characteristics				
Percentage of females		-.30*		
		(.13)		
Online sample (baseline = other)		.01		
		(.07)		
North American (baseline = other)		.12**		
		(.04)		
Control variables				
Measurement approach				.08†
(baseline = valence-compositional)				(.04)
Within-subjects design				-.10*
				(.04)
Positive condition present				.05
				(.04)
Negative condition present				-.08*
				(.04)
Constant	.47***	.59***	.21	.48***
	(.05)	(.10)	(.15)	(.06)
Observations	322	274	225	322

NOTE. — Standard errors in parentheses. *** p < .001, ** p < .01, * p < .05, † p < .10; In Model 2, the estimated p-value is untrustworthy due to insufficient degrees of freedom

Chapter 3
Sounds of Emotion. Eliciting Positive, Negative or Mixed Emotional Impulses with Experimental Stimuli Based on Controlled Musical Composition

by Jana-Verena Gerhart [29] & Oliver Emrich [30] [31]

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[31] Statement of contribution: The authors jointly developed theoretical positioning, research idea, and experimental designs. Jana-Verena Gerhart identified relevant literature and drafted the composition concept and manuscript. She organized the recording and production of the music stimuli, set up the empirical studies and was responsible for data collection, preparation and analysis. Oliver Emrich contributed to the theory development, as well as the conceptual development of the composition concept and the music stimuli. He furthermore iteratively reviewed the manuscript providing detailed feedback.

Abstract

When music is used to induce emotion in experiments, researchers tend to rely on different pre-existing pieces of music for each manipulated emotion condition (Joseph et al., 2020). As result, music stimuli are often quite heterogeneous, which bears the risk that obtained differences between emotional conditions are confounded by features other than emotion (e.g., cognitions or preferences associated with the individual stimuli). To address these challenges, the following chapter presents the development and empirical validation of controlled music stimuli for inducing positive, negative, and mixed emotional impulses. Each stimulus varies on relevant musical, research-derived parameters to elicit the respective emotional impulse, while the overall musical structure is kept constant across all three versions. This procedure enables the stimuli to be as homogeneous and controlled as possible. Two pre-registered experiments ($N_{overall}$ = 652) validate that the controlled stimuli reliably evoke the intended emotional impulses and are comparable with existing stimuli identified by past research.

3.1 Introduction

Emotions are a relevant object of consumer research, that is often investigated through experiments (Williams, 2014). When it comes to designing such experiments, music can be used as a stimulus medium to elicit emotional impulses in different emotional conditions (Di Muro & Murray, 2012). While music has several advantages (such as not requiring participants' attentive focus), existing *music stimuli* often bear risks of confounds: For instance, if music is familiar to participants, music-evoked episodic memories can spark emotional responses unrelated to the emotional character of the music itself (Juslin & Västfjäll, 2008). Moreover, when different pieces of music are used to evoke distinct emotions in different experimental groups, confounds can result from stimulus heterogeneity: Consider an experimental researcher adopting an indie-electro song by Radiohead to evoke negative emotional impulses and a Yann Tiersen piano piece to evoke mixed emotional impulses. In such an experiment, obtained differences between the two experimental groups might result from the different emotional characters of the underlying music. However, because this music is heterogeneous in several non-emotional dimensions as well, group differences could also originate in different cognitions, experiences, and preferences associated with Radiohead versus Yann Tiersen.

In view of these challenges, this chapter sets out to provide stimulus material that is effective in inducing the intended emotion but has "minimal potential for biasing participants" (Warrenburg, 2020, p. 240). In detail, it presents a research-derived composition concept for a set of three controlled music stimuli that enable the induction of positive, negative, and mixed emotional impulses. With these controlled music stimuli, researchers can harness the potential of music for inducing emotion, and at the same time decrease the risks of confounds.

In the following, we discuss the emotional potential of music, on the basis of which address the idiosyncrasies of music as an emotion induction medium and identify different forms of existing music stimuli. We then present a research-derived composition concept: For each stimulus condition, this concept varies distinct musical parameters that have been identified by research to be associated with the respective emotional effect. At the same time, the overall musical structure is kept constant across all three stimulus conditions to ensure a homogeneous musical basis. After documenting the composition concept of the controlled

music stimuli, we present two pre-registered experiments that validate them in their evoked emotional impulses and compare them to reference stimuli identified by previous research.

With this work, we set out to contribute to the methodological body of experimental procedures in consumer emotion research from three major perspectives: First, we provide a holistic reflection of music as an emotion induction medium that might aid researchers in their decision whether to use music to induce emotional impulses. Second, we provide a set of three controlled and empirically validated music stimuli that can be used to elicit emotional impulses in experiments, while diminishing risks of confounds. Third, each of these controlled music stimuli is complemented with a music-theoretical analysis that allows its emotional effect to be retraced back to specific compositional parameters. We hope that the controlled music stimuli are of value to consumer researchers and provide impetus for harnessing the potential of music in the area of (mixed) emotion research.

3.2 Conceptual Background

3.2.1 Emotional Effects of Music

To a considerable extent, the appeal music is ascribed to is its impact on emotion (Juslin & Västfjäll, 2008; Zentner et al., 2008): For instance, individuals engage in music listening to regulate their emotions (Cook et al., 2019), use music to re-live emotional experiences of their past (Barrett et al., 2010; Janata et al., 2007), and experience the “rest of the world disappear” in live concerts (Gabrielsson & Lindström, 2000, p. 123). Such music-evoked emotional experiences are often accompanied by physical sensations such as shivers and chills (Goldstein, 1980; Mori & Iwanaga, 2017; Sloboda, 1991) and increased levels of physiological arousal (Rickard, 2004; Wassiliwizky et al., 2017). These strong emotional effects might be unsurprising, given that the expression of emotion through vocal stimuli (e.g., sound, speech, or music) is evolutionarily rooted and serves a socially adaptive function (Scherer, 1995). As an *organon*, the emotional impact of music unfolds in contexts ranging from national anthems (Garofalo, 2010), to film music (Cohen, 2011), to ambient soundscapes in retail venues (Morrison et al., 2011; Spence et al., 2014).

According to Juslin and Västfjäll (2008), there are different mechanisms through which music gives rise to emotion: Musically evoked emotion can originate from *brain stem reflexes* in the form of visceral responses to auditory signals (e.g., negative emotion caused by loud or

dissonant sounds that signal threat or danger). It can originate from *evaluative conditioning* as a response to an external stimulus with which the music has been paired. It can originate from *emotional contagion* "because the listener perceives the emotional expression of the music, and then 'mimics' this expression internally" (p. 565). It can furthermore originate from stimulated *visual imagery* or *episodic memories*. Finally, it can originate from *musical expectancy* (i.e., violation, delay, or confirmation of expectations regarding the music). While *evaluative conditioning*, *visual imagery,* and *episodic memories* rely more heavily on cognitive mechanisms that can vary between individuals (e.g., due to different experiences or abilities), *brain stem reflexes*, *emotional contagion*, and *musical expectancy* might be associated with more generalizable patterns of evoked emotion.

In addition to these mechanisms, there are two different loci from which emotion can be experienced in music (Evans & Schubert, 2008): On the one hand, emotion can be *expressed* through emotion. This external locus of emotion is also referred to as *affective judgment* and describes the objective assessment of "the emotional characteristics of some stimulus" (Coles et al., 2019, p. 613). On the other hand, emotion can be *induced* by music. This internal locus of emotion is also referred to as *emotional experience* and describes emotions that are aroused and felt in response to a stimulus (Wedin, 1972; Zentner et al., 2008). Often, the two loci of emotion are highly correlated, with affective judgment being higher than emotional experience in tendency (Ali & Peynircioğlu, 2010; Evans & Schubert, 2008; Hunter et al., 2010). However, the two loci of emotion do not necessarily coincide: Some studies find divergent emotional outcomes between affective judgment and emotional experience (Juslin & Västfjäll, 2008; Konečni et al., 2008; Zentner et al., 2008; for an overview, see Gabrielsson, 2001). Such a divergence may arise, for example, from meta-emotions evoked by music: When a listener finds pleasure in recognizing sadness in music, the internal locus is shaped by negative valence, while the external locus is shaped by positive valence (Peltola & Eerola, 2016).

3.2.2 Music as Medium for Eliciting Emotional Impulses

The potential of music to elicit emotional impulses is harnessed in scientific research (for overviews, see Berrios et al., 2015a; Siedlecka & Denson, 2019; Warrenburg, 2020). In this context, music differs from other emotion induction media (e.g., autobiographical recall) in

embodying aesthetic features. Such aesthetic features can evoke distinct *aesthetic emotions* that are based on "*an aesthetic evaluation/appreciation* of the objects or events under consideration" (Menninghaus et al., 2019, p. 185). A broad body of research has investigated such aesthetic emotions, often under the emotional labels of awe, wonder, self-transcendence, or being moved (Konecni, 2005; Schindler et al., 2017; Trost et al., 2012). Thus, apart from its general emotional potential, music might be particularly suitable for giving rise to such distinct emotional encounters. Noteworthily, the notion of aesthetics itself can impact emotions: For instance, photographs were perceived more positively when framed as artworks compared to information materials (Wassiliwizky et al., 2015).

For emotion induction, the aesthetic character of music might imply that music is especially suited to evoke positive emotional impulses, whereas it might be less suited to evoke (strong) negative emotional impulses. Another mechanism supports this notion: As music does not pose a proximate, material threat to music listeners' well-being or survival, distancing processes allow them to *positively embrace* negative emotions, which often renders an emotional experience more intense and profound (Hanich et al., 2014; Menninghaus et al., 2017). In line with these notions, musically evoked emotions tend to be more positive compared to the average emotional encounters in everyday life (Juslin & Laukka, 2004), with intense levels of negative emotions being rather uncommon (Hunter et al., 2008).[32]

In comparison to other emotion induction media (e.g., video), music tends to have weaker effect sizes (Joseph et al., 2020), but bears two key advantages: On the one hand, music does not necessarily require participants' attentive focus. Therefore, emotion can be subconsciously induced via music that is played in the background (Lowe et al., 2019). In this context, it can also be paired with other stimulus material. On the other hand, music allows emotion to be evoked in a non-intentional way (Hunter et al., 2008). Here, emotion is not directed at a specific object ("I am feeling positive *about* the music") but takes on a non-intentional form ("The music makes me feel positive"; Schimmack & Diener, 1997). Other emotion induction procedures lack such non-intentionality: When positive emotions are

[32] Nonetheless, such negative emotional encounters can exist, e.g., in *specific contexts* (such as grieving, Van den Tol & Edwards, 2013) or mediated by additional *meaning systems* (e.g., lyrics, Bannister, 2020).

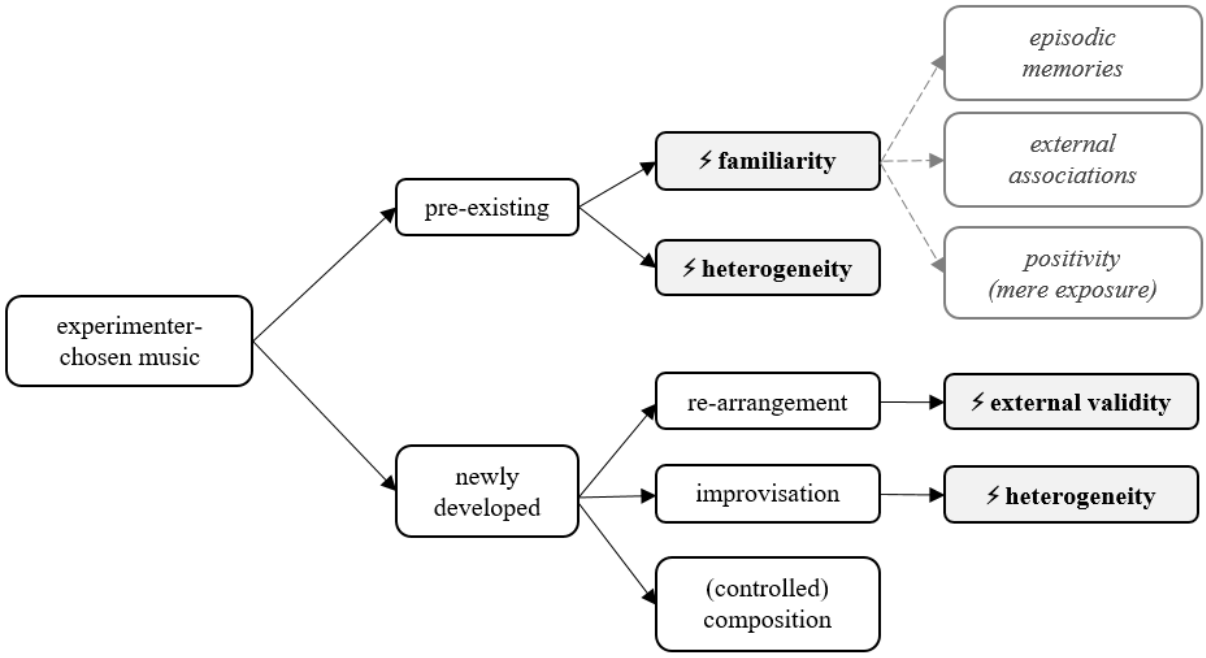
induced by letting participants win in a gambling task, the emotions are directed to the instance of having won the task (Larsen et al., 2004).[33]

3.2.3 Methodological Challenges of Music Stimuli

When music is used to induce emotional impulses in research, stimuli are typically selected by experimenters (as opposed to participants). This procedure allows a higher control of possible confounds (Eerola & Vuoskoski, 2013; Hevner, 1936), but has the disadvantage that it often provides less intense emotional experiences than participant-chosen music (e.g., Grewe et al., 2007; Liljeström et al., 2013; Weth et al., 2015).

There are different forms of experimenter-chosen music (for an overview, see Figure 3-1). In an initial stage, researchers decide between using existing or newly developed pieces of music. In research practice, researchers have predominantly used pre-existing pieces of music (for a review, see Västfjäll, 2001), which often belonged to the classical genre (Eerola & Vuoskoski, 2013).

Figure 3-1. Methodological challenges associated with different forms of experimenter-chosen music stimuli



[33] For music, object-specific emotion could be evoked through cognitive appraisal (e.g., if a person is delighted by the way a piece of music is composed; Juslin & Västfjäll, 2008).

While such pre-existing music stimuli tend to be of high external validity, it poses the challenge that some participants might be familiar with it, which could lead to confounds on three levels: First, familiar music bears the risk of evoking episodic memories (Juslin & Västfjäll, 2008), which can spark emotional responses unrelated to the emotional characteristics of the music itself (e.g., a sad piece of music can be linked to a beautiful memory). Second, familiar music can be associated with external content (e.g., television commercials or films) that "can shape the emotional experiences in unwanted or at least uncontrolled ways" (Eerola & Vuoskoski, 2013, p. 322). Third, familiar music tends to be perceived as more positive and might thus skew the emotional effect towards positivity (Janiszewski, 1993; Schellenberg et al., 2008). In research practice, this risk of familiarity might *not* be trivial: Often, experimenter-selected music has a considerate level of recognition (e.g., involving familiar pieces such as "In the Hall of the Mountain King" by Edvard Grieg; Västfjäll, 2001).

Apart from familiarity, pre-existing music stimuli pose the challenge of stimulus heterogeneity*:* Here, confounds might emerge if experimental conditions differ on relevant factors other than emotion. Consider an experiment in which music by Ludwig van Beethoven is used to elicit positive emotional impulses and music by The Cure is used to elicit mixed emotional impulses (e.g., relying on music used by Hunter et al., 2008). Apart from their emotional attributes, each of these pieces embodies unique characteristics that potentially elicit cognitions beyond emotion: Certain *musical instruments*, for instance, tend to be stereotyped to a certain gender (Kelly, 1997; Steblin, 1995) or context (e.g., organ music might be associated with church and religion; Cullhed, 2020; Juslin & Laukka, 2004), while certain *styles of music* tend to be associated with certain personality types, value concepts or group memberships (Rentfrow & Gosling, 2003; Schwartz & Fouts, 2003). In the above case, group differences might not be reliably traced back to the effect of emotional impulses but might as well have arisen from extra-emotional cognitions. In sum, while being high in external validity, the use of pre-existing music "lack[s] the control of musical and acoustical parameters" (Eerola & Vuoskoski, 2013, p. 320).

As an alternative to pre-existing music stimuli, researchers can rely on re-arranged, improvised, or newly composed music. With respect to *re-arrangements*, researchers have altered existing music into new stimulus material by manipulating certain parameters, such as loudness, pitch, mode, or tempo (Hunter et al., 2010; Husain et al., 2002; Ilie &

Thompson, 2006). While the resulting stimuli tend to be highly controlled, they involve the risk of sounding artificial and being of lower external validity (Eerola & Vuoskoski, 2013). With respect to *improvisation*, researchers have analyzed music performed by professional musicians showcasing various emotional expressions (e.g., Timmers & Ashley, 2007). While the resulting stimuli tend to be novel (i.e., non-familiar), they involve the risk of heterogeneity. The third approach, *newly composed music*, can provide a viable solution for these existing challenges: If all employed stimuli relied on a homogeneous musical basis and only deviated on specific musical parameters to elicit the intended emotional impulse, the risks of familiarity, heterogeneity, and artificiality could be diminished. While there are stimuli composed for research purposes (e.g., Vieillard et al., 2008), these stimuli did not account for a consistent musical basis across different emotional conditions. Therefore, we set out to contribute newly composed, controlled stimulus material to the body of experimental procedures in emotion research.

3.3 Development of the Controlled Music Stimuli

In the following part, we develop a composition concept, on the basis of which the controlled music stimuli were created.[34] Based on the acknowledgment that "there are structural properties that cause the listener to perceive certain emotional expressions in [pieces of] music" (Västfjäll, 2001, p. 175), this composition concept was systematically derived from music-theoretical and psychological research. For each emotional condition, it incorporated distinct manifestations of musical parameters that research found to be associated with the respective emotional effect. On a higher level, it furthermore addressed the previously discussed generalizable mechanisms of music-based emotion evocation by Juslin and Västfjäll (2008): brain stem reflexes, emotional contagion, and musical expectancy.[35]

[34] As a formally trained classical musician (Artist Diploma) with more than 20 years of experience in musical practice, the first author is familiar with analyzing, arranging, and composing music.

[35] These mechanisms seem of particular relevance to the composition of the *negative stimulus* as most existing music might not have been composed with the explicit premise to evoke negative responses and therefore provides only limited insights into musical parameters accounting for "truly negative" emotional responses.

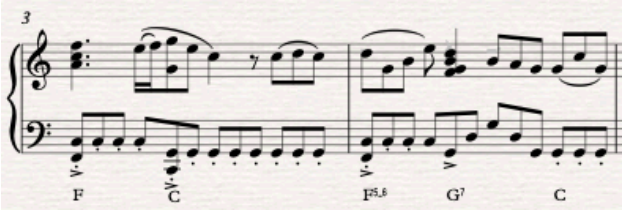
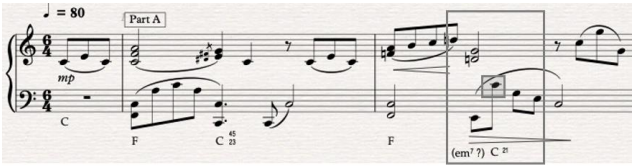
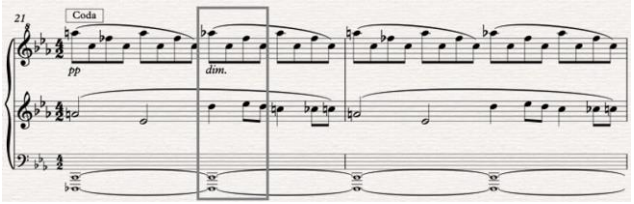
As a contextual boundary condition, it should be acknowledged that these parameter-based inferences can only be regarded as *averaged tendencies* that might not be ubiquitously valid. For instance, while scientific findings suggest that a fast tempo is associated with positive emotional impulses (e.g., Dalla Bella et al., 2001), there are musical pieces in a fast tempo that predominantly evoke fear (Hevner, 1935). Thus, the emotional effect of a single musical parameter can be influenced by other musical parameters in the broader context of a piece. In consequence, musical parameters tend to evoke the intended emotional impulse more reliably when they are simultaneously paired with multiple cues of the same valence*:* "[T]he larger the number of [same-valence] cues used, the more reliable [is] the communication" (Juslin & Laukka, 2004, p. 220). Following this notion of redundancy, the composition concept incorporated a variety of such same-valence cues.

The concept is documented in Table 3-1. It is organized alongside the musical dimensions of (1) tempo and harmony, (2) ambitus[36] and melody, as well as (3) rhythm and dynamics. The first section outlines the *idiosyncrasies* of each emotional stimulus. The second section outlines the *shared musical foundation* that is homogeneous across all three stimuli. A condensed overview of this composition concept is provided in Appendix 3.1. The musical scores of the stimuli are provided in Appendix 3.2.

[36] A tonal ambitus describes "the range of a voice, instrument or piece" (Powers et al., 2001, para. 1).

Table 3-1. Composition concept of the controlled music stimuli

	Idiosyncrasies		
	Positive stimulus	**Mixed emotional stimulus**	**Negative stimulus**
Tempo & Harmony	• *comparatively fast tempo* (120 bpm) paired with *major mode* (i.e., Part A in C major; Part B in E♭ major; Part A' and Coda in B♭ major), based on research documenting major modes and fast tempo to be associated with positive emotional impulses (Dalla Bella et al., 2001; Gagnon & Peretz, 2003; Husain et al., 2002; Palmer et al., 2013; Peretz, 1998) [EC] • *simple harmonic material* (i.e., predominantly major chords, little harmonic material outside the key) and *predictable harmonic progressions* (e.g., in form of a classical dominant-tonic cadence, see Figure 3-2: shifts between tonic [C major] and subdominant [F major], followed by dominant seventh [G^7 major] resolving back into tonic), based on research documenting positively valenced "anticipatory arousal" (Ali & Peynircioğlu, 2010, p. 177) resulting from the formation of musical predictions, as well as the perception of resolved tensions to be associated with positive emotional impulses [ME]	• *inconsistent cues of mode and tempo*: comparatively slow tempo (80 bpm) combined with major mode (i.e., Part A in C major; Part B in A♭ major, Part A' in E♭ major; Coda in B♭ major), based on research documenting music with inconsistent cues to be associated with mixed emotional impulses (Hunter et al., 2008; Ladinig & Schellenberg, 2012; Larsen & Stastny, 2011; Larsen et al., 2017a) [EC] • *comparatively complex harmonic material* (e.g., major and minor chords, suspensions), still based on in clear harmonic reference frame, intended to result in mixed emotional impulses due to ambiguity (e.g., musical anticipations sometimes disappointed) [ME] • *harmonic expectation violation* (e.g., repeated opening gesture not directly leading back tonic, but moving to chord E-D-G, opening up the possibility of being either dominant parallel [E minor 7, with the notes E-G-B-D] or tonic with a secondary lead [C major, with the notes D-(C-E-G)], finally resolved through note C, see Figure 3-5), intended to result in mixed emotional impulses due to ambiguity in musical expectancy [ME]	• *comparatively slow tempo* (ca. 70 bpm) paired with *minor mode* (formally C minor), based on research documenting minor modes and slow tempo to be associated with negative emotional impulses (Dalla Bella et al., 2001; Gagnon & Peretz, 2003; Husain et al., 2002; Palmer et al., 2013; Peretz, 1998) [EC] • *no clear tonal center* (i.e., no clear harmonic mode substantiated in harmonic progression of piece), resulting in inability to resolve accumulated tension and to form musical expectations around a tonal reference point; *shattered harmonic hints* (e.g., a minor, shattered by diminished fifth D-A♭, see Figure 3-8), intended to result in negative emotional impulses due to discouragement to form musical anticipations [ME] • subtle, yet noticeable *instability in tempo* ("senza tempo" as musical instruction implies the piece to be played at free pace; Kühn, 2016), based on research documenting variabilities and irregularities in tempo to be associated with negative emotional impulses (Gabrielsson & Juslin, 1996; Juslin et al., 2001; Laukka & Gabrielsson, 2000) [BR]

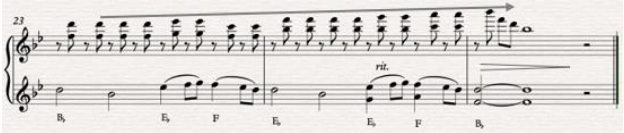
		• *musical expectancy violations* (see above), based on research documenting mixed emotional impulses to be associated with emotional phenomenon of musical chills[37] (Guhn et al., 2007; Mori, 2022) ME	• *dissonant intervals* (e.g., tritones, small seconds) and "uneloquent" harmonic transgressions (e.g., parallel fifths), based on research documenting dissonances (Timmers & Ashley, 2007; Vieillard et al., 2008) and disrupting compositional elements (Koelsch et al., 2006; Wedin, 1972) to be associated with negative emotional impulses BR, EC
	Figure 3-2. Dominant-tonic cadence  NOTE. — Positive stimulus, measures 3–4.	*Figure 3-5. Harmonic expectation violation*  NOTE. — Mixed emotional stimulus, measures 1–2.	*Figure 3-8. Shattered harmonic hints*  NOTE. — Negative stimulus, measures 21–22.
Ambitus & Melody	• *wide but natural tonal ambitus* (ranging from contra A to e3), transcending into high, 'heavenly' spheres in Coda (ranging from d1 to b♭3), based on research documenting wide ambitus and high pitch to be associated with positive emotional impulses (Gabrielsson & Lindström, 2001; Juslin & Laukka, 2004) BR, EC • *ascending melodic contours* (see Figure 3-3), based on research documenting rising melodic lines to be associated with positive emotional impulses (Gerardi & Gerken, 1995) EC	• *cross-wise combination of positive and negative emotional cues*: natural tonal ambitus (ranging from contra G to e3) with melodic arches traversing through wide ambitus spectrum – resembling extremeness of negative stimulus but avoiding extreme jumps between registers or empty middle voices, intended to evoke mixed emotional impulses through conflicting cues (see Figure 3-6) BR • *ascending and descending melodic contours,* intended to evoke mixed emotional impulses through conflicting cues EC	• *extreme tonal ambitus* (ranging from contra D♭ to a3), based on research documenting large pitch contrasts to be associated with fear (Juslin & Laukka, 2004) – unfolding on *horizontal level* through sudden, harsh jumps between registers, and on *vertical level* through extremely high and low voices played simultaneously, leaving *empty middle voices* – intended to result in impressions of hollowness and unnaturalness that translate into negative emotional impulses BR

[37] Musical chills arise "due to the intensification of bittersweet sadness in music" (Panksepp, 1995, p. 192) and correlated in their intensity, number, and duration with emotional experiences of both happiness and sadness (Bannister, 2020; Mori & Iwanaga, 2017).

Ambitus & Melody (continued)

- predominance of *consonant intervals* (e.g., perfect fifths as prominent intervals of bass line), based on research documenting consonant intervals (such as perfect fifths; Juslin & Laukka, 2004) to be associated with positive emotional impulses [ME]

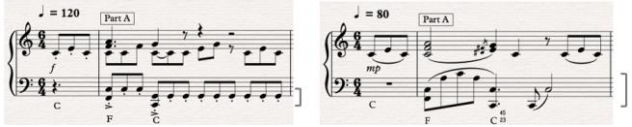
Figure 3-3. Ambitus & ascending melodic lines



NOTE. — Positive stimulus, measures 23–25.

- predominance of *consonant intervals,* with considerate number of *out-of-key notes* and *complex intervals*, intended to result in mixed emotional impulses due to musical expectancy violations [ME]

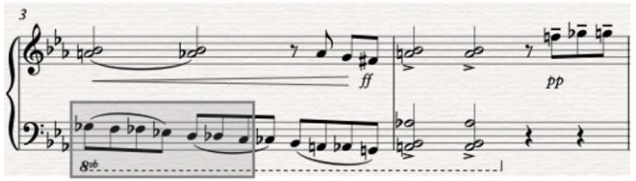
Figure 3-6. Ambitus of accompanying voices



NOTE. — Left: Positive stimulus; right: mixed emotional stimulus, measure 1 (both).

- *descending melodic contours*, based on research documenting falling melodic lines to be associated with negative emotional impulses (Juslin & Laukka, 2004) [EC]
- *distinct melodic patterns*, such as the base figure of the *passus duriusculus* [Lamentobass] (i.e., a line of semitone chromatic steps, used in musical rhetoric to relate to a state of particular painfulness and great suffering, Krones, 2016; see Figure 3-9) and *suspiratios* (i.e., steps of seconds separated by small pauses that mirror a gesture of sighing [Seufzermotive]), intended to result negative emotional impulses [EC]
- *lack of melodic predictability* in overarching structure, based on research documenting alien sounding music to be associated with negative emotional impulses (Merrill et al., 2023); intended to result in discouragement to form musical expectations [ME]

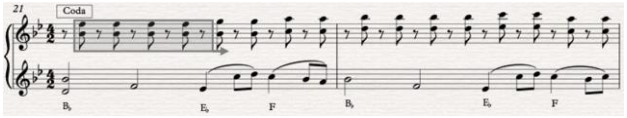
Figure 3-9. Base figure of passus duriusculus



NOTE. — Negative stimulus, measures 3–4.

- *energetic, flowing rhythmic accompaniment* (e.g., accented eighth-note triplets in A-part; syncopated backbeats in Coda see Figure 3-4), based on research documenting flowing rhythmical motions (Hevner, 1936), staccato notes (Rigg, 1937), and rhythmical variations (Thompson & Robitaille, 1992) to be associated with positive emotional impulses [EC]
- rather constant level of loudness with slight dynamical developments alongside melodic phrases, based on research documenting a low variability in loudness to be associated with positive emotional impulses (Juslin & Laukka, 2004) [BR]

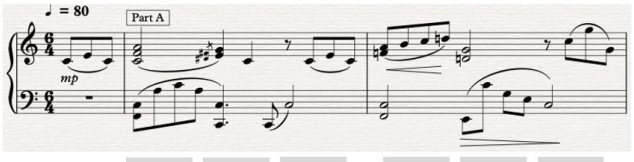
Figure 3-4. Syncopated backbeats



NOTE. — Positive stimulus, measures 21–22.

- *firm metric structure* combined with ongoing *rhythmical drive* (flowing rhythmical motion in accompaniment, subdivided into firm two-beat units [indicated by the grey bars in Figure 3-7]), based on research documenting a firm beat (e.g., chorale-like chords centering on each full beat) to be associated with solemnity, and flowing rhythmical motions to be associated with playfulness (Hevner, 1936) – intended to result in mixed emotional impulses due to conflicting cues between meter (firm grouping of beats) and rhythm (flowing rhythmical patterns) [EC]
- *elaborate dynamical unfolding* (e.g., long crescendos), based on research documenting gradual volume increases to be associated with the mixed emotional phenomenon of musical chills (Guhn et al., 2007) [BR]

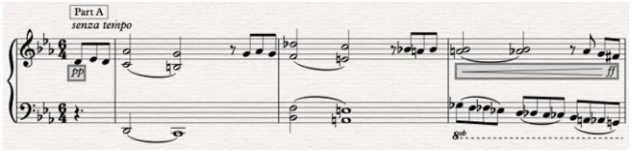
Figure 3-7. Rhythmical units



NOTE. — Mixed emotional stimulus, measures 1–2.

- rhythmical structures interrupted by *unnaturally long breaks*, based on research documenting unnaturalness to be associated with negative emotional impulses (Juslin, 1997; Juslin & Laukka, 2004); further intended to result in perceptions of music severed into isolated fragments, impeding musical sensemaking on a rhythmical level [ME]
- *moments of high loudness*, based on research documenting intense volume to be associated with negative emotional impulses (Gabrielsson & Lindström, 1995; Imberty, 1979; Laukka & Gabrielsson, 2000) [EC]
- *extreme dynamical ambitus* (ranging from ppp to fff) transgressed in very little time (see Figure 3-10), based on research documenting large dynamic variation to be associated with negative emotional impulses (Juslin, 1997) [BR]
- *abrupt changes in loudness* (e.g., *subito forte*) intended to result in negative emotional impulses by impeding gradual habituation to dynamic levels of music [BR, EC]

Figure 3-10. Dynamic progression



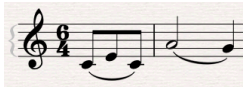
NOTE. — Negative stimulus, measures 1–3.

Shared musical foundation

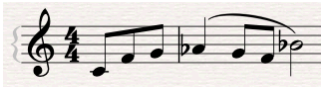
- *musical style*: all stimuli are classical solo piano music (i.e., a genre frequently found in existing stimulus material Peretz, 1998; Schellenberg et al., 2012)
- *instrumentation*: stimuli recorded by the same artist on the same instrument
- *melody*: highly similar melodic material amongst the stimuli (i.e., opening musical gesture, musical motifs, rhythmical structures; see Figure 3-11)
- *voice distribution*: melody starting in the high register and shifting to bass register in the Coda
- *musical keys*: similar key sequences (i.e., positive stimulus: C major [Part A], E♭ major [Part B], B♭ major [Part A' and Coda]; mixed emotional stimulus: C major [Part A], A♭ major [Part B], E♭ major [Part A'], and B♭ major [Coda]; negative stimulus: written in C minor but lacking a clear tonal center)
- *formal structure, phrase length & musical meter:* four sections, each of which is distinct in length and metric properties (i.e., [1] an eight-bar A-part in a $^{6}/_{4}$ beat, [2] an eight-bar B-part in a $^{4}/_{4}$ beat, [3] a four-bar A'-part in a $^{6}/_{4}$ beat, as well as [4] a five-bar coda in a $^{4}/_{4}$ beat); overall length of 25 bars
- *musical functions*: each section with the same music function for all stimuli (i.e., A-part: introducing the principal melodic theme; B-part: contrasting this theme; A'-part: revisiting principal melodic theme in modified form; Coda: concluding the piece)
- *duration*: more than one minute long, aligning with an average duration of music stimuli used in emotion research (Eerola & Vuoskoski, 2013); an identical number of bars, resulting in slight differences in duration due to distinct manifestations of the musical parameter *tempo* (i.e., positive stimulus: 77 seconds; mixed emotional stimulus: 118 seconds; negative stimulus: 106 seconds)

Figure 3-11. Shared musical gestures of the three stimulus versions

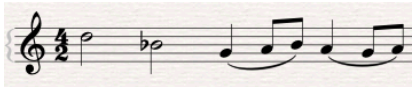
Musical gesture of A-part



Musical gesture of B-part



Musical gesture of Coda



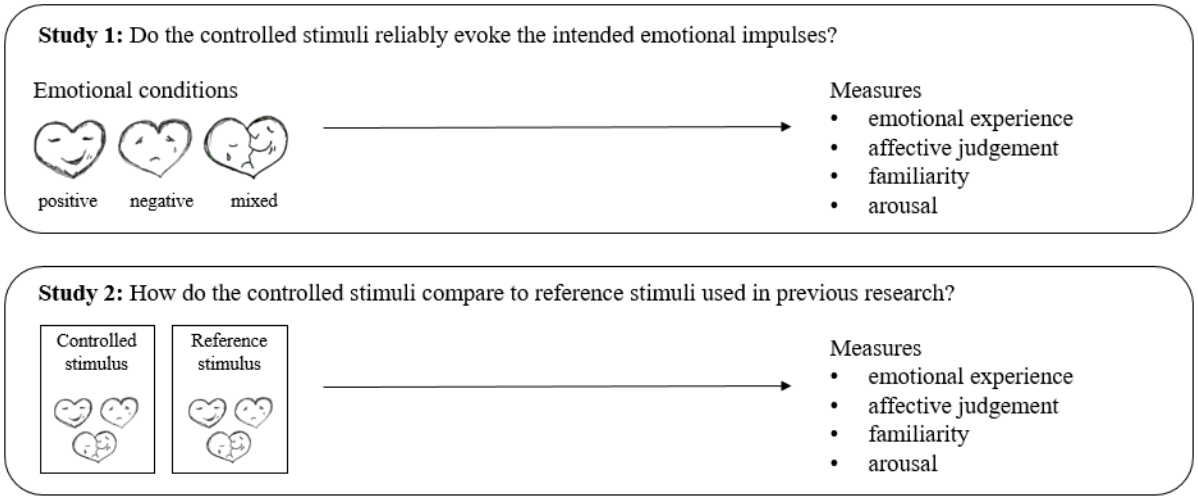
GENERAL NOTE. — Reference to psychological mechanisms of emotion evocation (Juslin & Västfjäll, 2008): BR = Brain stem reflexes, EC = Emotional contagion, ME = Musical expectancy

3.4 Empirical Test of the Controlled Music Stimuli

On the basis of the composition concept, the controlled music stimuli were composed and recorded (recordings are available at https://shorturl.at/ituR4). In the following, we present two pre-registered experiments to validate the controlled music stimuli in their emotional effects. In detail, these experiments test the hypotheses that the positive stimulus evokes higher positive, the negative stimulus evokes higher negative, and the mixed emotional stimulus evokes higher mixed emotional impulses than the respective other two stimuli.

Figure 3-12 provides an overview of this research, while an overview of all obtained measures is provided in Appendix 3.3. Approval from Johannes Gutenberg University's institutional review board was obtained with respect to all musical pieces used in the following experiments.

Figure 3-12. Overview of the current research



3.5 Experiment 1: Emotional Impulses Evoked by the Controlled Music Stimuli

Experiment 1 is based on a one-factorial between-subjects design (stimulus condition: positive versus negative versus mixed emotional impulses) and investigates whether the controlled stimuli evoke the intended emotional impulses. Preregistration for this study is available at https://aspredicted.org/6KG_KGN.

3.5.1 Method

Procedure. After passing an audio test and an instructional manipulations check (aligned at Oppenheimer et al., 2009), participants were randomly assigned to listen to one of the three controlled music stimuli. We asked participants to close their eyes, immerse themselves in the music, and answer a set of questions once they had an impression of the music.

Measures. We measured emotional experience by asking participants how they experienced the controlled music stimulus on an emotional basis and affective judgment by asking participants how they evaluated the stimulus on an emotional basis. Instructions informed participants that positive and negative emotions did not necessarily exclude each other and that, in some situations, people felt positive and negative emotions at the same time. Concerning *emotional experience*, we used instructions from previous papers (i.e., „The music made me feel… “, Mantel and Kellaris 2003, p. 534; see also Pham et al. 2001; Fang, Singh and Ahluwalia 2007; Coles et al. 2019; Aaker, Drolet and Griffin 2008). Adapting items from Holbrook et al. (1984), we asked participants to what degree the music made them feel contented and melancholic, hopeful and despairing, satisfied and unsatisfied. Furthermore, we asked participants how much the music made them feel happy and sad, cheerful and blue, joyful and down, adapting items from Lau-Gesk and Meyers-Levy (2009). Thus, participants evaluated six emotional items of positive valence and six emotional items of negative valence. Adopting the approach of Larsen et al. (2001), all items were rated on *unipolar scales* (1 = not at all; 7 = very much), in order to account for the occurrence of positive and negative emotions at the same time, while each of the six positive items could be paired with a negative emotional antonym: The first three item pairs were explicitly conceived as such (Holbrook et al., 1984), while the latter three item pairs were confirmed to be emotional antonyms on the basis of a thesaurus search (retrieved on January 15, 2022, from https://www.merriam-webster.com/thesaurus/; see Table 3-2 for an overview of emotional items). With respect to *affective judgment*, we employed the two items “The music sounds happy [sad]” (used by Hunter et al., 2010, 2011; Zhang et al., 2018), using the same emotion scale types as before. Items were randomized in order within the emotional experience and affective judgment categories. Apart from emotional impulses, we measured familiarity (“How familiar does this piece of music sound?”; adopted from Hunter et al., 2011), and music-related arousal (using the three 7-point semantic differentials passive–

active, mellow–fired, low–high energy, adopted from Berger & Milkman, 2012). The full questionnaire is documented at https://shorturl.at/ituR4. All measures were obtained while participants listened to the music.

Table 3-2. Emotional antonym pairs to measure emotional experience

Positive valence	Negative valence
contented	melancholic
hopeful	despairing
satisfied	unsatisfied
happy	sad
cheerful	blue
joyful	down

Sample. We recruited English-speaking participants (using tablet or desktop devices capable of playing audio) on Prolific, asking them to ensure they were in a quiet environment. Out of 363 participants who started the survey, three participants were excluded due to a failed audio check, and nine participants did not complete the survey. The final sample comprised 351 participants (M_{age} = 42.2, SD_{age} = 14.2; 227 female, 121 male, 3 diverse). With respect to attrition, participants in the negative condition evinced a higher attrition rate compared to the mixed emotional condition (p = .045), while no further differences in attrition were found between the other conditions (all ps > .10). It seems likely that increased attrition in the negative condition was driven by the evoked negative emotional impulses, which might lead to more conservative inferences about the emotional effect of this stimulus: As participants with highly negative experiences might have been more strongly inclined to drop out, negative emotional impulses evoked by the negative stimulus could be even higher in reality. Our preregistered exclusion criterion of 10 seconds was not hit by any participant (minimum view time = 18 seconds).

3.5.2 Results

Emotional impulses. We aggregated the six items of positive *emotional experience* (contented, hopeful, satisfied, happy, cheerful, joyful) into a combined measure of positive emotional experience (Cronbach's alpha = .95). Likewise, we aggregated the six items of

negative emotional experience (melancholic, despairing, unsatisfied, sad, blue, down) into a combined measure of negative emotional experience (Cronbach's alpha = .88). To obtain a measure of mixed emotional experience, we calculated the minimum score for each of the six emotional antonym pairs (Schimmack, 2001) and aggregated the resulting scores into a combined measure of mixed emotional experience (Cronbach's alpha = .77). Analogously, we calculated mixed emotional *affective judgment* as minimum score of the two unipolar items (see Table 3-3 for descriptive statistics).

Table 3-3. Means and standard deviations for emotional measures (Experiments 1 and 2)

			Emotional experience			**Affective judgment**		
			positive	negative	mixed	positive	negative	mixed
Study	Condition	N	M (SD)	M (SD)	M (SD)	M (SD)	M (SD)	M (SD)
Experiment 1	pos	118	4.75 (1.24)	1.73 (.65)	1.59 (.55)	5.36 (1.29)	1.75 (.99)	1.67 (.83)
	neg	113	2.11 (1.09)	4.17 (1.22)	1.84 (.69)	1.80 (1.05)	5.08 (1.49)	1.66 (.79)
	mix	120	4.13 (1.23)	2.58 (1.10)	2.19 (.78)	4.08 (1.50)	3.19 (1.52)	2.48 (1.05)
Experiment 2 controlled set	pos	99	4.53 (1.23)	1.96 (.94)	1.77 (.69)	4.86 (1.56)	2.07 (1.48)	1.75 (.96)
	neg	101	1.92 (.91)	4.04 (1.19)	1.69 (.61)	1.61 (.88)	4.89 (1.53)	1.55 (.81)
	mix	101	3.94 (1.22)	2.80 (1.15)	2.21 (.72)	3.82 (1.49)	3.47 (1.62)	2.48 (1.10)
Experiment 2 reference set	pos	102	5.42 (1.12)	1.48 (.66)	1.42 (.63)	6.35 (.93)	1.14 (.51)	1.14 (.51)
	neg	103	3.10 (1.08)	3.57 (1.18)	2.25 (.70)	2.50 (1.26)	4.87 (1.50)	2.19 (.98)
	mix	96	4.52 (1.42)	2.04 (1.00)	1.77 (.75)	5.04 (1.63)	2.10 (1.33)	1.81 (.87)

NOTE. — In Experiment 2, no differentiation is made between participants who evaluated the stimulus in the first or the second round.

For each of the six dependent measures (i.e., emotional experience and affective judgment of positive, negative, and mixed emotional valence), we fit linear regressions using robust standard errors. We regressed each measure on pairs of dummy-coded predictors of emotional impulses: For *positive* emotional experience, we fit the model with the *negative* and *mixed emotional* impulses as predictors (each one coded as 0 = absent, 1 = present), leaving the positive impulse condition as baseline; analogously, we proceeded for the other dependent variables.

As documented in Table 3-4 (Model 1), the controlled music stimuli reliably evoked the

intended emotional impulses: The positive stimulus evoked higher positive emotional experience on the respective positive, the negative stimulus evoked higher emotional impulses on the respective negative, and the mixed emotional stimulus evoked higher emotional impulses on the respective mixed emotional measures, compared to the other stimulus conditions (see also Figure 3-13).

Table 3-4. Regression analyses investigating emotional impulses evoked by the music stimuli (Experiment 1)

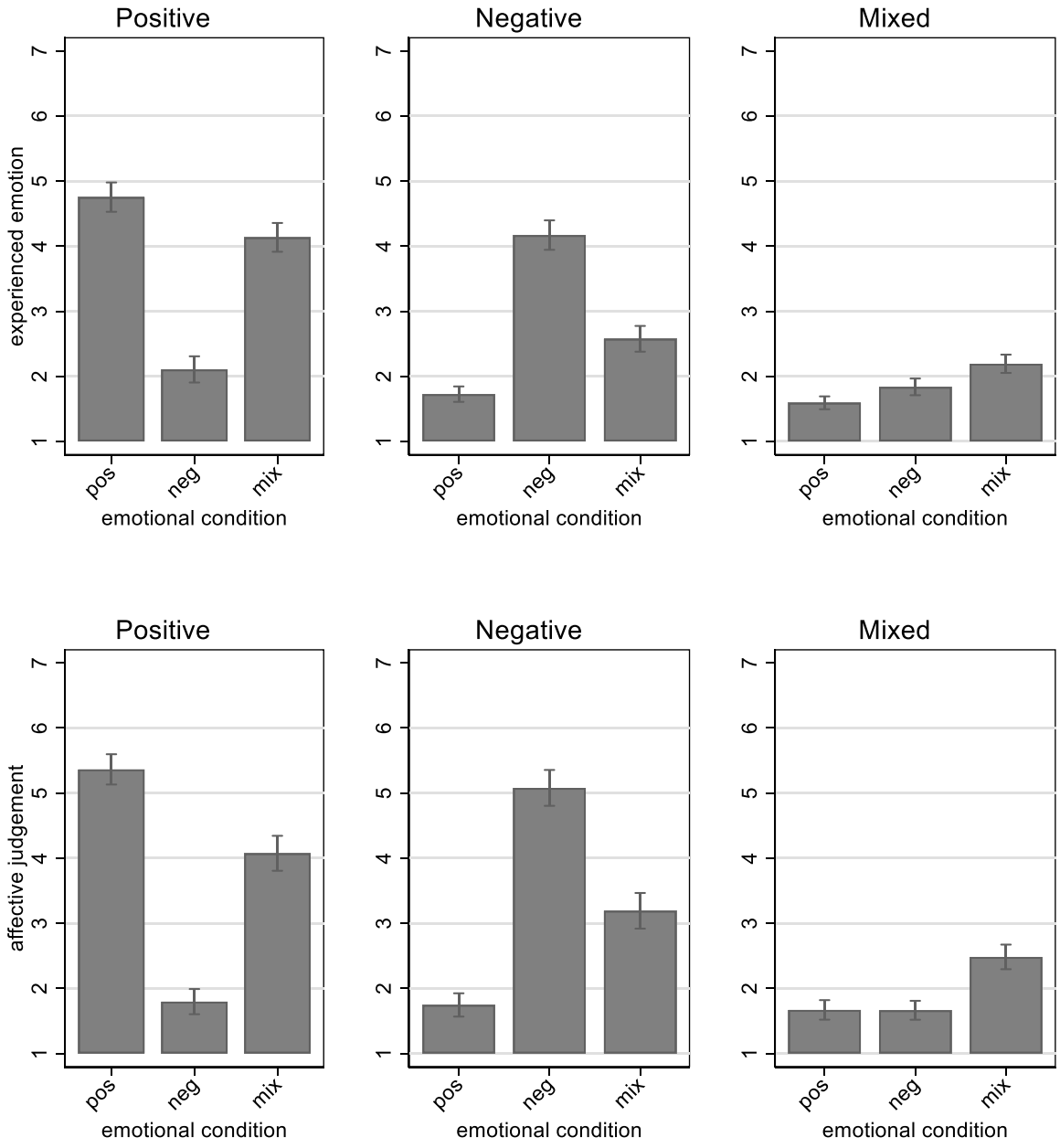
	Positive valence		**Negative valence**		**Mixed emotional valence**	
DV	emotional experience	affective judgment	emotional experience	affective judgment	emotional experience	affective judgment
Parameter			**Model 1 (main effects)**			
pos			-2.44 (.13)***	-3.33 (.17)***	-.60 (.09)***	-.81 (.12)***
neg	-2.65 (.15)***	-3.57 (.15)***			-.36 (.10)***	-.82 (.12)***
mix	-.62 (.16)***	-1.29 (.18)***	-1.59 (.15)***	-1.89 (.20)***		
constant	4.75 (.11)***	5.36 (.12)***	4.17 (.11)***	5.08 (.14)***	2.19 (.07)***	2.48 (.10)***
Parameter			**Model 2 (main effects incl. covariates)**			
pos			-2.37 (.13)***	-3.18 (.18)***	-.58 (.10)***	-.78 (.14)***
neg	-2.29 (.17)***	-3.14 (.16)***			-.29 (.10)**	-.75 (.13)***
mix	-.19 (.17)	-.76 (.18)***	-1.65 (.15)***	-1.93 (.20)***		
familiarity	.11 (.04)**	.13 (.04)**	.02 (.03)	-.04 (.05)	.09 (.03)**	.08 (.04)*
arousal	.32 (.06)***	.39 (.06)***	-.11 (.05)*	-.14 (.06)*	-.02 (.03)	-.03 (.04)
constant	3.02 (.29)***	3.23 (.30)***	4.52 (.23)***	5.70 (.25)***	2.02 (.12)***	2.38 (.16)***

NOTE. — Columns represent linear models. Cells represent unstandardized coefficients (standard error in parentheses) of estimate. *** p < .001, ** p < .01, * p < .05.

In post-hoc analyses, we fit the initial regression models with familiarity and music-related arousal (Cronbach's alpha = .82) as covariates. As documented in Table 3-4 (Model 2), the effects on evoked emotional impulses remained robust, with the exception of the difference between the positive and mixed emotional stimulus on the measure of positive emotional

experience: This contrast showed the pre-registered effect only in tendency. However, as mixed emotions are characterized by the co-occurrence of both positive and negative emotions (Larsen et al., 2001), this lack of differentiation can be aligned with theory: The demarcation of positive and mixed emotions does not require the *positive condition* to be higher in evoked positive emotional impulses. Instead, it requires the *mixed emotional condition* to be higher in evoked co-occurrence of positive and negative emotional impulses.

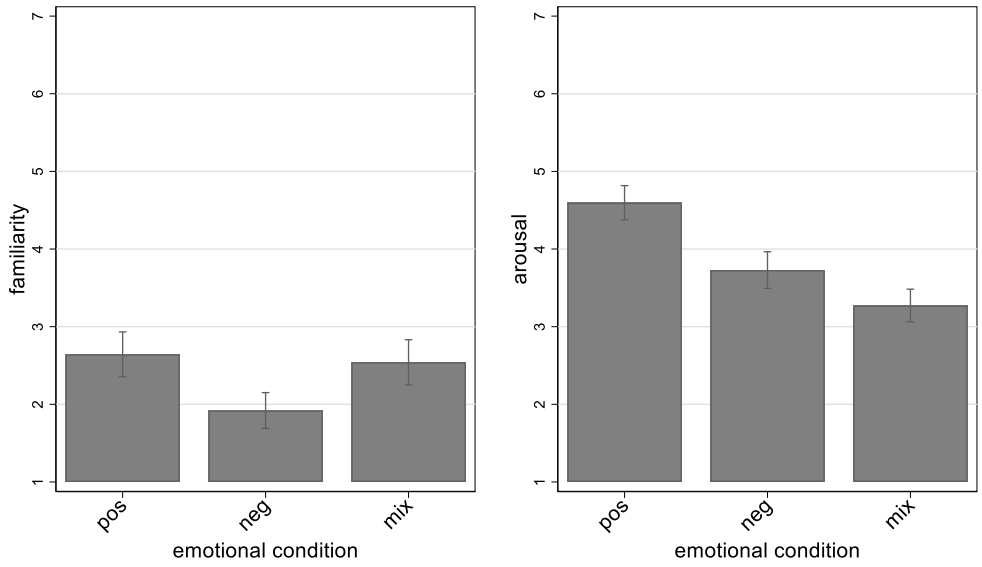
Figure 3-13. Emotional experience and affective judgment (Experiment 1)



NOTE. — Error bars represent the 95% confidence interval.

Differences in familiarity & arousal. To explore the controlled music stimuli with respect to familiarity and music-related arousal, we fit two ANOVAs with stimulus condition (positive vs. negative vs. mixed emotional) as a predictor and (a) familiarity, as well as (b) music-related arousal as dependent variables. Both models documented significant differences amongst the emotional impulse conditions: For *familiarity* ($F(2, 348) = 7.83$, $p < .001$), post-hoc analyses showed that participants evaluated the negative stimulus as less familiar than both the positive ($M_{neg} = 1.92$ vs. $M_{pos} = 2.64$; $p < .001$) and the mixed emotional stimulus ($M_{neg} = 1.92$ vs. $M_{mix} = 2.54$; $p < .01$), while no differences were found between the positive and mixed stimulus ($p > .59$). For *arousal* ($F(2, 348) = 35.89$, $p < .001$), post-hoc analyses showed that participants evaluated the positive stimulus as more arousing than the negative ($M_{pos} = 4.60$ vs. $M_{neg} = 3.73$; $p < .001$) and the mixed emotional stimulus ($M_{pos} = 4.60$ vs. $M_{mix} = 3.27$; $p < .001$), and that the negative stimulus was evaluated as more arousing than the mixed emotional stimulus ($M_{neg} = 3.73$ vs. $M_{mix} = 3.27$; $p < .01$; see Figure 3-14).

Figure 3-14. Familiarity and music-related arousal (Experiment 1)



NOTE. — Error bars represent the 95% confidence interval.

3.5.3 Discussion

Results of Experiment 1 provide empirical evidence that the controlled music stimuli reliably evoked the intended emotional impulses, both with respect to emotional experience and affective judgment (see Chapter 3.2.1).

The negative stimulus was rated as less familiar than the positive and mixed emotional stimulus, which might be explained by participants' expectation that music is a predominantly *pleasurable* experience (Juslin & Laukka, 2004). However, the three stimuli in general evince rather low ratings of familiarity (below the scale midpoint of 3.5) and reliably evoke the intended emotional impulses when controlling for familiarity. Thus, a potential confound through familiarity seems rather unlikely.

Finally, the controlled stimuli differed in music-related arousal: The positive stimulus evinced the highest arousal rating, followed by the negative stimulus. For the positive stimulus, music-related arousal likely originates in its comparatively fast tempo; for the negative stimulus, it likely originates in its sudden dynamic shocks and instability in tempo. In principle, it would be possible to homogenize the controlled music stimuli along these dimensions. However, such homogenization might have weakened the intensity of evoked emotional impulses, and would furthermore inhibit the incorporation of (non-)conflicting cues between harmonic mode and tempo (Hunter et al., 2008; Larsen & Stastny, 2011). On this basis, we opted for a balanced approach and intentionally allowed *some* heterogeneity in music-related arousal.

3.6 Experiment 2: Comparison with Musical Reference Stimuli

Experiment 2 is based on a 2 (stimulus set: controlled stimuli vs. reference stimuli; within-subjects factor) x 3 (stimulus condition: positive versus negative versus mixed emotional impulses; between-subjects factor) design and investigates whether the controlled stimuli evoke the intended emotional impulses. Furthermore, it compares each controlled stimulus with an existing music stimulus identified by past research (Hunter et al., 2008). Preregistration for this study is available at https://aspredicted.org/N44_M99.

3.6.1 Method

Procedure. After passing an audio test, participants listened to two music stimuli from two different sets (i.e., one of the three controlled music stimuli and one of three musical excerpts from existing mixed emotions research by Hunter et al., 2008). In detail, the three musical excerpts were: Santiago by Zafra (i.e., a piece with consistently happy cues,

henceforth referred to as *positive reference stimulus*), Exit Music by Christopher O'Riley (i.e., a piece with consistently sad cues, henceforth referred to as *negative reference stimulus*), and La Noyee by Yann Tiersen (i.e., a piece with conflicting happy and sad cues, henceforth referred to as *mixed emotional reference stimulus*). Each excerpt was a piece of 30 seconds length from an commercial recording. While the original research by Larsen and Stastny (2011) employed a stimulus body of 48 musical excerpts from different musical styles, we selected three instrumental pieces to ensure comparability to the controlled music stimuli and to avoid confounds through lyrics. [38] Participants were subsequently exposed to one music stimulus from each set with a randomized order of sets and emotional impulse at each stage: All combinations of stimuli between the two sets were possible.

Measures. We measured emotional experience, affective judgment, familiarity, and music-related arousal for each of the two music stimuli in the same way as in the previous study. The full questionnaire is documented at https://shorturl.at/ituR4.

Sample. We recruited English-speaking participants (using tablet or desktop devices capable of playing audio) on Prolific, assuring that no overlap occurred between participants of Experiment 1. Out of the 319 participants who started the survey, four participants were excluded due to a failed audio check, and 14 participants did not complete the survey. The final sample comprised 301 participants (M_{age} = 36.5, SD_{age} = 13.5; 227 female, 71 male, 3 diverse). Attrition did not differ between the emotional impulse conditions of the controlled stimulus set, the emotional impulse conditions of the reference stimulus set, or the order of presentation of the stimulus sets (all p's >.10). Our preregistered exclusion criterion of 10 seconds was not hit by any participant (minimum view time = 49 seconds).

3.6.2 Results

Emotional impulses. We calculated measures of positive, negative, and mixed emotional experience and affective judgment as in the previous experiment (all Cronbach's alphas > .77 for positive, negative, and mixed emotional experience in the controlled and reference stimulus set). Descriptive statistics are documented in Table 3-3.

[38] Note that these musical excerpts have not been explicitly conceptualized as stimulus material. However, researchers might be enticed to adopt them to induce emotions in the context of mixed emotions research, as the excerpts with conflicting cues "elicited mixed emotions" (Larsen & Stastny, 2011, p. 1469).

As a first exploratory step, we analyzed the effects of each *stimulus set* (i.e., the reference and controlled music stimuli) in isolation. For both stimulus sets, we fit linear regressions with robust standard errors, in which we regressed each of the six dependent measures (i.e., emotional experience and affective judgment with positive, negative, and mixed emotional valence) on pairs of dummy-coded predictors of emotional impulses as in Experiment 1.

Results are documented in Table 3-5 (Model 1a/b): With respect to the controlled stimulus set, the results further substantiated that the controlled stimuli reliably evoked the intended emotional impulses. However, with respect to the reference set, the *negative stimulus version* evoked significantly higher mixed emotional impulses than the mixed emotional stimulus (both on the measures of mixed emotional experience and affective judgment).

Table 3-5. Regression analyses investigating emotional impulses evoked by the music stimuli (Experiment 2)

	Positive valence		**Negative valence**		**Mixed emotional valence**	
DV	emotional experience	affective judgment	emotional experience	affective judgment	emotional experience	affective judgment
Parameter			**Model 1a (controlled stimulus set)**			
pos			-2.08 (.15)***	-2.82 (.21)***	-.44 (.10)***	-.73 (.15)***
neg	-2.62 (.15)***	-3.24 (.18)***			-.53 (.09)***	-.92 (.14)***
mix	-.60 (.17)**	-1.04 (.22)***	-1.24 (.16)***	-1.43 (.22)***		
constant	4.53 (.12)***	4.86 (.16)***	4.04 (.12)***	4.89 (.15)***	2.21 (.07)***	2.48 (.11)***
Parameter			**Model 1b (reference stimulus set)**			
pos			-2.09 (.13)***	-3.74 (.16)***	-.35 (.10)***	-.68 (10)***
neg	-2.32 (.15)***	-3.86 (.15)***		-2.77 (.20)***	.48 (.10)***	.38 (.13)**
mix	-.89 (.18)***	-1.31 (.19)***	-1.53 (.15)***			
constant	5.42 (.11)***	6.35 (.09)***	3.57 (.12)***	4.87 (.15)***	1.77 (.08)***	1.81 (.09)***
Parameter			**Model 2 (Main effects)**			
pos			-2.13 (.10)***	-3.39 (.13)***	-.43 (.07)***	-.72 (.09)***
neg	-2.49 (-.11)***	-3.59 (.12)***			.00 (.07)	-.26 (.10)**
mix	-.73 (-.12)***	-1.18 (.14)***	-1.44 (.11)***	-2.19 (.15)***		
set	-.89 (.09)***	-1.20 (.10)***	.58 (.08)***	.76 (.10)***	.07 (.05)	.20 (.07)**
constant	5.42 (.10)***	6.22 (.10)***	3.55 (.09)***	4.57 (.12)***	1.96 (.06)***	2.05 (.08)***
Parameter			**Model 3 (Main effects incl. covariates)**			
pos			-1.93 (.12)***	-2.87 (.17)***	-.36 (.07)***	-.63 (.10)***
neg	-1.98 (.12)***	-2.89 (.14)***			-.09 (.07)	-.36 (.10)***
mix	-.53 (.12)***	-.89 (.14)***	-1.33 (.12)***	-1.90 (.16)***		
set	-.53 (.10)***	-.73 (.11)***	.47 (.08)***	.46 (.11)***	-.01 (.05)	.10 (.07)
arousal	.19 (.04)***	.33 (.04)***	-.12 (.03)***	-.30 (.05)***	-.10 (.02)***	-.13 (.03)***
familiarity	.15 (.03)***	.09 (.03)**	.03 (.02)	.03 (.03)	.04 (.02)*	.04 (.02)*
constant	3.77 (.26)***	3.98 (.28)***	3.94 (.16)***	5.62 (.22)***	2.34 (.12)***	2.54 (.16)***

(Table 3-5 continuing)

	Positive valence		**Negative valence**		**Mixed valence**	
DV	emotional experience	affective judgment	emotional experience	affective judgment	emotional experience	affective judgment
Parameter			**Model 4 (Interaction effects)**			
pos			-2.12 (.13)***	-3.83 (.15)***	-.35 (.09)***	-.69 (.10)***
neg	-2.33 (.15)***	-3.88 (.15)***			.54 (.09)***	.40 (.13)**
mix	-.88 (.18)***	-1.30 (.19)***	-1.60 (.15)***	-2.91 (.19)***		
set	-.87 (.15)***	-1.48 (.17)***	.48 (.16)**	.01 (.20)	.47 (.09)***	.66 (.13)***
pos x set			-.02 (.19)	.88 (.26)**	-.14 (.13)	-.03 (.17)
neg x set	-.33 (.21)	.59 (.23)**			-1.05 (.13)***	-1.31 (.18)***
mix x set	.29 (.25)	.25 (.28)	.32 (.22)	1.40 (.29)***		
constant	5.41 (.11)***	6.36 (.09)***	3.60 (.11)***	4.95 (.14)***	1.75 (.07)***	1.81 (.09)***
Parameter			**Model 5 (Interaction effects incl. covariates)**			
pos			-1.70 (.18)***	-3.03 (.23)***	-.38 (.10)***	-.73 (.10)***
neg	-1.05 (.19)***	-2.46 (.22)***			.51 (.12)***	.37 (.15)*
mix	-.55 (.16)**	-1.00 (.17)***	-1.22 (.18)***	-2.19 (.24)***		
set	.03 (.16)	-.55 (.17)**	.62 (.16)***	.26 (.20)	.45 (.11)***	.63 (.15)***
pos x set			-.38 (.21)	.20 (.25)	-.08 (.14)	.05 (.17)
neg x set	-1.42 (.22)***	-.63 (.25)*			-.99 (.15)***	-1.23 (.20)***
mix x set	.24 (.23)	.32 (.26)	-.16 (.25)	.52 (.32)		
arousal	.32 (.04)***	.40 (.05)***	-.14 (.04)***	-.26 (.05)***	-.02 (.02)	-.02 (.03)
familiarity	.15 (.03)***	.09 (.03)*	.02 (.03)	.03 (03)	.03 (.02)	.04 (.02)*
constant	2.82 (.29)***	3.54 (.34)***	3.95 (.16)***	5.61 (.22)***	1.73 (.15)***	1.78 (.19)***

NOTE. — Columns represent linear models. Cells represent unstandardized coefficients (standard error in parentheses) of estimate. *** $p < .001$, ** $p < .01$, * $p < .05$.

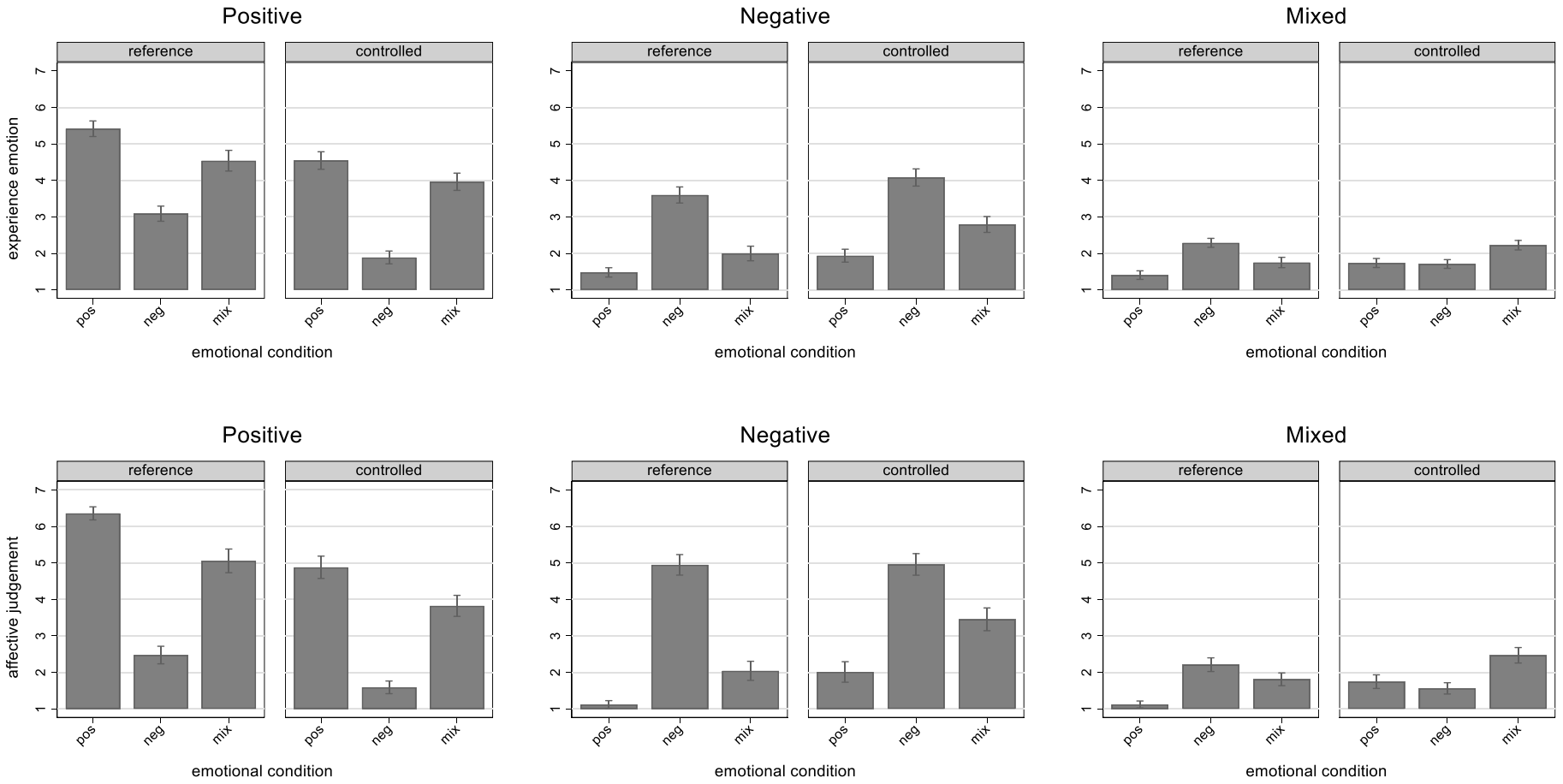
As a next step, we investigated the entire sample of observations, including the stimulus set (0 = controlled stimuli, 1 = reference stimuli) as an additional predictor and a random intercept for participants to account for repeated measurement.[39] As documented in Table 3-5 (Model 2 and 3), the music stimuli evoked the intended emotional impulses, with one exception: If the two stimulus sets are analyzed combinedly, the mixed emotional stimulus *does not differ from the negative stimulus* in evoked mixed emotional experience.

To explore this lack of differentiation, we fit the previous regression models with the full factorial design of the stimulus set and emotional impulse condition as independent variables. As documented in Table 3-5 (Model 4), there are significant two-way interactions of emotional impulse condition (i.e., the contrast of the negative and mixed emotional conditions) and stimulus set on both measures of mixed emotional impulses (see also Figure 3-15). In planned contrasts, participants in the *mixed emotional impulse condition* experienced higher mixed emotional impulses in the controlled stimulus set than in the reference stimulus set (experienced mixed emotions: $M_{controlled} = 2.22$, $M_{reference} = 1.75$; $z = 5.27$, $p < .001$; mixed emotional affective judgment: $M_{controlled} = 2.47$, $M_{reference} = 1.81$; $z = 4.88$, $p < .001$). From another perspective, the *reference stimulus set* induced higher levels of mixed emotional impulses in the negative than in the mixed emotional impulse condition (experienced mixed emotions: $M_{neg} = 2.29$, $M_{mix} = 1.75$; $z = 5.83$, $p < .001$; mixed emotional affective judgment: $M_{neg} = 2.21$, $M_{mix} = 1.81$; $z = 3.08$, $p < .01$). The *controlled stimulus set,* in turn, induced higher levels of mixed emotional impulses in the mixed emotional than in the negative impulse condition (experienced mixed emotions: $M_{neg} = 1.71$, $M_{mix} = 2.22$; $z = -5.86$, $p < .001$; mixed emotional affective judgment: $M_{neg} = 1.56$, $M_{mix} = 2.47$; $z = -6.79$, $p < .001$).

These findings might indicate that the negative and mixed emotional impulse conditions of the *controlled stimulus set* better discriminated the level of evoked mixed emotional impulses (see Figure 3-16). Results remained robust if models controlled for music-related arousal and familiarity (see Table 3-5, Model 6).

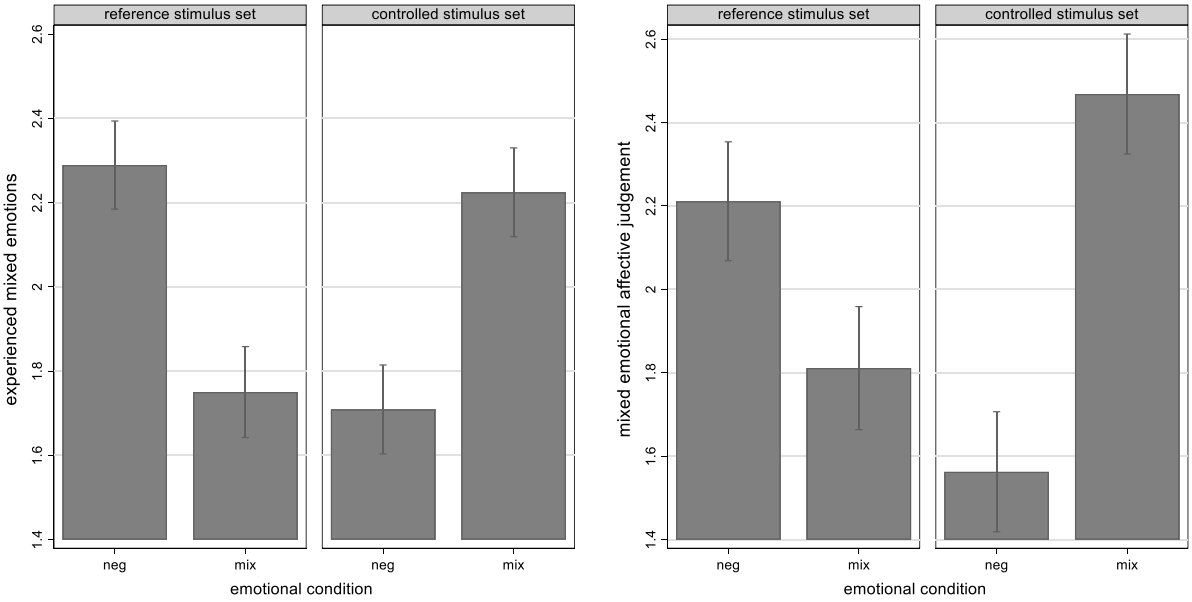
[39] We slightly deviate from the pre-registered criterion to include a random intercept for participants *if its inclusion was justified by a likelihood ratio test:* To account for repeated measurement, we include a random intercept *in all models*, even though not all likelihood ratio tests yielded significant differences between the models including and excluding a random intercept for participants.

Figure 3-15. Emotional experience and affective judgment between the stimulus Versions and sets (Experiment 2)



NOTE. — Error bars represent the 95% confidence interval.

Figure 3-16. Interaction of emotional impulse condition and stimulus set (Experiment 2)



NOTE. — For ease of interpretation, the plot does not represent the positive stimulus version. Error bars represent the 95% confidence interval.

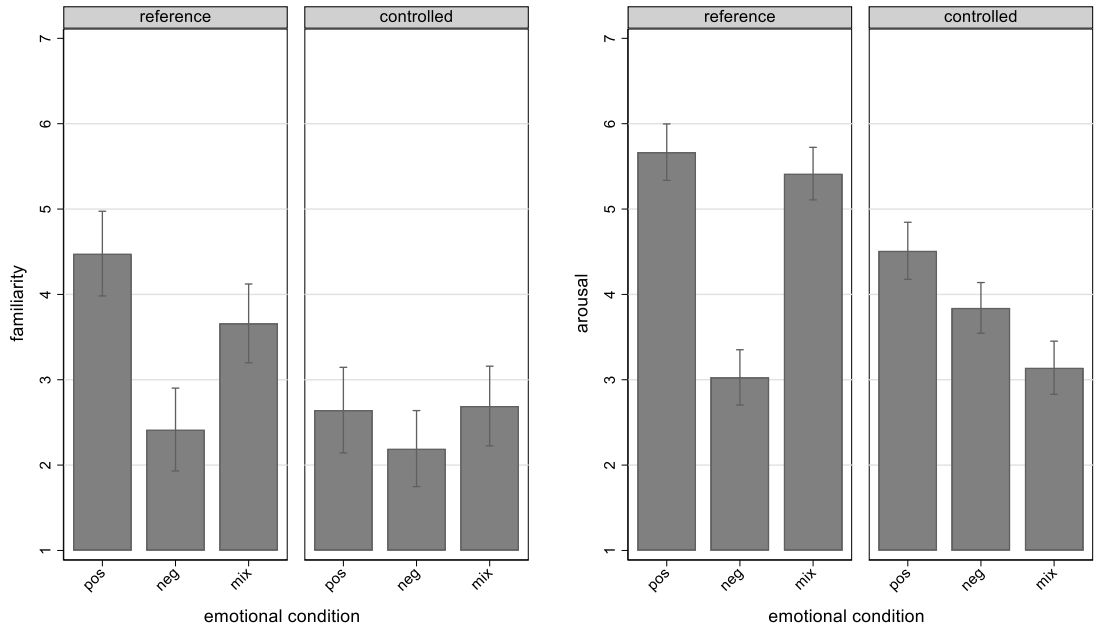
Differences in familiarity & arousal. For both stimulus sets, we fit two ANOVAs with emotional impulse condition (positive versus negative versus mixed emotional) as predictor and (a) familiarity, as well as (b) music-related arousal (Cronbach's alpha > .83 for both stimulus sets) as dependent variables. To avoid potential downstream effects of an antecedent stimulus, we confined the analyzed samples to the measures of the first stimulus presented to participants.

Amongst the three *reference stimuli*, there were differences in *familiarity* ($F(2, 144) = 16.68$, $p < .001$): The negative stimulus was rated as less familiar than both the positive stimulus ($M_{neg} = 2.42$ vs. $M_{pos} = 4.48$; $p < .001$) and the mixed emotional stimulus ($M_{neg} = 2.42$ vs. $M_{mix} = 3.66$; $p < .001$), while the mixed emotional stimulus was rated as less familiar than the positive ($p < .05$). Furthermore, there were differences in *arousal* ($F(2, 144) = 93.78$, $p < .001$): The negative stimulus was rated as less arousing than both the positive ($M_{neg} = 3.03$ vs. $M_{pos} = 5.67$; $p < .001$) and the mixed emotional stimulus ($M_{neg} = 3.03$ vs. $M_{mix} = 5.42$; $p < .001$), while no differences were found between the positive and negative stimulus ($p > .3$). Amongst the three *controlled stimuli*, there were no significant differences in *familiarity* ($F(2, 151) = 1.47$, $p > .3$), but in *music-related arousal* ($F(2, 151) = 15.16$, $p < .001$): The mixed

emotional stimulus was rated as less arousing than both the positive (M_{mix} = 3.14 vs. M_{pos} = 4.51; p < .001) and the negative stimulus (M_{mix} = 3.14 vs. M_{neg} = 3.84; p < .01), while the negative stimulus was rated as less arousing than the positive (p < .01; see Figure 3-17).

Finally, we compared the two stimulus sets themselves: Independent sample t-tests (analyzing the first stimulus presented to participants across all three emotional impulse conditions) showed that the reference set generally had higher levels of familiarity ($M_{reference}$ = 3.51 vs. $M_{control}$ = 2.49; t = 4.89, p < .001) and music-related arousal ($M_{reference}$ = 4.71 vs. $M_{control}$ = 3.80; t = 5.44, p < .001).

Figure 3-17. Familiarity and music-related arousal (Experiment 2)



NOTE. — Error bars represent the 95% confidence interval.

3.6.3 Discussion

Results of Experiment 2 substantiate the evidence that the controlled music stimuli reliably evoke the intended emotional impulses. Moreover, this study documents that the controlled stimuli are comparable in their emotional effects to existing reference stimuli identified by past research.

Compared to these reference stimuli, the controlled music stimuli are generally perceived as less positive. Moreover, the controlled stimuli appear to be advantageous in discriminating mixed emotional impulses between the mixed emotional and negative stimulus conditions. Possibly, this advantage originates in the fact that the negative controlled music stimulus was composed with the explicit purpose to evoke negative emotional impulses: Compared with the negative reference stimulus, this stimulus evinces higher levels of such negative emotional impulses. This notion is mirrored by Larsen and McGraw (2014, p. 268) who observe that "even slow minor songs elicit considerable levels of mixed emotions, presumably because their sad cues were accompanied by the array of cues […] that make music pleasant".

In line with the previous experiment, the controlled music stimuli were rated as rather low in familiarity (below the scale midpoint of 3.5) and evinced – *in contrast to the previous study* – no differences in familiarity. The reference stimuli received higher ratings of familiarity, which might not necessarily be beneficial, as familiarity can pose a risk of confounds (Mattila & Wirtz, 2001).

With respect to music-related arousal, the controlled stimuli evinced the same tendencies as in the previous study (i.e., positive > negative > mixed), while differences in music-related arousal were also found for the reference stimulus set (i.e., positive = mixed > negative). In a comparison of the two sets, heterogeneity in music-related arousal was higher for the reference stimuli: When comparing the absolute difference between the two stimulus conditions *with the highest and lowest arousal rating* in each of the two sets, this difference was significantly higher for the reference stimuli ($\Delta_{pos\text{-}neg} = 2.64$) than for the controlled stimuli ($\Delta_{pos\text{-}mix} = 1.37$; $p < .001$).

3.7 Conclusion

3.7.1 Methodological Contribution

This research offers newly composed music stimuli that can be used for inducing positive, negative, and mixed emotional impulses in experiments. While existing experimenter-chosen music stimuli bear the risks of potential confounds (e.g., through episodic memories, external associations, or stimulus heterogeneity; Västfjäll, 2001), and re-arranged music

stimuli bear the risk of sounding artificial (Eerola & Vuoskoski, 2013), we aimed to provide solutions for these challenges through a theory-based composition concept. Relying on music-theoretical and psychological research, we systematically derived musical parameters associated with the evocation of certain emotional impulses. These parameters are integrated into a composition concept that ensures the intended emotional effect of each stimulus while holding the underlying musical foundation constant across all stimulus versions. In sum, this approach yields the advantage that the resulting stimuli are (a) effective in emotion induction, (b) as controlled and homogeneous as possible, and (c) coherent musical pieces of high external validity.

Two empirical studies show that the controlled music stimuli reliably evoke the intended emotional impulses, and are comparable in their emotional effects to a set of reference stimuli identified by existing research: While there are structural differences between the two stimuli sets (e.g., the reference stimuli are 30-seconds excerpts that fade out at a certain point, whereas the controlled stimuli are through-composed pieces between 77 to 118 seconds length), the evoked emotional impulses are consistent in their direction of effect, as well as comparable in their magnitude. Finally, the controlled negative stimulus elicited stronger negative emotional impulses than the negative reference stimulus, which might be due to the fact that it was composed with the *particular goal of evoking negative emotional responses* (which might likely not be the case for most pre-existing negative music stimuli). As a result, the controlled stimuli might be better suited to discriminate between the negative and mixed emotional conditions in terms of evoked mixed emotional impulses.

3.7.2 Limitations and Future Research Directions

While the controlled music stimuli seem promising in their potential to evoke emotional impulses with a diminished risk of confounds arising from stimulus heterogeneity and familiarity, they still bear limitations. First, their emotional effects can only be generalized to individuals within the Western music tradition and, within this population, might be influenced by interindividual personality traits (e.g., musical sophistication, Schaal et al., 2014) or preferences (Kreutz et al., 2008).

Second, the controlled stimuli differ in music-related arousal, with the positive stimulus involving the highest arousal ratings, followed by the negative stimulus. Possibly, these differences originate in the manipulated parameters of tempo and dynamics (see Chapter 3.3). As these dimensions were deliberately manipulated to intensify the emotional effect of the stimuli – in particular, there is considerable evidence for the emotional effect of tempo (Dalla Bella et al., 2001; Gagnon & Peretz, 2003) – we decided to accept this heterogeneity to enhance the intensity of evoked emotional impulses. However, it needs to be acknowledged that the differences in music-related arousal can pose disadvantages for certain research contexts.

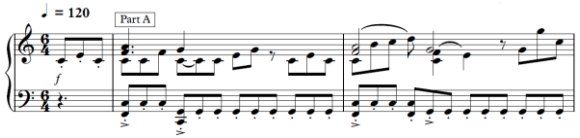
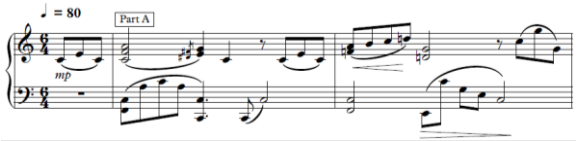
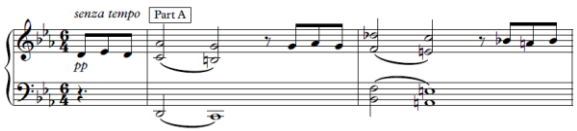
Third, we validated the emotional effect of the controlled music stimuli *while* participants were listening to the music and could not draw inferences about the existence, intensity, or duration of emotional impulses once the listening experience had ended. We assume that this immediate emotional effect of the controlled music stimuli is of primary interest to emotion researchers, given the advantage of music to induce emotional impulses in the background (e.g. when the music is paired with other stimuli presented at the same time).

Fourth, our work centers on the emotional qualities of *positive*, *negative*, and *mixed emotional* valence, and thus generalizes a mélange of different granular emotions. As most existing mixed emotions research is based on this generalized valence perspective (e.g., Aaker et al., 2008; Larsen et al., 2017a), we considered the controlled music stimuli to be the most valuable in their current form.

Finally – as experimental music stimuli are unlikely to evoke intense emotional responses (Joseph et al., 2020) – the emotional effect of the controlled music stimuli should be regarded as *situational influence* that does not completely change a participant's mood but rather provides an emotional impulse in a certain direction. This limitation does not necessarily constitute a drawback, because ethical considerations call into question the evocation of intense negative emotional experiences. Moreover, it is these moderate-intensity emotional states that may be of empirical relevance to consumer researchers.

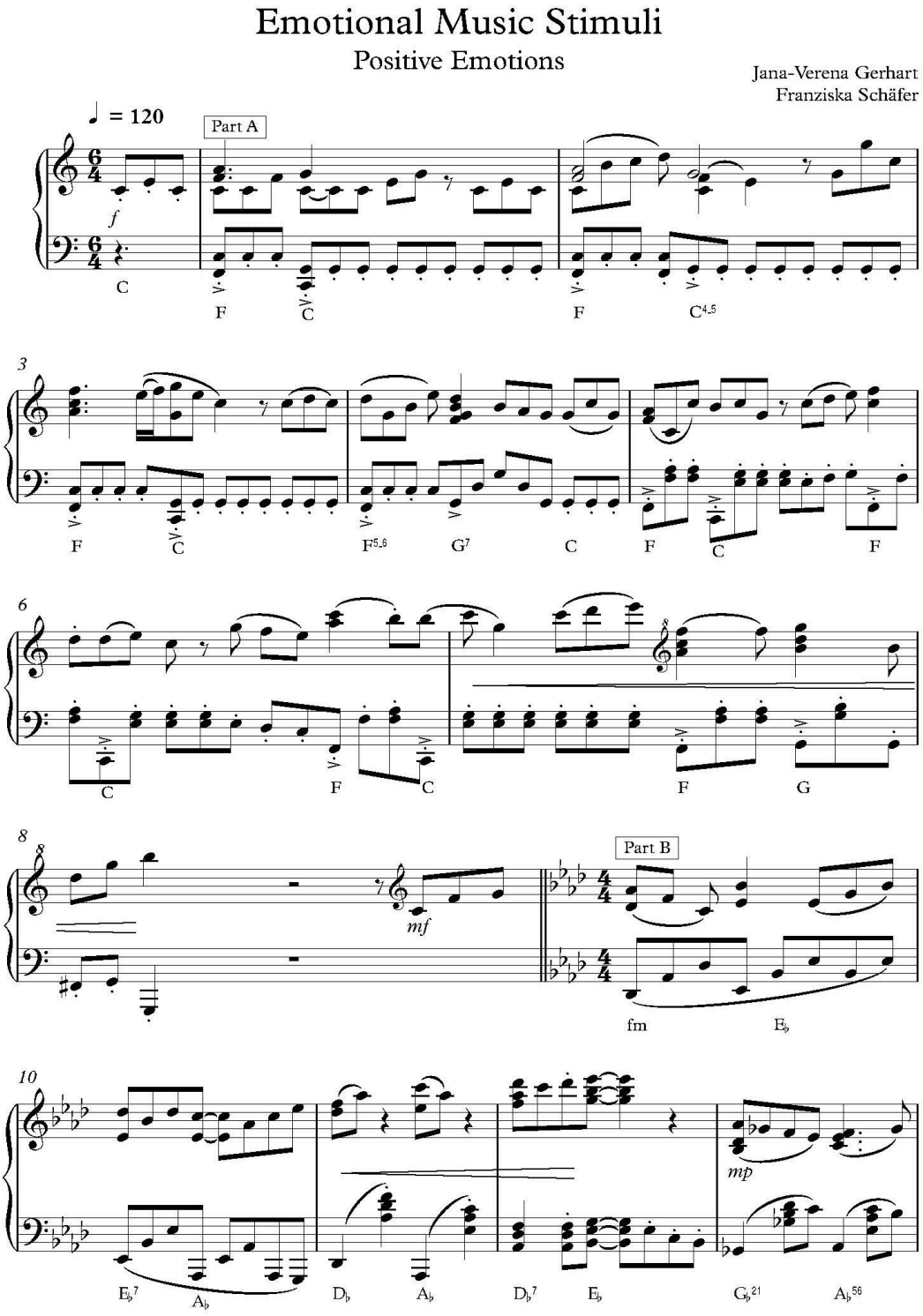
Appendix 3.1: Overview of the Composition Concep

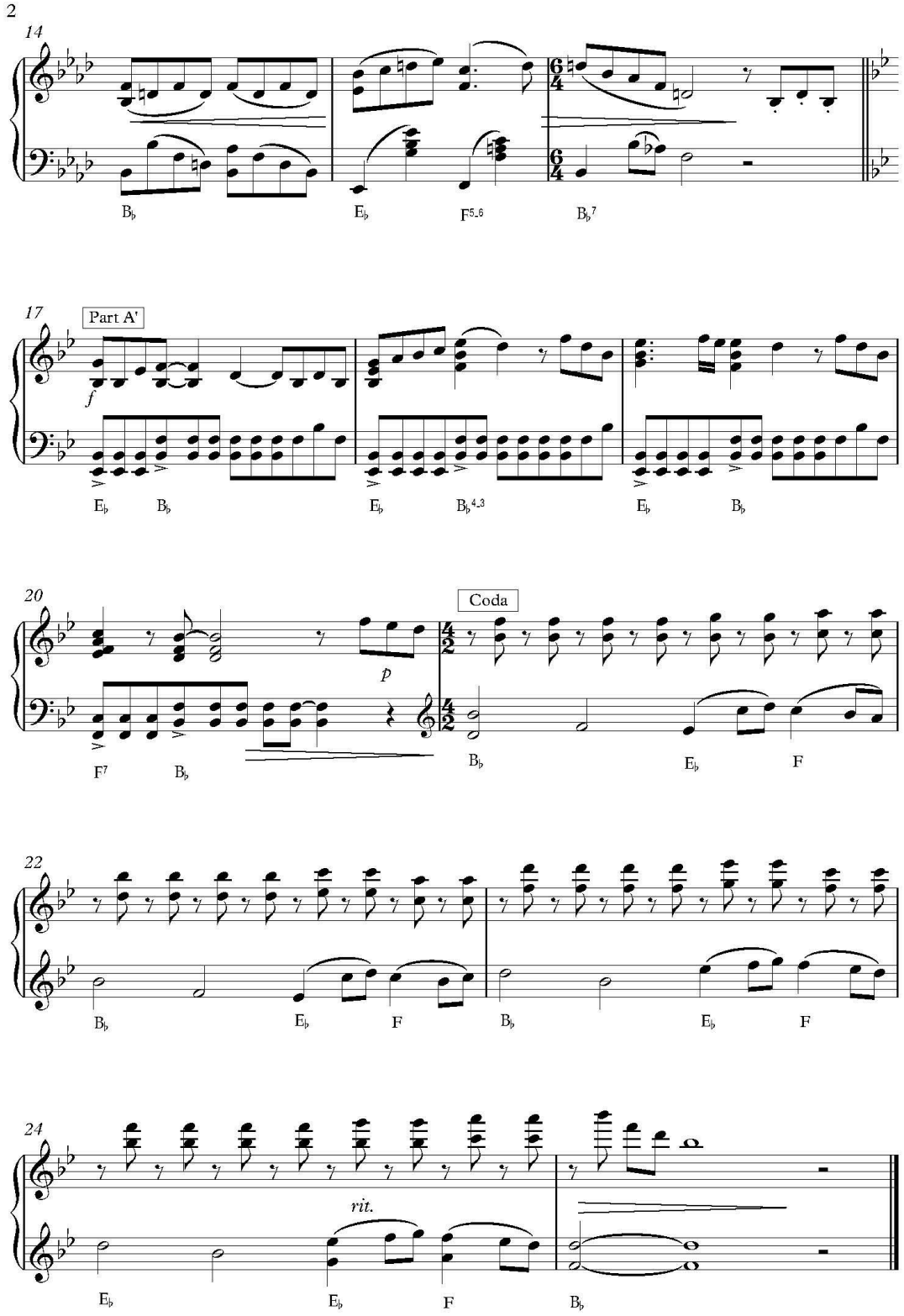
Table A3-1. Musical characteristics of the controlled music stimuli

	Idiosyncrasies		
	Positive stimulus	**Mixed emotional stimulus**	**Negative stimulus**
	 Duration: 77 sec	 Duration: 118 sec	 Duration: 106 sec
Tempo & Harmony	• fast tempo • major mode • simple, predictable harmonic progressions • ease of building musical expectations	• slow tempo • major and minor mode • complex, unexpected harmonic progressions • musical expectations often violated	• slow, instable tempo • no tonal center • unpredictable harmonic development • inability to build musical expectations
Ambitus & Melody	• natural ambitus, normal to high pitch • ascending melodic lines • consonant intervals; few outside-key notes	• natural ambitus, normal to high pitch • ascending and descending melodic lines • consonant, complex intervals; some outside-key notes	• extreme ambitus, empty middle voices • descending melodic lines • dissonant in intervals • pain-related rhetoric figures
Rhythm & Dynamics	• accentuated, flowing rhythm • syncopations • constant level of loudness	• flowing rhythm, firm beat • syncopations • gradual crescendos, musical climaxes	• fragmentation through unnaturally long breaks • abrupt changes in loudness; extreme dynamic contrasts, harsh turns
	Similarities/Uniformities		
	• Musical style & instrumentation • Melody & voice distribution • Musical keys		• Formal structure, phrase length & musical meter • Musical function of the parts • Similar duration

Appendix 3.2: Musical Scores of the Controlled Stimuli

Figure A3-1. Musical scores of the controlled stimuli

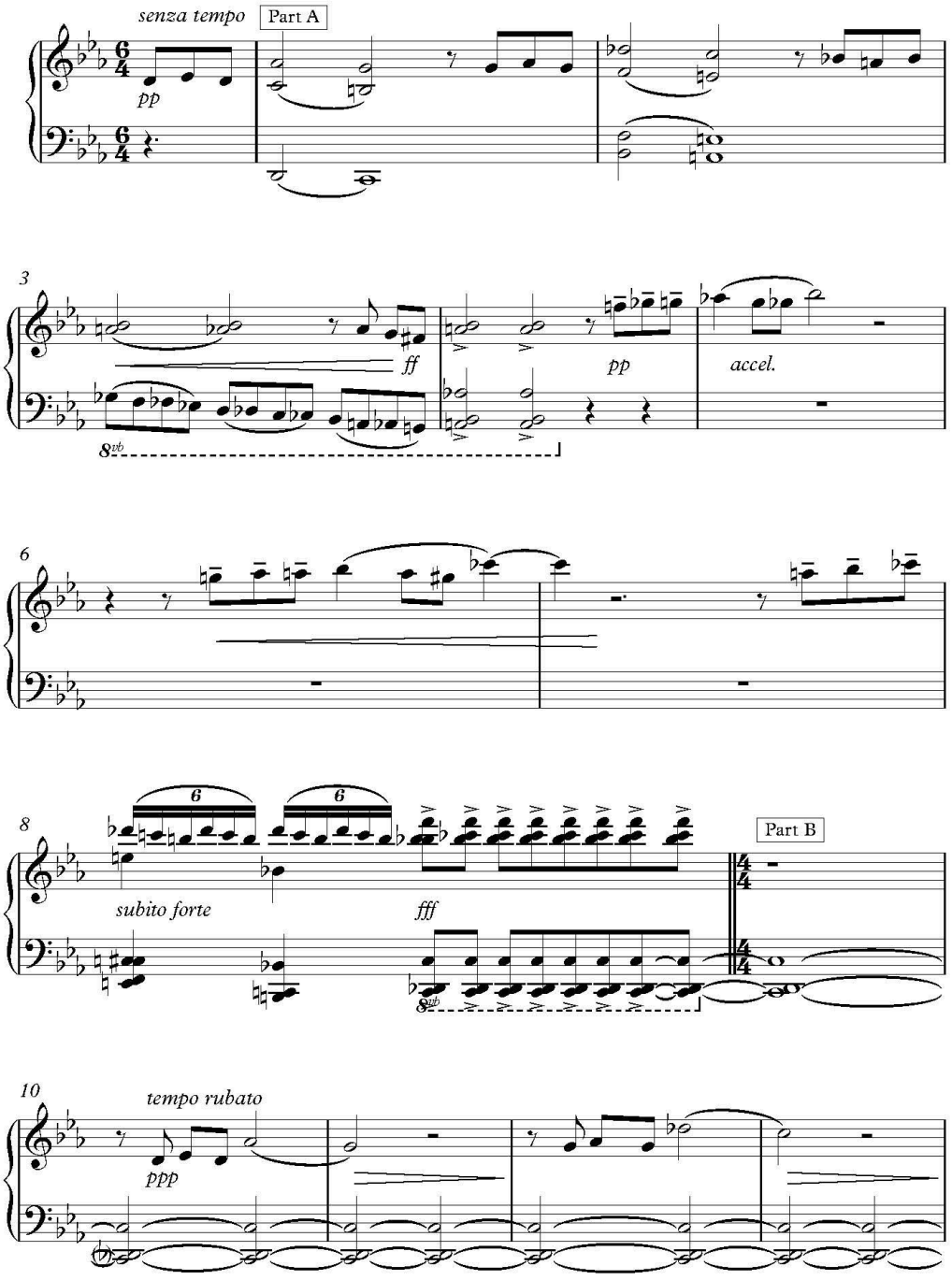


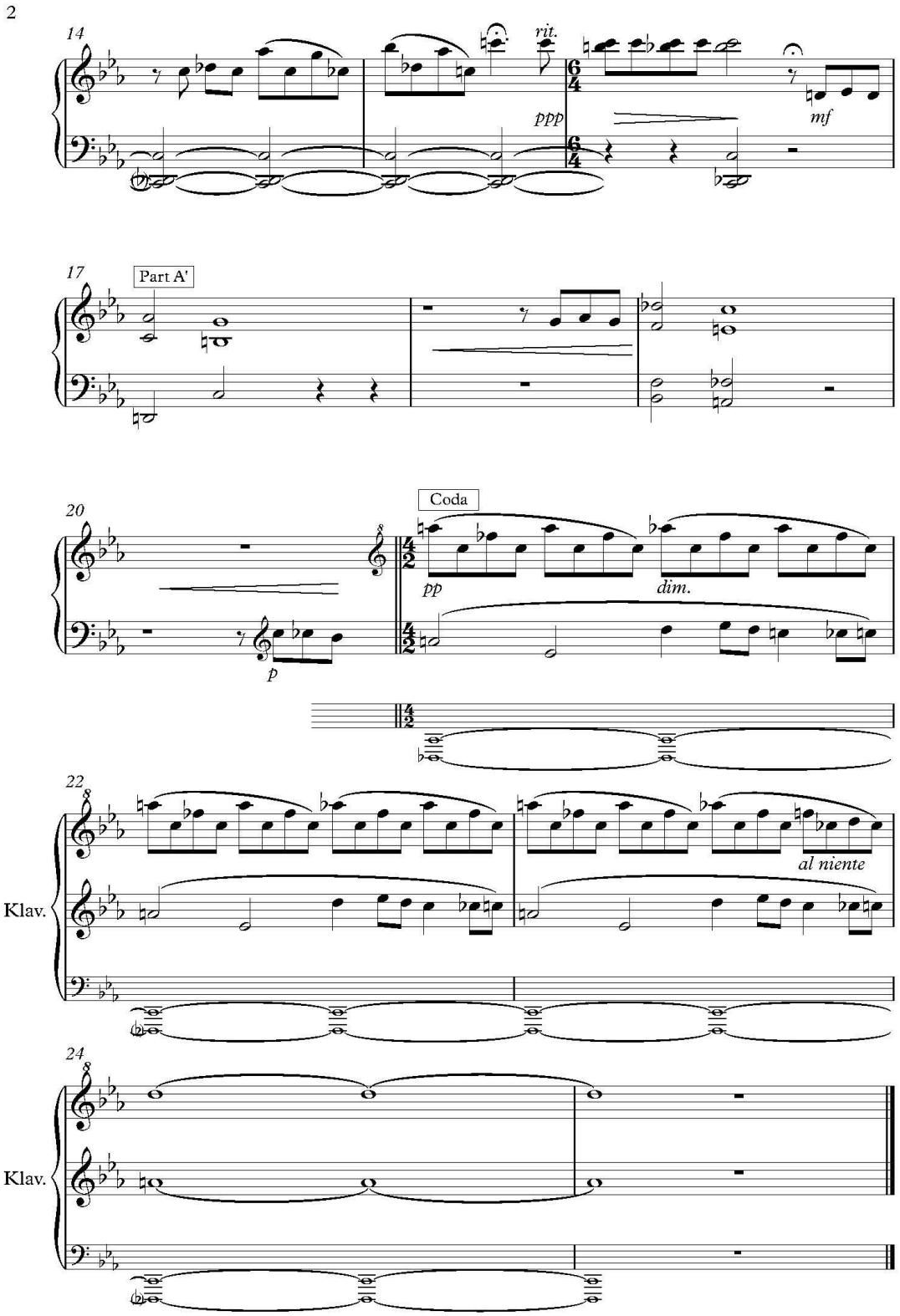

2
14
B♭
E♭
F5.6
B♭7
17
Part A'
f
E♭
B♭
E♭
B♭4.3
E♭
B♭
20
Coda
p
F7
B♭
B♭
E♭
F
22
B♭
E♭
F
B♭
E♭
F
24
rit.
E♭
E♭
F
B♭

Emotional Music Stimuli

Negative Emotion

Jana-Verena Gerhart
Franziska Schäfer

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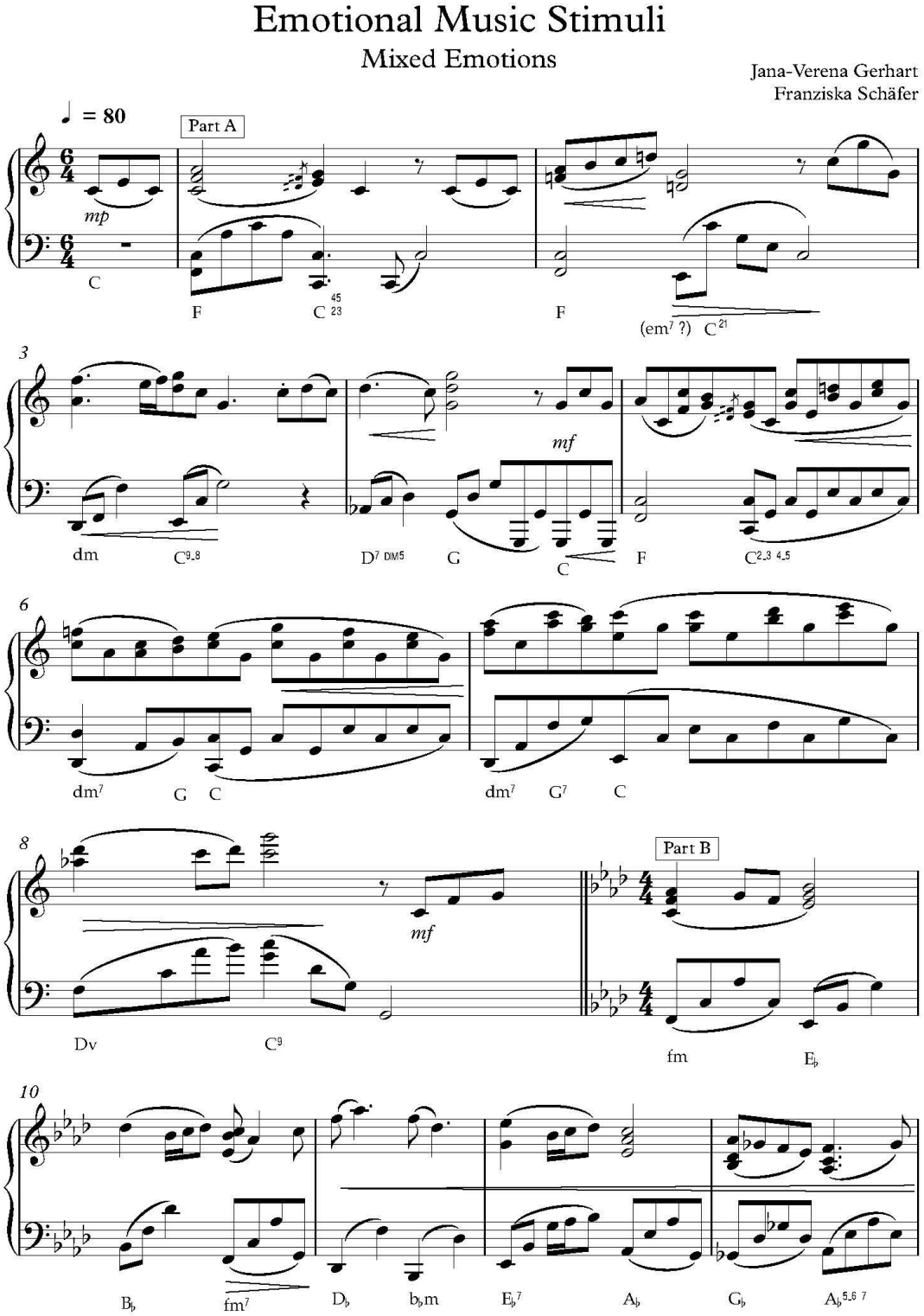
Emotional Music Stimuli
Mixed Emotions
Jana-Verena Gerhart
Franziska Schäfer
♩ = 80
Part A
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(em7 ?)
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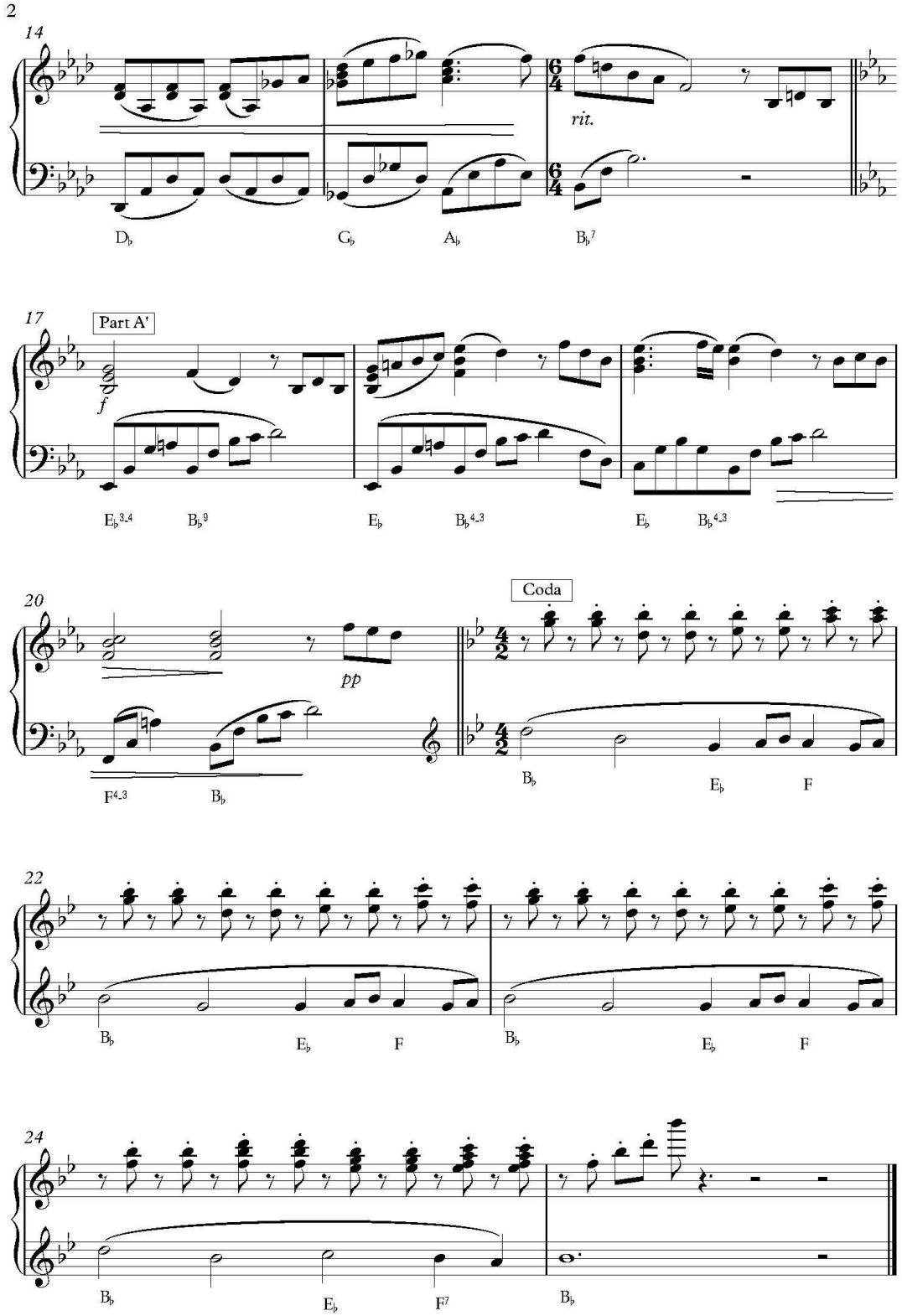
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Appendix 3.3: Measures Taken in All Studies

The list below includes all measures taken during the studies reported in this chapter. A solid circle indicates measures reported in the manuscript. An unfilled circle denotes measures taken but not reported on in the manuscript.

Experiment 1: Emotional impulses evoked by the controlled music stimuli

Audio check & Instructional Manipulation Check

- Who was talking in the audio sample? [a man; a woman; a child]
- What was the content about? [countries, weather forecast; survey instructions; numbers]
- Do not click on the scale items that are labeled from 1 to 7, but leave this question empty. This is an attention check. [1 not at all; 7 very much]

Emotional experience

We are interested in how you experience this piece of music on an emotional basis.
Please indicate your answer on the statements below.
Please note: Positive and negative emotions do not necessarily exclude each other. In some situations, people feel positive and negative emotions at the same time.

- How down does the music make you feel?
- How cheerful does the music make you feel?
- How blue does the music make you feel?
- How sad does the music make you feel?
- How joyful does the music make you feel?
- How happy does the music make you feel?
- How contented does the music make you feel?
- How hopeful does the music make you feel?
- How despairing does the music make you feel?
- How melancholic does the music make you feel?
- How unsatisfied does the music make you feel?
- How satisfied does the music make you feel?

[items anchored: 1 not at all; 4 moderately; 7 extremely]
(adapted from Holbrook et al., 1984; Lau-Gesk & Meyers-Levy, 2009)

Affective judgment

We are interested in how you evaluate this piece of music on an emotional basis.

Please indicate your answer on the statements below.

- How SAD does the music SOUND?
- How HAPPY does the music SOUND?

[items anchored: 1 not at all; 4 moderately; 7 extremely]
(adopted from Hunter et al., 2010, 2011; Zhang et al., 2018)

Familiarity

- **How familiar does this piece of music sound?** [1 not familiar at all; 7 very familiar]
  (adopted from Hunter et al., 2011)

Arousal

How arousing does this piece of music sound?

- [-3 very passive; 3 very active]
- [-3 very low energy; 3 very high energy]
- [-3 very mellow; 3 very fired up]

(adopted from Berger & Milkman, 2012)

Demographics

- Please indicate your age in years. [open measure]
- Please indicate your gender. [female; male; diverse]
  - Please indicate your highest institutional education. [no educational qualification General Certificate of Secondary Education; A-Levels (or equivalent); Vocational qualification; Bachelor and/or Master; PhD]

Experiment 2: Comparison with musical reference stimuli

Audio check

- Who was talking in the audio sample? [a man; a woman; a child]
- What was the content about? [countries, weather forecast; survey instructions; numbers]

Emotional experience

We are interested in how you experience this piece of music on an emotional basis.
Please indicate your answer on the statements below.
Please note: Positive and negative emotions do not necessarily exclude each other. In some situations, people feel positive and negative emotions at the same time.

- How down does the music make you feel?
- How cheerful does the music make you feel?
- How blue does the music make you feel?
- How sad does the music make you feel?
- How joyful does the music make you feel?
- How happy does the music make you feel?
- How contented does the music make you feel?
- How hopeful does the music make you feel?
- How despairing does the music make you feel?
- How melancholic does the music make you feel?
- How unsatisfied does the music make you feel?
- How satisfied does the music make you feel?

[items anchored: 1 not at all; 4 moderately; 7 extremely]
(adapted from Holbrook et al., 1984, Lau-Gesk & Meyers-Levy, 2009)

Affective judgment

We are interested in how you evaluate this piece of music on an emotional basis.
Please indicate your answer on the statements below.

- How SAD does the music SOUND?

- How HAPPY does the music SOUND?

[items anchored: 1 not at all; 4 moderately; 7 extremely]
(adopted from Hunter et al., 2010, 2011; Zhang et al., 2018)

Familiarity

- **How familiar does this piece of music sound?** [1 not familiar at all; 7 very familiar]
  (adopted from Hunter et al., 2011)

Arousal

How arousing does this piece of music sound?

- [-3 very passive; 3 very active]
- [-3 very low energy; 3 very high energy]
- [-3 very mellow; 3 very fired up]

(adopted from Berger & Milkman, 2012)

Note: These measures (i.e., emotional experience, affective judgment, familiarity, arousal) are obtained a second time for the second stimulus.

Demographics

- Please indicate your age in years. [open measure]
- Please indicate your gender. [female; male; diverse]
  - Please indicate your highest institutional education. [no educational qualification General Certificate of Secondary Education; A-Levels (or equivalent); Vocational qualification; Bachelor and/or Master; PhD]

Chapter 4
Feeling Mixed, Choosing Mild? Mixed Emotions Increase Preferences for Low-Arousal Products in Online Product-Recommendation Settings

by Jana-Verena Gerhart[40] & Oliver Emrich[41] [42]

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[41] Prof. Dr. Oliver Emrich, Johannes Gutenberg University Mainz, Chair of Management and Social Media, Jakob-Welder-Weg 9, 55128 Mainz, Germany, oemrich@uni-mainz.de

[42] Statement of contribution: The authors jointly developed theoretical positioning, research idea, and experimental designs. Jana-Verena Gerhart identified relevant literature, developed the conceptual model and drafted the manuscript. She set up the empirical studies and was responsible for data collection, preparation and analysis. Oliver Emrich contributed to the theory development, the development of the experimental stimuli as well as the experimental design. He furthermore iteratively reviewed the manuscript providing detailed feedback.

ABSTRACT

Consumer emotions can be regarded as personalization input factors. Three pre-registered experiments using music to induce emotional impulses provide evidence that consumer mixed emotions (compared with positive and negative emotions) evoke preferences for low-arousal products. Notably, this effect is enhanced by contrast framing in the recommendation-set architecture (i.e., the inclusion of a high-arousal product). These insights highlight that considering consumer emotions can improve recommendation effectiveness and that non-target products can be of relevance in recommendation settings. Theoretically, this research contributes to the affect as information theory (Schwarz & Clore, 1983, 2003) and mixed emotions literature (Larsen et al., 2001), showing that mixed emotions give rise to distinct product preferences that deviate from positive and negative emotions.

4.1 Introduction

Suppose it is the time between the years. Something meaningful is coming to an end, but you are full of energy and anticipation for what is about to follow. It is a peculiar state, this tension arising from the interplay of positive and negative emotions. Does it affect which products you would choose in an online recommendation setting?

In online purchase contexts, recommendation systems have been described as the "backbones of the Internet economy" (Ying et al., 2006, p. 355). Often, they are based on personalization (Senecal & Nantel, 2004), using information such as past behavior (Chung et al., 2016) or personality characteristics (Tucker, 2014) as input factors. Whereas these input factors tend to be of a dispositional nature (i.e., they are stable over time), personalization can also be achieved through *contextual* input factors (e.g., not using historical data; Bleier, 2021), one of which is *consumer emotion* (Teeny et al., 2021).

Emotion and its impact on consumer preferences and behavior are subjects of a long-standing body of research (Chen & Pham, 2019; Gardner, 1985; Holbrook & Batra, 1987), documenting, for instance, that consumer decision-making can be shaped by emotional valence: consumers often engage in self-protective actions to regulate *fear* and select pleasant stimuli to prolong *happiness* (Kranzbühler et al., 2020). These incidents can be rooted in affect as information theory (Schwarz & Clore, 1983, 2003), in that emotions often influence judgment as sources of information.

Research that explicitly addresses consumer emotion as a personalization input factor is scarce, and furthermore has not considered the occurrence of *mixed emotions* (i.e., the simultaneous or sequential experience of emotions of both positive and negative valence; Larsen and Green 2013; Rothman and Melwani 2017). In fact, individuals experience mixed emotions 33% of the time (Trampe et al., 2015). Mixed emotions are evoked by encounters that stand out from the status quo (e.g., meaningful endings, Ersner-Hershfield et al., 2008; Septianto, 2021) and are used in brand communication (Hong & Lee, 2010; Williams & Aaker, 2002). However, mixed emotions have another side: they can cause arousing, unpleasant, or disharmonious states (Larsen & McGraw, 2011; Schimmack, 2005) and induce a state of tension (Carrera & Oceja, 2007). Such tension appears to translate into

distinct preference patterns; for instance, mixed emotions entice consumers to approach risky products with immediate hedonic rewards (Hamby & Russell, 2022).

The current research adds two perspectives to this notion. First, it investigates mixed emotions in the context of personalization. Second, it focuses on a more generalized dimension of product attributes: preference for low-arousal products. In detail, we suggest that mixed emotional impulses instill preferences for low-arousal products in the form of compensatory responses aimed at releasing experienced tension. However, products embody multiple attributes competing for a consumer's attention; thus, a product's low-arousal quality might be overshadowed by other attributes. We therefore argue the proposed effect is particularly pronounced if products' arousal qualities are made salient to consumers. For instance, this salience might be achieved by contrast framing in the recommendation-set architecture (i.e., contrasting the low-arousal product with a high-arousal product of the same kind).

By investigating *how and why mixed emotional impulses affect consumer preferences*, we contribute to the literature on mixed emotions and contextual personalization input factors. We furthermore contribute to assortment literature investigating, for instance, the role of assortment alignability on consumer perceptions (Som & Lee, 2012). To this body, we add insights into the element of contrast framing within the recommendation-set architecture.

4.2 Theoretical Background

4.2.1 Product Recommendations and Personalization Input Factors

Recommendation systems are important sources of information in online shopping environments (Senecal & Nantel, 2004). They function as selection systems "designed to facilitate purchase decisions by helping customers easily identify products that match their tastes and needs" (Köcher et al., 2019, p. 24). As such, efficient recommendation systems reduce consumers' search costs or uncertainty by mitigating complex structures and presenting relevant products to consumers (Häubl & Trifts, 2000; Pathak et al., 2010; Xiao & Benbasat, 2007).

When *personalizing* recommendation systems, retailers most commonly use past behavior (such as a consumer's previous browsing behavior) as a personalization input factor. Similar

to attitudinal characteristics or motivational variables, past behavior can be regarded as a *dispositional* personalization input factor (Teeny et al., 2021). Apart from dispositional personalization input factors, personalization can be achieved by *contextual* characteristics, such as consumers' temporary mindsets or emotions (Bleier, 2021). Table 4-1 provides an overview of research addressing these different forms of personalization input factors.

4.2.2 Consumer (Mixed) Emotions as Contextual Personalization Input Factor

We build our theorizing on affect as information theory (Greifeneder et al., 2011; Schwarz & Clore, 1983, 2003). This theory posits that emotions influence judgment as sources of information, which might pertain to both consciously and unconsciously experienced emotions. In the context of *emotional enforcement*, products or information that match a consumer's current emotional state tend to be evaluated more favorably (e.g., emotion-congruency effect; Kim et al., 2010) and weighted more heavily (e.g., affect confirmation; Adaval, 2001). Moreover, the informative value of an emotional claim increases if this claim corresponds to the activated goals of consumers (Bosmans & Baumgartner, 2005). From another perspective, consumer judgment can be influenced by mechanisms of *emotion regulation* and *mood management* (Andrade & Cohen, 2007; Singer & Salovey, 1988; Zillmann, 1988). In particular, negative emotions, such as feelings of discomfort, can spark counterbalancing behavioral responses aimed at regulating emotions (for a review, see Gross, 1998). Such emotion-regulation strategies also emerge in consumption contexts. For instance, participants in an emotional state of anxiety showed increased preferences for products with features of lower uncertainty (Lowe et al., 2019).

Whereas most existing research investigates consumer judgment with respect to positive and/or negative emotions, these emotional valence states are not mutually exclusive but can co-occur in the form of *mixed emotions* (Larsen & McGraw, 2011; Russell & Carroll, 1999). Mixed emotions are associated with eudaimonic well-being (Berrios et al., 2018a), evoked by meaningful endings (Ersner-Hershfield et al., 2008; Larsen et al., 2021; Zhang et al., 2010), and are found to increase associative thinking (Fong, 2006; Hostler & Berrios, 2021; Rees et al., 2013). However, mixed emotions are also associated with the experience of role conflict (Fong & Tiedens, 2002) and the activation of conflicting goals (Berrios et al., 2015b, 2018b) and accompany encounters of outcomes that could have been better (Larsen

et al., 2004; Norris & Larsen, 2020). From a psychological perspective, the co-existence of positive and negative emotions deprives individuals of clear behavioral guidance (Cacioppo et al., 1997, 1999; Priester & Petty, 1996). Thus, mixed emotions are often perceived as unpleasant or disharmonious (Diener & Iran-Nejad, 1986; Larsen & McGraw, 2011; Samson et al., 2016; Schimmack, 2005; Watson & Stanton, 2017). They have been found to induce states of tension (Carrera & Oceja, 2007) and to evoke increased levels of discomfort in consumption contexts (Bee & Madrigal, 2013; Williams & Aaker, 2002). Regarding the implications of affect as information theory, the experience of mixed emotions (e.g., in recommendation settings) may translate into distinct product preferences. In detail, consumers might seek products that are suited to counterbalance experienced tension and affective ambiguity, for instance, in the form of low-arousal products.

Table 4-1. Comparison of personalization input factors

				Personalization input factor/ targeted recipient characteristics			
Paper	Object[1]	Findings	Detailed description	DEM	MIND	BEHAV	EMO
Lambrecht and Tucker (2013)	ads	In a field and lab experiment in the context of travel/vacation, dynamic retargeted ads were less effective than generic ads of the same brand if consumers were in the early stages of their decision process.	**past behavior**: Participants were shown images of previously viewed products.			X	
Bleier and Eisenbeiss (2015)	ads	Field and lab experiments showed personalization enhanced browsing behavior on retail websites. This effect decreased with consumers' progress in their decision process. The role of ad informativeness and intrusiveness in this context depended on consumers' browsing mode (experiential vs. goal-directed).	**past behavior**: Participants were shown banners with products of the category and/or brand a consumer most recently viewed.			X	
Fong et al. (2019)	recom-menda-tions	Field experiments on an e-book platform showed personalized promotions increased sales of similar products but discouraged exploration of dissimilar products.	**past behavior:** Participants were presented book promotions of the same genre, in which over two-thirds of previous purchases were made.			X	
Ansari (2003)	Emails	The article introduces a model for content personalization in permission-based e-mail marketing and showed this model can increase click-through behavior.	**past behavior**: Participants were presented e-mails that were optimized in design and content on the basis of clickstream data.			X	
Wattal et al. (2012)	Emails	Field data of a large online retailer showed product-based personalization in e-mails increased consumer response, whereas detrimental effects were found for personally identifiable information (i.e., name).	**name**: E-mails contained a personalized greeting; **past behavior**: Consumers were grouped into preference pools according to the offers they viewed in the past.	X		X	
Sahni et al. (2018)	Emails	Field experiments showed personalizing e-mails with a consumer's name benefitted advertisers (e.g., higher opening rates, sales leads).	**name**: A consumer's name was added into the subject line.	X			
Hess et al. (2020)	ads	Personalized public advertising led to negative outcomes for threatening self-congruent ads, but to positive outcomes for bolstering self-congruent ads.	**appearance**: In-store ads were personalized based on consumers' age, gender, and body measurements.	X			

Dijkstra (2005)	information	Smokers who received personalized health information, compared with standardized information, showed a higher quitting behavior after 4 months.	Texts included either a participant's name, sex, or perceived negative outcomes of smoking.	X	X		
Tucker (2014)	ads	A field experiment with a nonprofit firm showed perceived control over privacy increased efficiency of personalized ads (i.e., clicking behavior).	**interests/affiliation**: Personalized ads mentioned the college individuals attended, as well as celebrities whom individuals had expressed affinity with.	X	X		
Current paper	recommendations	Three experiments showed mixed emotional impulses increased choice of low-arousal products and that this effect was strengthened by contrast framing in the recommendation set.	**consumer emotion**: Emotional impulses were induced via controlled music stimuli.				X

NOTE. — [1]Object of personalization; DEM = Socio-demographical or biometrical information; MIND = Mindsets or personality traits; BEHAV = Product-related behavior; EMO = Emotion

4.2.3 Contrast Framing in Recommendation Sets

Although product recommendations tend to be designed to cater to consumers' existing needs, they can also *influence* consumers. For instance, consumer perceptions can be affected by numerical attributes of product recommendations (e.g., pricing; Köcher et al., 2019), recommendation framing (e.g., user-based vs. item-based; Gai & Klesse, 2019), or the selection of presented attributes (Häubl & Murray, 2003). Moreover, consumers can be influenced by the *composition* of the recommendation sets themselves (i.e., recommendation-set architecture). That is, the presentation of contrasting product alternatives can alter the way a focal product is mentally represented or anchored (Lynch et al., 1991). Such *contrast framing* can, for instance, be established through extreme-priced products. The inclusion of such contrasting alternatives in a recommendation set can affect how consumers perceive the price of some focal products (Adaval & Wyer, 2011; Krishna et al., 2006; see also Simonson & Tversky, 1992). Moreover, products can be contrasted with each other if they are not aligned by a storyline. When a contrasted alternative is difficult to process, this contrast can positively affect the focal product (Shen et al., 2010). In general, contrasting perceptions can also be elicited by juxtaposing products with low and high levels of an attribute, such as low-arousal and high-arousal products.

Arousal describes the "subjective experience of energy mobilization, which can be conceptualized as an affective dimension ranging from sleepy to frantic excitement" (Di Muro & Murray, 2012, p. 574). From one perspective, it characterizes an individual's affective experience, where, at a certain magnitude, it is accompanied by cognitive depletion (Fedorikhin & Patrick, 2010) and aversion to incongruity (Noseworthy et al., 2014). From another perspective, *products* can be ascribed an arousal quality of a certain magnitude (also referred to as "product promoting either activity (e.g., exercise) or passivity (e.g., relaxation)"; Rucker & Petty, 2004, p. 3). Existing research documents that consumers' desired levels of arousal influence perception and decision-making (Wirtz et al., 2000). For example, consumers in a pleasant mood more strongly chose products that corresponded to their own arousal level, whereas the opposite was found for consumers in an unpleasant mood (Di Muro & Murray, 2012). In a similar vein, consumers engaged in positive or negative word of mouth to increase states of energetic arousal or eliminate states of tense arousal (Teeny et al., 2020). Moreover, consumers evaluated products or environments

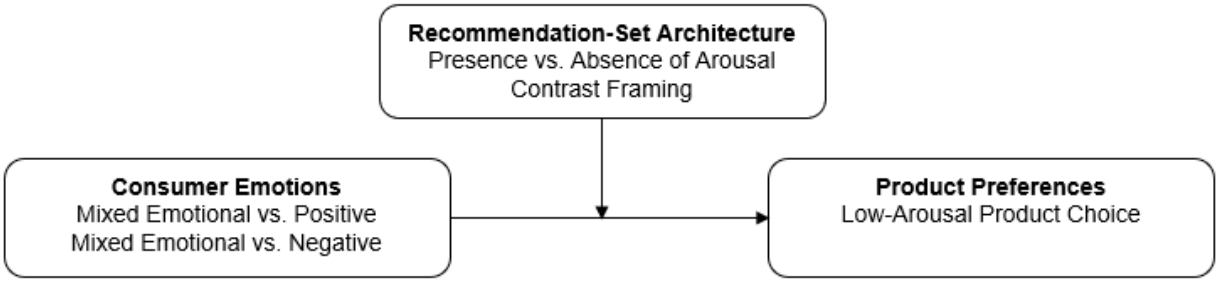
more positively if they matched their internal arousal level in a pleasant context (Das et al., 2018; Mattila & Wirtz, 2001; Yan et al., 2016); however, when the arousal quality of a product decreased pleasantness (e.g., because it did not match a consumer's at motivational orientation), consumer behavior was negatively affected (Kaltcheva & Weitz, 2006).

Combining these insights with the notion of *contrast framing*, we propose that arousal contrasts within the recommendation set can affect consumer preferences. As products embody multiple attributes competing for a consumer's attention, the juxtaposition of a low-arousal product with a high-arousal alternative can draw this attention toward the attribute of interest: the products' arousal level. On a more general level, this effect has been observed in terms of brightness, where contrasts between product and environment brightness let products visually stand out (Reynolds-McIlnay et al., 2017). Building on this notion, we propose that contrast framing can be a beneficial means to make products' arousal qualities more salient. This high salience might better enable consumers to identify the arousal quality of a product for regulating their emotional states. Thus, this notion implies *homogeneous* recommendation choice sets, which are often the object of consumer research on product alternatives (e.g., Dhar, 1997; Parker & Lehmann, 2011), might not always be optimal. In addressing consumer (mixed) emotions, heterogeneity in terms of contrasting product options might be beneficial.

4.3 Conceptual Framework

Based on this theoretical background, we investigate the relationship between consumer (mixed) emotions and low-arousal-product preferences. As a potential moderator strengthening the effectiveness of mixed emotions as a contextual personalization input factor, we analyze the presence versus absence of contrast framing in the recommendation-set architecture (see Figure 4-1).

Figure 4-1. Conceptual framework



According to affect as information theory, temporary emotional impulses can influence consumer judgment. In alignment with theories of emotion regulation and mood management, individuals often react to stressful experiences with compensatory responses geared toward easing discomfort (e.g., coping strategies; for a review, see van Harreveld et al., 2009b). Because mixed emotions can be associated with such stressful experiences, for instance, in the form of ambivalence and tension (Carrera & Oceja, 2007), they may evoke compensatory responses. Existing research supports this notion: Hamby and Russell (2022) document that activated ambivalence among individuals who consume risky products (e.g., energy drinks, cognitive enhancers) increases their consumption decisions toward these products. Thus, consumer ambivalence is associated with the compensatory response of seeking hedonically rewarding consumption with immediate consumption outcomes. Whereas risky products are a rather narrow category, the research at hand pursues a more general perspective in investigating low-arousal-product preferences. Because "products may metaphorically be seen as embodying coagulated, potential energy" (Gould, 1991, p. 196), it suggests that consumers perceive a product's arousal level as a means to release experiences of affective ambiguity and tension arising from mixed emotional encounters. We formally hypothesize the following:

H1: Consumers experiencing mixed emotional impulses show an increased preference for low-arousal products, relative to consumers experiencing (a) positive emotional impulses as well as (b) negative emotional impulses.

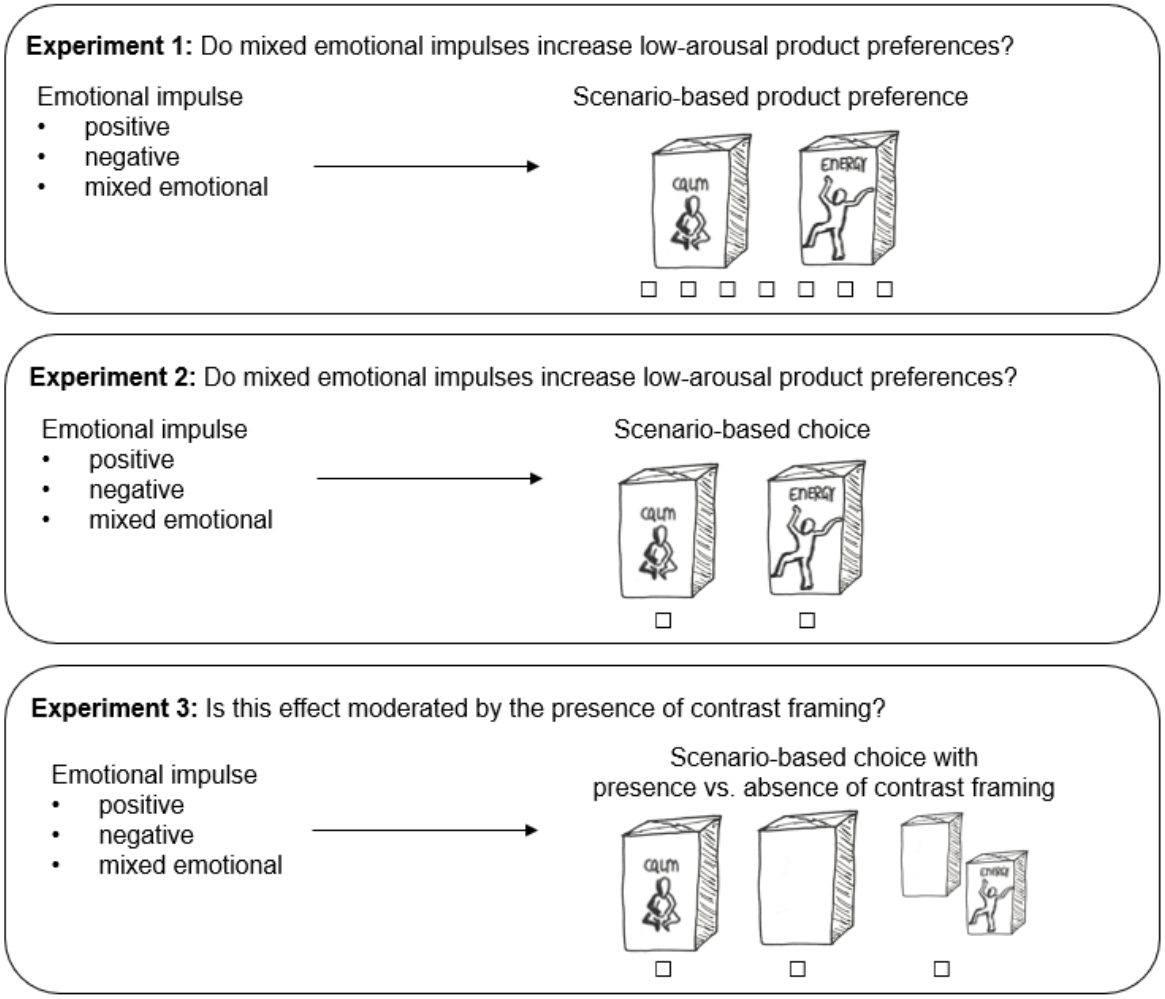
We furthermore propose that this effect is influenced by contrast framing in the recommendation-set architecture. Research shows consumers include choice alternatives in their decision-making (Dellaert & Häubl, 2012). Such alternatives can influence preferences

even if they constitute non-target products. For instance, because consumers strive toward extremeness aversion (Chernev, 2004; Neumann et al., 2016), the inclusion or exclusion of extreme choice alternatives can affect consumer judgment. In the context of price estimations, consumers were influenced by irrelevant numerical information (i.e., anchoring; Lewis et al., 2019). These phenomena can be explained by "people's difficulty in evaluating absolute attribute values and tradeoffs and their tendency to gravitate to available relative evaluations" (Simonson, 2008, p. 155). We argue that such relative evaluations also emerge when consumers are seeking low-arousal products to elevate experienced tension. When the recommendation choice set includes a high-arousal product, consumers have a reference point toward which they can assess the potential of the low-arousal product. In other words, contrast framing makes the low-arousal quality of the focal product more salient. This potential seems especially of value to consumers experiencing mixed emotional impulses. We thus argue the following:

H2: The effect of mixed emotional impulses on the choice of low-arousal products (compared with positive and negative emotional impulses) is higher in the presence of contrast framing than in its absence.

Overview of studies. We test the two hypotheses in three pre-registered experiments in which we induce emotional impulses through controlled music stimuli developed in Chapter 3 stimuli and measure participants' product preferences. We employ different dependent measures of product preferences, ranging from scenario-based preference measures between product pairs (Experiment 1) to product choice (Experiments 2 and 3). An overview of studies is provided in Figure 4-2, while an overview of all obtained measures is provided in Appendix 4.13.

Figure 4-2. Overview of studies



4.4 Experiment 1: Preferences Between Product Pairs

Do mixed emotional impulses increase low-arousal-product preferences (H1)? In Experiment 1, we investigate this hypothesis by assessing product preferences through pairwise comparisons of low- and high-arousal products. Preregistration for this study is available at https://aspredicted.org/PRR_SF9.

4.4.1 Method

Pretest. We identified six product pairs as stimulus material. Each pair pertained to the same category (e.g., tea) and consisted of a low-arousal product and a high-arousal product (Table 4-2 for stimulus material). The products of each pair significantly differed from each other in

arousal, with the mean arousal rating of the low-arousal product being above the scale midpoint, and the mean arousal rating of the high-arousal product being below the scale midpoint (see Appendix 4.1 for documentation).

Procedure. After passing an audio test, participants were randomly assigned to one condition in a one-factorial design (emotional impulse: positive vs. negative vs. mixed). Emotional impulses were induced through the controlled music stimuli developed in Chapter 3. Participants imagined a shopping scenario in which they encountered different products. While listening to the respective music stimulus, participants were presented the six pairs of low- and high-arousal products and, for each pair, chose between the low- and high-arousal products. Adopting the procedure of Nave et al. (2018), participants indicated on a 9-point agreement scale which of the two products they preferred (1 = *strongly left product*, 5 = *indecisive*, 9 = *strongly right product*; for an example of recommendation display, Appendix 4.2). To counterbalance the arrangement of product pairs, each participant was randomly assigned to one of two different sets. In these sets, the first product presented on the left side of the screen was either a high-arousal product (set 1) or a low-arousal product (set 2), with this order of presentation alternating for the subsequent products, respectively. In each set, products were presented in the same order of categories: book, bath supplement, cookbook, workout video, voucher to a swimming pool, and tea. After listening to the music stimulus and completing product choice, participants assessed the music on two dimensions: emotional experience (i.e., how they *experienced* the music on an emotional basis) and affective judgment (i.e., how they *evaluated* the music on an emotional basis). Instructions informed participants that positive and negative emotions did not necessarily exclude each other and that, in some situations, people felt positive and negative emotions at the same time. With respect to emotional experience, we used instructions from previous research (i.e., „The music made me feel… “, Mantel & Kellaris, 2003) and asked participants to rate their emotional experience on six emotional antonym pairs (see Appendix 4.3), an approach adopted from Larsen et al. (2001). All items were evaluated on 7-point unipolar scales (1 =

Table 4-2. Overview of the pre-tested product stimuli

Book	Bath supplement	Coobook	Video workout	Voucher to a swimming pool	Tea	Drink
High arousal						
						
Low arousal						
						
used in studies 1,2,3	used in studies 1,2,3	used in studies 1,2,3	used in studies 1,2,3	used in studies 1,2	used in studies 1,2,3	used in study 3

Random Products								
				n/a		
				n/a		

NOTE. — For copyright reasons, this representation shows drawings of the products instead of the original image material. The stimuli used in the studies showed actual photos. Some German terms are translated into English.

not at all, 7 = *very much*) to account for the occurrence of positive and negative emotions at the same time (Larsen et al., 2001). With respect to affective judgment, we employed two items: "The music sounds happy [sad]" (Hunter et al., 2010, 2011; Zhang et al., 2018). The full questionnaire is documented at https://shorturl.at/ituR4.

Sample. We recruited German-speaking participants (using tablet or desktop devices capable of playing audio) on Prolific. Out of 208 participants who started the survey, one failed the audio check and four did not complete the study. The final sample comprised 203 participants (M_{age} = 30.8, SD_{age} = 11.1; 100 men, 101 women, 2 diverse). Attrition did not differ between emotional conditions or product sets (all p's > .20). All participants met the pre-registered inclusion criterion of spending at least 18 seconds on the page where the music stimuli and product recommendations were presented (minimum view time = 38 seconds).

4.4.2 Results

Emotional impulses. Descriptive statistics are documented in Table 4-3. We aggregated the six items of positive emotional experience into a combined measure of positive emotional experience (Cronbach's alpha = .97). Likewise, we aggregated the six items of negative emotional experience into a combined measure of negative emotional experience (Cronbach's alpha = .93). To obtain a measure of mixed emotions, we calculated the minimum score for each of the six emotional antonym pairs (Schimmack, 2001) and aggregated the resulting scores into a combined measure of mixed emotional experience (Cronbach's alpha = .79).

To investigate emotional impulses between the stimulus conditions, we fit linear regressions using robust standard errors for each of the six dependent measures (i.e., emotional experience/affective judgment for positive/negative/mixed emotional valence). For each dependent measure, we fit a model, regressing this measure on pairs of dummy-coded predictors (i.e., emotional impulse conditions). For *positive* emotional experience, the dummy-coded predictors were the negative and mixed emotional impulse (each coded as 0 = absent, 1 = present); analogously, we proceeded for the other dependent variables.

Table 4-3. Descriptive statistics of dependent measures (Experiments 1-3)

Condition		**Low-arousal product choice**[1]		**Pos emo experience**	**Neg emo experience**	**Mix emo experience**	**Pos affective judgment**	**Neg affective judgment**	**Mix affective judgment**
	n	M (SD)		M (SD)	M (SD)	M (SD)	M (SD)	M (SD)	M (SD)
Experiment 1									
pos	70	5.41 (1.16)		5.29 (1.10)	1.44 (.62)	1.38 (.46)	5.84 (1.02)	1.5 (.86)	1.44 (.69)
neg	67	4.84 (1.13)		2.48 (1.13)	4.13 (1.34)	2.02 (.68)	2.18 (1.27)	4.58 (1.59)	1.88 (.86)
mix	66	5.99 (1.30)		4.82 (1.09)	1.96 (.96)	1.77 (.65)	4.5 (1.32)	3.05 (1.55)	2.5 (1.01)
Experiment 2									
							Arousal		
pos	102	3.10 (1.45)		5.42 (.87)	2.11 (1.01)	2.01 (.86)	4.11 (1.46)		
neg	98	3.40 (1.40)		2.44 (1.07)	4.34 (.98)	2.15 (.81)	4.22 (1.32)		
mix	96	4.00 (1.62)		4.79 (1.05)	2.94 (.98)	2.65 (.77)	2.94 (1.21)		
Experiment 3									
		Contrast framing							
		present	absent				Arousal	Emo. contrast	
pos	318	.96 (.86)	1.14 (.88)	4.73 (1.41)	2.26 (1.19)	2.03 (.99)	4.30 (1.21)	3.64 (1.43)	
neg	315	.96 (.87)	1.12 (.88)	2.17 (1.25)	4.30 (1.40)	1.95 (1.03)	4.26 (1.49)	3.89 (1.57)	
mix	318	1.15 (.84)	1.14 (.89)	4.20 (1.33)	2.94 (1.28)	2.46 (1.02)	3.66 (1.16)	3.98 (1.48)	

NOTE. — [1]Experiment 1: preference for low-arousal product [1;7]; Experiments 2-3: number of low-arousal products selected [Experiment 2: choosing six times between two products; Experiment 3: for each condition, choosing three times between three products]

Table 4-4. Emotional impulses evoked by the controlled music stimuli (Experiments 1-3)

	Positive emotional valence		**Negative emotional valence**		**Mixed emotional valence**		**Arousal**	
DV/ estimate	emotional experience	affective judgment	emotional experience	affective judgment	emotional experience	affective judgment		
				Experiment 1				
pos			-2.69 (.18)***	-3.08 (.22)***	-.39 (.10)***	-1.06 (.15)***		
neg	-2.81 (.19)***	-3.66 (.20)***			**.25 (.12)***	-.62 (.16)***		
mix	-.47 (.19)***	-1.34 (.20)***	-2.17 (.20)***	-1.54 (.27)***				
				Experiment 2				
pos			-2.23 (.14)***		-.64 (.12)***			-.11 (.20)
neg	-2.98 (.14)***				-.50 (.11)***		.11 (.20)	
mix	-.63 (.14)***		-1.40 (.14)***				-1.17 (.19)***	-1.28 (.18)***
				Experiment 3				
pos			-2.04 (.10)***		-.42 (.08)***			.04 (.11)
neg	-2.56 (.11)***				-.50 (.08)***		-.04 (.11)	
mix	-.52 (.11)***		-1.36 (.11)***				-.64 (.09)***	-.60 (.11)***

NOTE. — Columns represent linear regression models. Cells represent unstandardized coefficients (standard error in parentheses) of estimate. *** $p < .001$, ** $p < .01$, * $p < .05$.

This experiment deviated from the stimulus validation conducted in Chapter 3 in that emotional impulse ratings were obtained in this study *after* participants completed listening to the music and indicated product preferences. Whereas the positive and negative controlled music stimuli reliably evoked the intended positive and negative emotional impulses, the mixed emotional stimulus evoked higher mixed emotional experiences only compared with the positive condition but was surpassed in this measure by the negative condition. Thus, the experience of mixed emotional impulses seems to have decreased during participants' choice between the products, supporting the notion that this choice itself might serve as a compensatory response to release experienced tension.[43] This notion is further supported by the finding that even in this delayed measure, the mixed emotional controlled stimulus evoked the highest level of *mixed emotional affective judgment* (see Table 4-4).

Product choice. We transferred participants' product choices (i.e., preference for the right vs. left product) into a measure of low-arousal preference (1 = *strong preference for the high-arousal product*, 9 = *strong preference for the low-arousal product*). With respect to the repeated measurement of product preferences, we conducted two likelihood-ratio tests that compared multilevel mixed-effects linear regression models including versus excluding a random intercept for participants and product sets (Rabe-Hesketh & Skrondal, 2012, p. 89). Because results indicated between-cluster variance with respect to participants ($\chi^2 = 39.94$, df = 1, $p < .001$), but not with respect to product sets ($\chi^2 = 2.37$, df = 1, $p > .10$), we fit subsequent models with a random intercept for participants and robust standard errors. In two models, we regressed product preference on two dummy-coded variables of mixed emotional impulse (0 = *absent*, 1 = *present*) and either positive or negative emotional impulses (0 = absent, 1 = present). Results are documented in Table 4-5. Mixed emotional impulses increased low-arousal-product preferences, both compared with positive emotional impulses ($\beta_{mix} = .58$, SE = .21, $p < .01$) and negative emotional impulses ($\beta_{mix} = 1.15$, SE = .21, $p < .001$) as baseline conditions (see Figure 4-3). In these models, the standard

[43] Moreover, research shows mixed emotions tend to be remembered less intensely than they were actually experienced (Aaker et al., 2008). Plausibly, a potentially remaining level of mixed emotional impulses elicited by the controlled music stimuli dissipated quickly once the music was over. The negative emotional impulses evoked by the negative stimulus versions, in turn, might have persisted longer, leaving this stimulus to be experienced as more mixed emotional in retrospect.

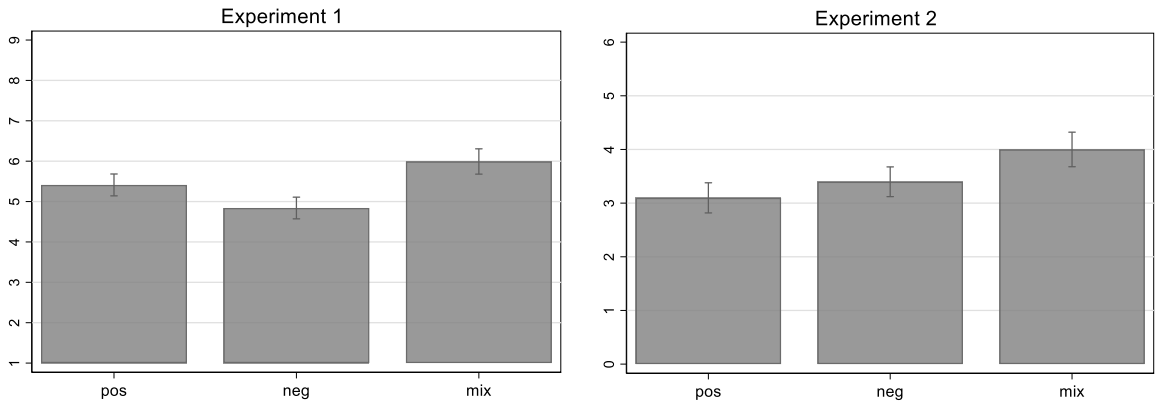
deviation of the random intercept differed significantly from zero (σ = .75, SE = .11, 95% CI = [.56; .99]), indicating distinct individual preferences for high- or low-arousal products in general.[44] Analyses of contrasts comparing the three emotional impulse conditions with the weighted grand mean are provided in Appendix 4.4.

Table 4-5. Regression models (Experiment 1)

Parameter	**Model 1a**	**Model 1b**
pos		.57 (.19)**
neg	- .57 (.19)**	
mix	.58 (.21)**	1.15 (.21)***
cons	5.41 (.14)***	4.84 (.14)***
Wald χ2	30.18	
AIC	5566.44	
BIC	5591.97	

NOTE. — Cells represent unstandardized coefficients of estimate (standard error in parentheses); *** p < .001, ** p < .01, * p < .05

Figure 4-3. Low-arousal choice mixed emotional impulse condition (Experiment 1 and 2)



NOTE. — Left: Linear regression of low-arousal preference on emotional condition; right: Poisson regression of number of selected low-arousal products on emotional condition. Error bars represent the 95% confidence interval.

[44] Pre-registered as an exploratory measure, we obtained a three-item measure of participants' tolerance for ambiguity (Moreau & Engeset, 2016, e.g., "I prefer jobs where the task to be accomplished is clear"). Analyses show (a) results are robust if this measure is included as a covariate and (b) this measure does not moderate the effect of emotional impulse.

4.4.3 Discussion

This experiment supported the hypothesis that consumers experiencing mixed emotional impulses show increased low-arousal-product preferences. We induced positive, negative, and mixed emotional impulses through the controlled music stimuli and measured product preferences using scales with low- and high-arousal pairs as respective endpoints. Because the music stimuli differ in their level of arousal, we cannot rule out that preferences for low-arousal products are driven by arousal congruency effects (i.e., individuals experiencing low arousal prefer low-arousal products). To rule out this possibility, we conducted a study in which we controlled for music-related arousal. Furthermore, we employed a more realistic product-recommendation setting to increase the external validity of the personalization context.

4.5 Experiment 2: Scenario-Based Choice

In Experiment 2, we provide further evidence that mixed emotional impulses increase low-arousal-product preferences (H1) by assessing preferences through scenario-based choice. Furthermore, this study sets out to disentangle the effects of valence and arousal as components of affective states by measuring music-related arousal. Preregistration for this study is available at https://aspredicted.org/TPK_B49.

4.5.1 Method

Procedure. After passing an audio test, as well as an instructional manipulation check (Oppenheimer et al., 2009), participants were informed that the study was about evaluating a piece of music and different products. As in Experiment 1, participants were randomly assigned to experience positive, negative, or mixed emotional impulses, using the controlled music stimuli developed in Chapter 3. We asked participants to close their eyes, immerse themselves in the music, and evaluate the music once they had an impression of it. While the music was playing, participants rated their emotional experience on six emotional antonym pairs (see Appendix 4.3), based on the same procedure as the previous study. Additionally, participants reported music-related arousal by indicating how activated the music made them feel (adapting a measure by Di Muro & Murray, 2012). After evaluating

the music, participants imagined a situation in which they browsed through the website of an online retailer. We then presented an online shop design with six product-recommendation displays, based on the same product pairs as Experiment 1 (for an example of recommendation display, see Appendix 4.5). For each recommendation display, we asked participants to click on the product they found most interesting at that moment based on their feelings. All measures were collected while participants listened to the music.[45] To randomize the order of products within the respective recommendation displays, each participant was randomly assigned to one of two sets: In the first set, the initial display showed the low-arousal product on the right, while the subsequent display showed the low-arousal product on the left (alternating in this manner for the subsequent product categories). In the second set, this order was reversed. In each set, the products were presented in the same order of categories: tea, bath supplement, book, cookbook, workout video, and voucher to a swimming pool. The full questionnaire is documented at https://shorturl.at/ituR4.[46]

Sample. We recruited German-speaking participants (using tablet or desktop devices capable of playing audio and who did not participate in the previous study) on Prolific. Out of 345 participants who started the survey, 13 failed the audio check, 12 failed the instructional manipulation check, and 24 did not complete the study. The final sample comprised 296 participants (M_{age} = 30.4, SD_{age} = 10.5; 156 women, 138 men, 2 diverse). Attrition did not differ between emotional conditions or sets (all p's > .20). All participants met the pre-registered inclusion criterion of spending at least 30 seconds on the page with the music stimuli and product recommendations (minimum view time = 67 seconds).

4.5.2 Results

Emotional impulses. Descriptive statistics are documented in Table 4-3. Aggregated scores of positive (Cronbach's alpha = .95), negative (Cronbach's alpha = .84), and mixed emotional experience (Cronbach's alpha = .74) were obtained and analyzed as in the previous study.

[45] In contrast to Experiment 1, the music stimulus was automatically repeated until participants completed the measures and left the site.

[46] Further pre-registered exploratory measures are not considered in subsequent analyses but are documented there.

Results showed the controlled music stimuli reliably evoked the intended emotional impulses (see Table 4-4). Moreover, the controlled stimuli varied in their level of *music-related arousal*. Regressing the aggregate measure of music-related arousal (Cronbach's α = .69) on the two dummy-coded variables of positive and negative emotional impulse (each coded as 0 = absent, 1 = present) revealed that the mixed emotional stimulus evoked lower music-related arousal than the other two stimuli (β_{pos} = 1.17, SE = .19, $p < .001$; β_{neg} = 1.28, SE = .18, $p < .001$; baseline = mixed emotional impulses), whereas the positive and negative stimuli did not differ in music-related arousal ($\beta_{pos\text{-}neg}$ = -.11, SE = .20, $p > .58$; see Appendix 4.6 for visualization).

Product choice. To investigate the effect of mixed emotional impulses on low-arousal-product choice (H1), we fit two logistic regression models with robust standard errors and a random intercept for participants. We entered two dummy-coded variables of mixed emotional impulse (0 = absent, 1 = present) and either positive or negative emotional impulses (0 = absent, 1 = present) as predictors, and the choice of the low-arousal product (0 = not selected, 1 = selected) as the dependent variable. The standard deviation of the random intercept significantly differed from zero (σ = .75, SE = .09, 95% CI = [.60; .95]), indicating distinct individual tendencies in the choice of low-arousal products in general. Results are documented in Table 4-6 and show that mixed emotional impulses increased low-arousal-product choice, both compared with the positive condition (β_{mix} = .71, SE = .18, $p < .001$) and the negative condition as baselines (β_{mix} = .49, SE = .18, $p < .01$).

In additional analyses, we fit Poisson regressions (i.e., a generalized linear model with a Poisson-distributed dependent variable and a log link function specified) with robust standard errors. We entered two dummy-coded variables of emotional impulse (see above) as predictors and the number of low-arousal products chosen by a participant (ranging from 0 to 6) as the dependent variable. As documented in Table 4-7, participants experiencing mixed emotional impulses chose low-arousal products more often than participants experiencing positive (β_{mix} = .26, SE = .06, $p < .001$) or negative emotional impulses (β_{mix} = .16, SE = .06, $p < .01$; see Figure 4-3). Analyses of contrasts comparing the three emotional impulse conditions with the weighted grand mean are provided in Appendix 4.7.

Table 4-6. Effect of mixed emotional impulses on low-arousal-product choice (Logistic regression models, Experiment 2)

Parameter	**Model 1a** *Main effects*	**Model 1b**	**Model 2a** *Robustness check*	**Model 2b**
pos		-.22 (.15)		-.22 (.15)
neg	.22 (.15)		.22 (.15)	
mix	.71 (.18)***	.49 (.18)**	.76 (.18)***	.54 (.19)**
music-related arousal			.04 (.05)	.04 (.05)
cons	.08 (.11)	.30 (.11)**	-.08 (.23)	.14 (.25)
Wald χ2	16.58		17.66	
AIC	2352.97		2354.40	
BIC	2374.90		2381.81	

NOTE. — Cells represent unstandardized coefficients of estimate (standard error in parentheses); *** p < .001, ** p < .01, * p < .05

Table 4-7. Effect of mixed emotional impulses on low-arousal-product choice (Poisson regression models, Experiment 2)

Parameter	**Model 1a** *Main effects*	**Model 1b**	**Model 2a** *Robustness check*	**Model 2b**
pos		-.09 (.06)		-.09 (.06)
neg	.09 (.06)		.09 (.06)	
mix	.26 (.06)***	.16 (.06)**	.27 (.06)***	.18 (.06**)
music-related arousal			.01 (.02)	.01 (.02)
cons	1.13 (.05)***	1.22 (.04)***	1.07 (.09)***	1.16 (.09***)
Wald χ2	18.01		19.20	
AIC	1108.77		1110.40	
BIC	1119.84		1125.16	

NOTE. — Cells represent unstandardized coefficients of estimate (standard error in parentheses); *** p < .001, ** p < .01, * p < .05

Arousal. To disentangle the affective components of valence and arousal, we exploratively fit the previous Poisson models with music-related arousal as an additional covariate. Music-related arousal showed no significant association with low-arousal choice, thus ruling out that increases in low-arousal choice were solely caused by differences in music-related arousal between the three music stimuli, while the previous findings remained robust (see Table 4-7, Models 2a/b).

4.5.3 Discussion

Relying on a scenario-based choice measure, this experiment provided further evidence that consumers experiencing mixed emotional impulses show increased preferences for low-arousal products. By controlling for music-related arousal, we provide evidence that these effects are driven by the valence component of mixed emotional impulses. So far, our dependent measures have involved consumer preferences *between* pairs of low- and high-arousal products. To broaden this context, we extended the recommendation set architecture by including additional products which allowed us to investigate the presence versus absence of a high-arousal product (i.e., contrast framing) as a potential moderating factor (H2).

4.6 Experiment 3: Moderation Through Contrast Framing

In Experiment 3, we investigate whether the effect of mixed emotional impulses of low-arousal-product choice is moderated by the presence versus absence of contrast framing (i.e., a contrasting high-arousal product of the same category as part of the recommendation set). Moreover, we provide insights into the underlying mechanism of this effect. Preregistration is available at https://aspredicted.org/39W_VGH.

4.6.1 Method

Pretests. For each product category, pretests identified two unrelated random products for the recommendation displays (see Table 4-2 for stimulus material). These random products belonged to different categories than the respective low- and high-arousal focal products and evoked higher arousal than the low-arousal product but lower arousal than the high-arousal product (see Appendix 4.8 for analyses).

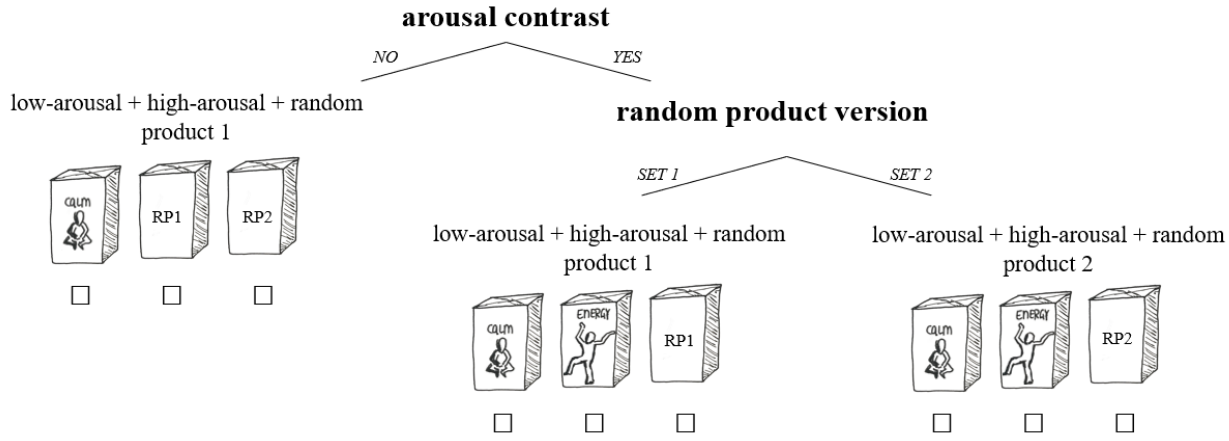
Procedure. Participants were randomly assigned to one of six conditions in a 3 (emotional impulse: positive vs. negative vs. mixed) x 2 (contrast framing: present vs. absent) mixed experimental design. Emotional impulses were manipulated between subjects, whereas contrast framing was manipulated within subjects (repeated six times in a counterbalanced

design). Nested in contrast framing, participants were assigned to one out of two random-product versions, to balance the presentation of random products.

After passing an audio test as well as an instructional manipulation check, participants were informed that the study was about evaluating a piece of music and different products. As in Experiment 2, participants listened to one of the three controlled music stimuli, developed in Chapter 3. We asked participants to immerse themselves in the music and to rate it on emotional experience (using the same 12 items as before) and music-related arousal (using three items by Berger & Milkman, 2012). To capture the ambiguity of the emotional experience (i.e., affective ambiguity), participants indicated how strongly they felt "contrasting emotions," "a mixture of emotions," "a combination of different emotions at the same time," and "different emotions at the same time"; these items were previously used for measuring mixed emotions by Berrios et al. (2015b). Afterward, participants imagined a situation in which they browsed the website of an online retailer. We then presented an online shop design with six product-recommendation displays (for an example of a recommendation display, see Appendix 4.9). Each recommendation display contained one low-arousal focal product among two other alternatives, either including a contrasting high-arousal product of the same category or not including it. The order of categories was tea, bath supplement, book, cookbook, workout video, and drink. The recommendations also included either one or two of the pretested random products. If the high-arousal product was *absent*, the recommendation set featured two random products. If the high-arousal product was *present*, the recommendation set included one random product. Nested in the presence of contrast framing, participants were shown either the first or the second random product in all recommendation displays (i.e., random product version 1 vs. 2; see Figure 4-4 for illustration). Participants clicked six times on the product they found most interesting at that moment based on their feelings while listening to the music. The music was automatically repeated until participants completed the measures and left the site. The full questionnaire is documented at https://shorturl.at/ituR4.[47]

[47] Further pre-registered exploratory measures are not considered in subsequent analyses but are documented in the full questionnaire.

Figure 4-4. Experimental conditions (Experiment 3)



Sample. We recruited German-speaking participants (using tablet or desktop devices capable of playing audio) from an online panel. Out of 1,147 participants who started the survey, 16 failed the audio check, 41 failed the instructional manipulation check, and 139 did not complete the study. The final sample comprised 951 participants (M_{age} = 44.85, SD_{age} = 14.56; 458 women, 489 men, 4 diverse).[48] Attrition did not differ between emotional conditions (all ps > .60). All participants met the pre-registered inclusion criterion of spending at least 30 seconds on the page where the music stimuli and product recommendations were presented (minimum view time = 52 seconds).

4.6.2 Results

Emotional impulses. Descriptive statistics are documented in Table 4-3. Aggregated scores of positive (Cronbach's alpha = .96), negative (Cronbach's alpha = .88), and mixed emotional experience (Cronbach's alpha = .85) were obtained and analyzed via regression models as in the previous studies. Results provided further evidence that the controlled music stimuli reliably evoked the intended emotional impulses (see Table 4-4). Moreover, the controlled stimuli varied in their level of music-related arousal (Cronbach's α = .69). The mixed emotional impulse condition evoked lower music-related arousal than the other two conditions (β_{pos} = .64, SE = .09, p < .001; β_{neg} = .60, SE = .11, p < .001; baseline = mixed impulses), whereas the positive and negative condition did not differ in music-related

[48] Our pre-registered sample size of 900 was exceeded (i.e., 5,6% higher than the target) because we decided not to technically enforce a cut-off.

arousal ($\beta_{pos\text{-}neg}$ = .04, SE = .11, p > .60; see Appendix 4.6). Therefore, we explicitly controlled for arousal in a robustness check.

Product choice. As in the previous study, we fit logistic regression models with robust standard errors and a random intercept for participants, including the choice of the low-arousal product (0 = not selected, 1 = selected) as a dependent variable and two dummy-coded variables of mixed emotional impulse (0 = absent, 1 = present) and either positive or negative emotional impulses (0 = absent, 1 = present) as predictors. Because we found no indication of endogeneity (Hausman test: $\chi^2(1)$ = .00, p > .90), we specified the logistic regression models as random-effects models. The standard deviation of the random intercept significantly differed from zero (σ = .42, SE = .06, 95% CI = [.32; .56]), indicating distinct individual tendencies in the choice of low-arousal products in general. Results are documented in Table 4-8 (Model 1a/b) and show mixed emotional impulses tended to decrease low-arousal-product choice, both compared with the positive (β_{mix} = .15, SE = .08, p = .06) and the negative condition (β_{mix} = .16, SE = .07, p < .05).[49] These effects remained robust if models controlled for contrast framing (0 = absent, 1 = present) and music-related arousal (which showed a positive main effect of $\beta_{arousal}$ = .08, SE = .02, p < .001; see models M2a/b in Table 4-8). The effects remained further robust if models controlled for the random-product version (0 = both random products displayed in the absence of contrast framing, 1 = the first random product displayed in the presence of contrast framing, 2 = the second random product displayed in the presence of contrast framing; see models M3a/b in Table 4-8).

[49] Note the main effect of contrast framing cannot be reasonably interpreted. The products that differ between these two conditions (i.e., a high-arousal product if contrast framing is present vs. another random product if contrast framing is absent) can have different levels of preferability that might bias the choice of the low-arousal product. To avoid misleading implications, we do not discuss the results on the main effects of contrast framing.

Table 4-8. Effect of mixed emotional impulses on low-arousal-product choice (Logistic regression models, Experiment 3)

Parameter	**Model M1a**	**Model M1b**	**Model M2a**	**Model M2b**	**Model M3a**	**Model M3b**
	Main effects		*Main effects incl. covariates*		*Main effects incl. random product version*	
pos		.01 (.08)		.01 (.08)		.01 (.08)
neg	-.01 (.08)		-.01 (.08)		-.01(.08)	
mix	.15† (.08)	.16* (.07)	.20** (.08)	.21** (.08)	.15 (.08)*	.16 (.08)*
music-related arousal			.08***(.02)	.08***(.02)		
contrast framing			-.17** (.06)	-.17**(.06)		
random product 1 (RP1)					-.07 (.07)	-.07 (.07)
random product 2 (RP2)					-.28***(.07)	-.28***(.07)
cons	-.65***(.06)	-.66***(.05)	-.91***(.12)	-.92***(.12)	-.57***(.06)	-.58***(.06)
Wald χ2	5.47		27.05		19.96	
AIC	7437.44		7421.03		7425.75	
BIC	7464.04		7460.93		7465.65	

Parameter	**Model M4a**	**Model M4b**	**Model M5a**	**Model M5b**
	Moderation effects		*Moderation effects incl. covariates*	
pos		.03 (.10)		.03 (.10)
neg	-.03 (.10)		-.03 (.10)	
mix	.01 (.10)	.04 (.10)	.06 (.10)	.08 (.10)
music-related arousal			.08***(.02)	.08***(.02)
contrast framing	-.28** (.10)	-.24* (.11)	-.28** (.10)	-.24* (.11)
contrast framing x pos		-.04 (.14)		-.04 (.14)
contrast framing x neg	.04 (.14)		.04 (.14)	
contrast framing x mix	.29*(.14)	.25†(.14)	.29* (.14)	.25†(.14)
cons	-.51***(.07)	-.54***(.07)	-.86***(.12)	-.89***(.13)
Wald χ2	18.99		31.90	
AIC	7429.02		7419.84	
BIC	7475.56		7473.04	

NOTE. — Cells represent unstandardized coefficients of estimate (standard error in parentheses); RP1 constitutes a dummy-coded variable nested in contrast framing: 0 = joint display of RP1 and RP2, 1 = display of RP1 with high-arousal product; the same logic applies to RP2; *** p < .001, ** p < .01, * p < .05, † p < .10

As in the previous study, we fit additional Poisson regressions with robust standard errors, including the number of low-arousal products chosen by a participant (ranging from 0 to 6) as the dependent variable and two dummy-coded variables of mixed emotional impulse (0 = absent, 1 = present) and either positive or negative emotional impulses (0 = absent, 1 = present) as predictors. As documented in Table 4-9, participants with mixed emotional impulses tended to choose low-arousal products more often than participants with positive (β_{mix} = .09, SE = .05, p = .06) or negative emotional impulses (β_{mix} = .10, SE = .05, p < .05). Results remained robust if we included arousal as a covariate.

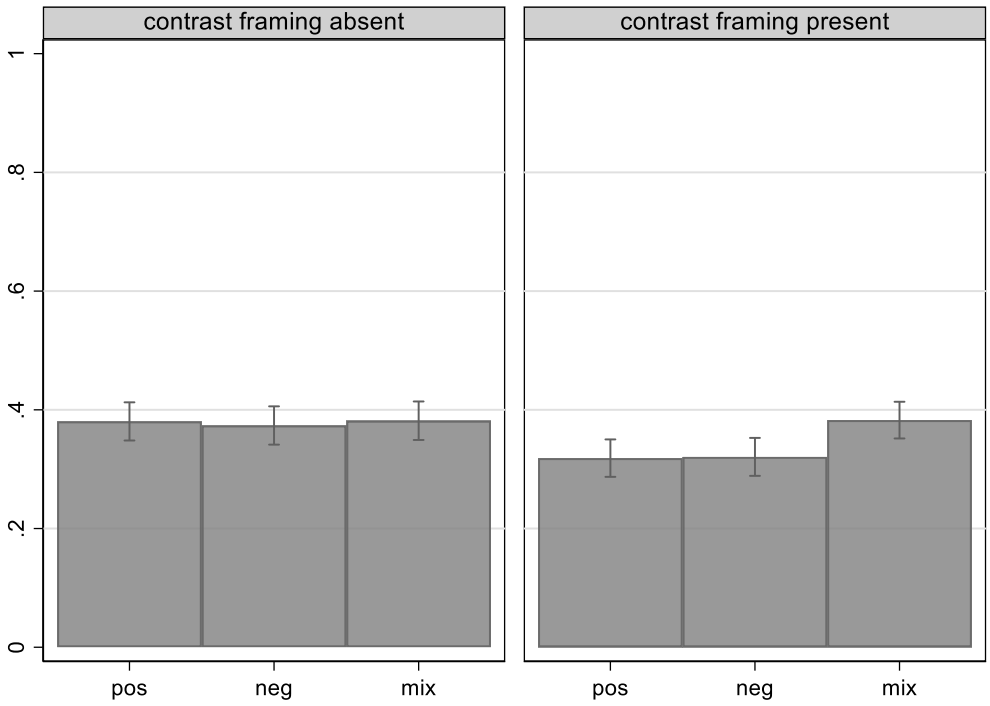
Table 4-9. Effect of mixed emotional impulses on low-arousal-product choice (Poisson regression models, Experiment 3)

Parameter	**Model 1a** *Main effects*	**Model 1b**	**Model 2a** *Robustness check*	**Model 2b**
pos		.01 (.05)		.01 (.05)
neg	-.01 (.05)		-.01 (.05)	
mix	.09 (.05) †	.10 (.05)*	.12 (.05)**	.13 (.05)**
music-related arousal			.05 (.01)***	.05 (.01)***
cons	.74 (.04)***	.73 (.03)***	.52 (.07)***	.52 (.07)***
Wald χ2	5.52		18.18	
AIC	3165.40		3158.94	
BIC	3179.97		3178.37	

NOTE. —Cells represent unstandardized coefficients of estimate (standard error in parentheses); *** p < .001, ** p < .01, * p < .05, † p < .10

Contrast framing. To investigate a potential moderating effect of contrast framing, we fit the previous logistic regression models with the respective two dummy-coded variables of emotional impulse, a dummy-coded variable of contrast framing (0 = absent, 1 = present), as well as the two interaction terms of the emotional impulse variables and contrast framing. As shown in Figure 4-5, contrast framing tended to moderate the effect of mixed emotions on low-arousal-product choice, compared with both positive ($\beta_{mix\_contrast}$ = .29, SE = .14, p < .05) and negative emotional impulses ($\beta_{mix\_contrast}$ = .25, SE = .14, p = .08; see models M4a/b in Table 4-8).

Figure 4-5. Contrast framing as a moderator of the effect of mixed emotional impulses on the probability of low-arousal choice (Experiment 3)



NOTE. — Error bars represent the 95% confidence interval.

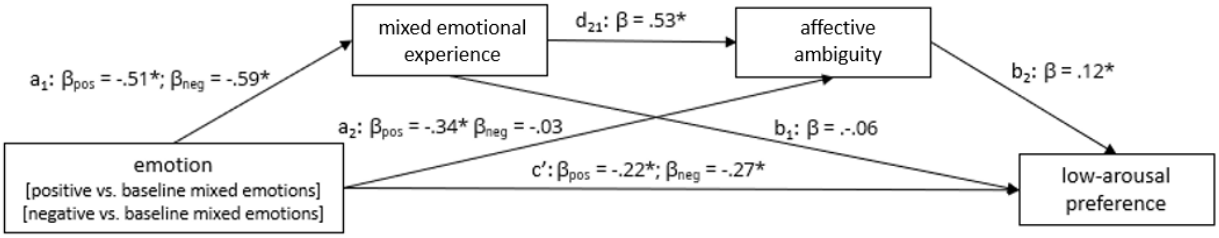
In exploratory analyses, we compared the three emotional impulse conditions with the weighted grand mean across conditions. In the *absence* of contrast framing, the emotional conditions did not differ from the weighted grand mean (M_{pos} = .38, M_{neg} = .37, M_{mix} = .38; all ps >.70). In the *presence* of contrast framing, however, the mixed emotional condition was significantly higher than the weighted grand mean (M_{mix} = .38, SE = .01, p < .01), whereas the positive and negative emotional did not differ from it (M_{pos} = .32, M_{neg} = .32, all ps > .09; see Appendix 4.10). Effects remain robust if we control for music-related arousal (see models M5a/b in Table 4-8).

Mediation analysis. To investigate whether low-arousal preferences are driven by experienced tension resulting from mixed emotional encounters, we conducted a serial mediation analysis (PROCESS Model 6; Hayes, 2022), pre-registered on an exploratory basis. We analyzed the emotional impulse condition (as a multi-categorial variable with the mixed emotional condition as the baseline) as a predictor, the experience of mixed emotional impulses and affective ambiguity (Cronbach's α = .91) as the first and second mediators

(sequentially entered), music-related arousal as a covariate, and the number of chosen low-arousal products as a dependent measure (see Figure 4-6 for a conceptual model).

We evaluated the indirect effects of the emotional impulse conditions on low-arousal-product choice through the two mediators in serial (emotional impulse → mixed emotional experience → affective ambiguity → low-arousal-product preference). A series of bootstrapping tests with 5,000 resamples indicated these indirect effects were significant, with the 95% bias-corrected bootstrap confidence intervals not including zero (positive emotional impulses: β = -.03 [-.05; -.01]; negative emotional impulses: β = -.04 [-.06; -.01]). Thus, mixed emotional impulses affected low-arousal-product preferences through individuals' experienced mixed emotional impulses and subsequent experienced affective ambiguity. For positive emotional impulses, the indirect effect through affective ambiguity alone was significant (β = -.04 [-.08; -.01], whereas no other effect indirect effects were significant. The direct effects of positive and negative emotional impulses on low-arousal choice were significant (positive emotional impulses β = -.22 [-.43; -.02]; negative emotional impulses: β = -.27 [-.46; -.07]). Effects on the serial mediation remained robust in a model without music-related arousal as a covariate (see Appendix 4.11 for both mediation models).

Figure 4-6. Serial mediation model (Experiment 3)



NOTE. — * p < .05 (based on bootstrapped confidence intervals)

4.6.3 Discussion

In recommendation displays, each featuring three recommended products, Experiment 3 further substantiated the effect of mixed emotional impulses on low-arousal-product preference. As in the previous study, we included music-related arousal as a covariate to rule out the explanation that low-arousal product choice was solely caused by differences in

arousal between the music stimuli. Whereas in Experiment 2, music-related arousal did not significantly predict low-tension choice, it showed a positive association in the current study. However, given that the mixed emotional music stimulus yielded *lower* music-related arousal ratings than positive and negative stimuli, it is unlikely that music-related arousal confounded the relationship. If the mixed stimulus were to shape product preference through its arousal (as opposed to its valence), it would be presumed to be *higher* in arousal than its reference conditions in order to evoke compensatory responses.

Regarding the underlying process, the effect of mixed emotional impulses on low-arousal product preferences is partially mediated by individuals' mixed emotional experience and subsequent experienced affective ambiguity. These insights provide further evidence that mixed emotional *valence* (and not arousal) accounts for the obtained findings and support our theorizing that mixed emotional impulses evoke compensatory responses, aligned at easing experienced tension.

Because the two mediators did not fully explain the entire relationship, further mechanisms may explain the effect of mixed emotional impulses on low-arousal-product choice. For instance, facets of experienced tension may exist that could not be captured through the subjective assessment of experienced affective ambiguity.

Finally, in support of our second hypothesis, contrast framing moderated the effect of mixed emotional impulses on low-arousal-product preference. This insight reveals that a non-target product in the recommendation-set architecture can affect preferences for a focal product sparked by mixed emotional impulses. From a retailer's perspective, this finding implies *homogeneity within the recommendation-set architecture is not always beneficial*. Although providing highly similar product recommendations that are closely aligned with a consumer's expression of interest may seem intuitive, contrast framing offers the benefit of making a focal product's potential to ease experienced tension more salient.

4.7 General Discussion

4.7.1 Theoretical Contributions

This research yields several theoretical contributions. First, it adds to the affect as information theory (Schwarz & Clore, 1983, 2003). Whereas this theory originally

documented that the *information value of emotions* decreased when the emotions' source was disclosed as irrelevant to a judgment task, further studies transposed this theory into the context of consumer decision-making. For instance, Kim et al. (2010) showed consumers evaluated product appeals more positively if they were congruent with their own emotional states. Moreover, Raghunathan et al. (2006) showed that consumers experiencing anxiety favored products that provided a sense of control, whereas consumers experiencing sadness favored products that provided a sense of comfort. To this body of research, we contribute insights into the information value of *mixed emotions*. We document evidence that the experience of mixed emotional impulses instills compensatory responses in consumers (i.e., low-arousal-product preferences), presumably aimed at releasing states of experienced tension. We furthermore show these responses persist when participants are made aware of their experience states by self-reporting their emotional states. In detail, results document the described preference pattern for low-arousal products both if experienced mixed emotional impulses are measured *before* (Experiments 2 and 3) or *after* the assessment of product preferences (Experiment 1).

Second, this research contributes to consumer research on mixed emotions. As documented in Appendix 4.12, a considerable body of research has investigated this subject and its consumption-related implications, such as consumption decisions (Ramanathan & Williams, 2007) or attitudes toward product appeals (Williams & Aaker, 2002). Moreover, research has investigated mixed emotions as antecedents of distinct preference patterns under the lens of self-made products (Septianto, 2021) or risky products with immediate rewards (Hamby & Russell, 2022). To this body of research, we complement the insight that preference for low-arousal products might be a compensatory response to cope with the tension arising from mixed emotional encounters. By focusing on low-arousal products, we identified and successfully pre-tested stimulus material of high- and low-arousal product pairs in seven different product categories (see Table 4-2).

Third, this research contributes to the personalization literature. Whereas existing research has investigated past behavior (e.g., Lambrecht & Tucker, 2013), mindsets (e.g., Dijkstra, 2005), or socio-demographical information (e.g., Sahni et al., 2018) as personalization input factors, we provide insights on consumer emotions as *contextual personalization input factors* (Bleier, 2021; Teeny et al., 2021). In this context, we document that consumer

emotions can give rise to distinct product preferences. Moreover, contrast framing can affect these preferences by making a certain product attribute stand out from other product attributes. With these insights, we contribute to the literature addressing the role of contrasts in product presentation (e.g., Reynolds-McIlnay et al., 2017).

Finally, this research is the first to induce emotional impulses through the controlled music stimuli developed in Chapter 3. By harnessing the potential of music to enable a subconscious (Lowe et al., 2019) and non-intentional (Hunter et al., 2008) emotion induction, while pairing it with other stimuli (i.e., the product recommendation displays), the controlled music stimuli have been shown to be suitable for use in experimental research.

4.7.2 Practical Implications

Mixed emotions research suggests certain life encounters give rise to the experience of mixed emotions (e.g., changing life stages, Larsen et al., 2001; meaningful endings, Ersner-Hershfield et al., 2008). This research finds distinct preference patterns associated with such mixed emotional encounters, which can be addressed through personalization. Moreover, this research provides a noteworthy implication concerning the design of product-recommendation displays: homogeneous recommendation choice sets (e.g., a search for a calming tea that returns product recommendations for more varieties of calming tea) might not always be optimal. Instead, contrast framing opens up the potential to highlight specific qualities of a product (e.g., its low arousal level), which can be used to cater to consumer emotions.

Apart from the natural occurrence of mixed emotional encounters, the insights of this research are relevant to two other perspectives. On the one hand, mixed emotional impulses can also be evoked through marketing appeals (e.g., Williams & Aaker, 2002). On the other hand, technological advances increase the ease and efficiency of emotion recognition in consumption settings, for instance, through facial recognition (Ko, 2018), audio mining (Wang et al., 2021), mouse cursor motions (Yamauchi & Xiao, 2018) or gait patterns (Janssen et al., 2008). It is possible that future applications might make information about emotional states available for personalization. For these applications, however, a comprehensive, enforceable, and democratically legitimized regulation on the use of such

data would be the first and foremost requirement (e.g., ensuring transparency and consumers' informed consent and ability to withdraw from the application as well as prohibiting inferring emotion in sensitive contexts). Thus, an *understanding* of the mechanisms accounting for the emergence of such emotion-related phenomena is of high importance. This research offers a (preliminary) attempt to gain a further understanding of emotion-based personalization. More research is needed to detect opportunities but even more importantly potential threats of the technology-assisted interaction with consumer emotions.

4.7.3 Limitations and Future Research Directions

Although this research shows that mixed emotions increase low-arousal product choice, future research should explore whether these preferences translate into higher willingness to pay or higher consumption satisfaction with low-arousal products. Moreover, the seven product categories used in our experiments belonged to everyday consumer goods (e.g., drinks, tea, books), raising the question of whether the effects of mixed emotional impulses might be weaker for product categories of higher involvement or identity relevance. Finally, we aimed to explain the underlying process of the effect of mixed emotional impulses on low-arousal-product preference through experienced tension resulting from mixed emotions. We operationalized these constructs through individuals' experienced mixed emotional impulses and subsequently experienced affective ambiguity. Although we find a significant serial mediation effect in support of our theorizing, the two mediators do not fully explain the entire relationship. It is possible that this is due to the difficulty of capturing the concept of affective ambiguity through subjective assessment.

Appendix 4.1: Arousal Product Pretest 1

We recruited German-speaking participants (using tablet or desktop devices) on Prolific. Out of 117 participants who started the survey, 103 completed it (M_{age} = 32.5, SD_{age} = 12.2; 47 female, 53 male, 3 diverse). Participants evaluated 29 products: These products were selected to form 15 pairs, each pair consisting of one low- and one high-arousal product from the same product category (one low-arousal product occurring twice). Products were presented in randomized order. To assess arousal, participants were asked to indicate their perception of each product on a three-item semantic differential scale (ranging from −3 to +3) with the anchors "stimulating-relaxing", "exciting-calming", and "arousing-unarousing", adopted from Di Muro and Murray (2012).

For each product pair, we aggregated the three arousal items into an overall scale of arousal (Cronbach's $\alpha > .69$) and compared ratings of the product pairs in two-tailed t-tests. From these product pairs, we selected six pairs with high differences in their arousal scores, for which the mean of the low-arousal product was above zero, and the mean of the high-arousal product was below zero (see Table A4-1).

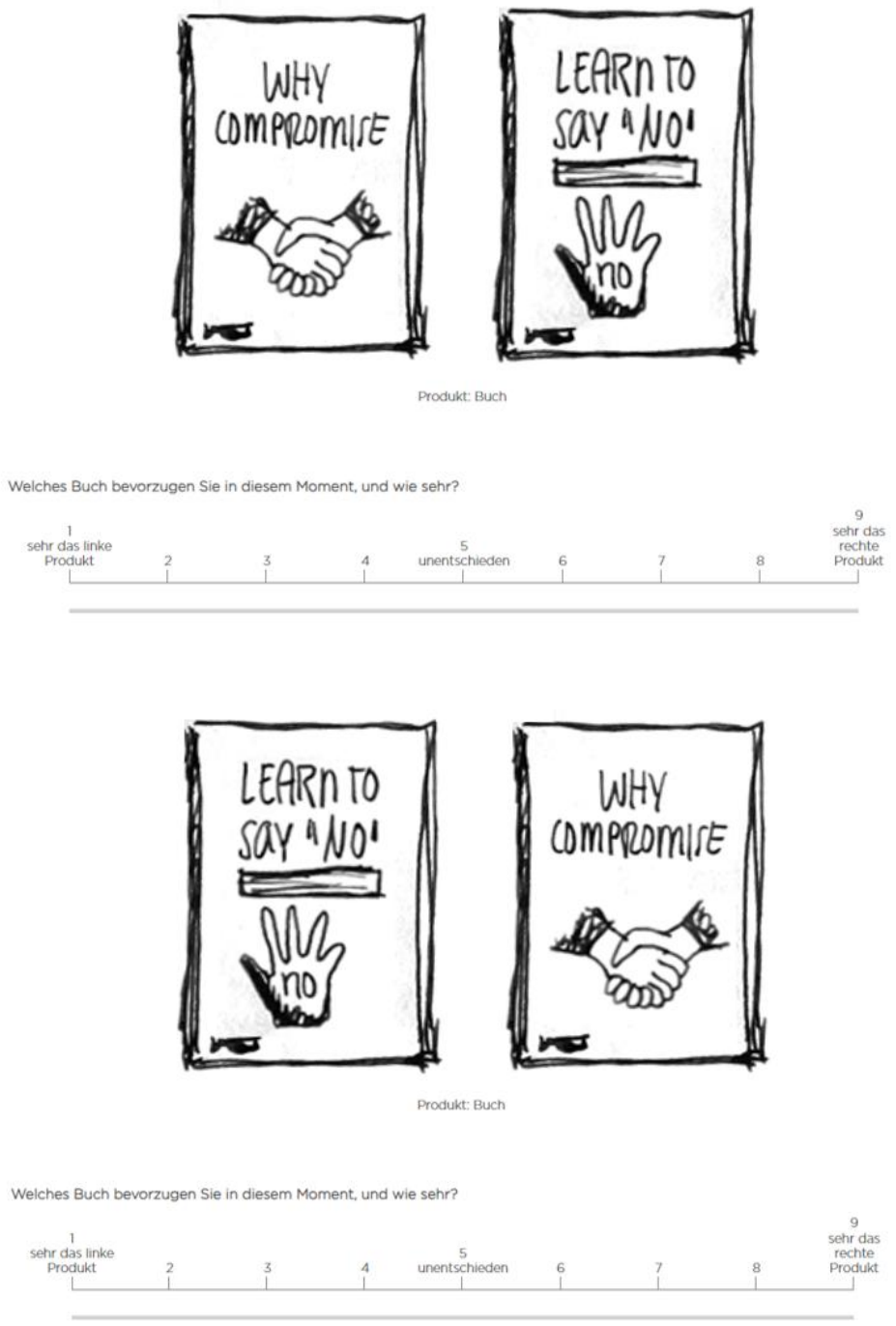
Table A4-1. Comparison of low- versus high-arousal product pairs (Pretest 1)

Low tension product	M (SD)	High tension product	M (SD)	t-statistic
Tea (Herbal guru)	1.5 (1.1)	Tea (Sportsfriend)	-.1 (1.4)	9.9***
Book (Compromises)	.2 (1.1)	Book (Learn to say "no")	-.8 (1.0)	8.3***
Cookbook (Alkaline)	.3 (1.3)	Cookbook (Chili)	-.9 (1.2)	7.7***
Workout video (Yoga)	1.5 (1.1)	Workout video (Power Workout)	-1.3 (1.1)	17.4***
Bath supplement (Relief)	1.5 (1.0)	Bath supplement (Energize)	-.4 (1.5)	13.0***
Voucher swimming (Spa)	1.1 (1.3)	Voucher swimming (Adventure)	-.1 (1.3)	8.6***

NOTE. — Comparisons are based on two-tailed tests; *** $p < .001$.

Appendix 4.2: Recommendation Display (Experiment 1)

Figure A4-1. Recommendation display (Experiment 1)



NOTE. — For copyright reasons, this representation shows drawings of the products instead of the original image material. The stimuli used in the studies showed actual photos. Some German terms are translated into English. German translation of instruction: “Which book do you prefer in this moment, and how much?” (1 = strongly left product; 5 = indecisive; 9 = strongly right product), adopted from Nave et al. (2018).

Appendix 4.3: Overview of Emotional Antonym Pairs

Table A4-2. Overview of emotional antonym pairs

Experiment 1[50]	
Positive valence	**Negative valence**
cheerful [fröhlich]	sad [traurig]
joyful [freudig]	gloomy [düster]
delighted [erfreut]	down [niedergeschlagen]
good [gut]	bad [schlecht]
pleased [angenehm]	displeased [unangenehm]
positive [positiv]	negative [negativ]

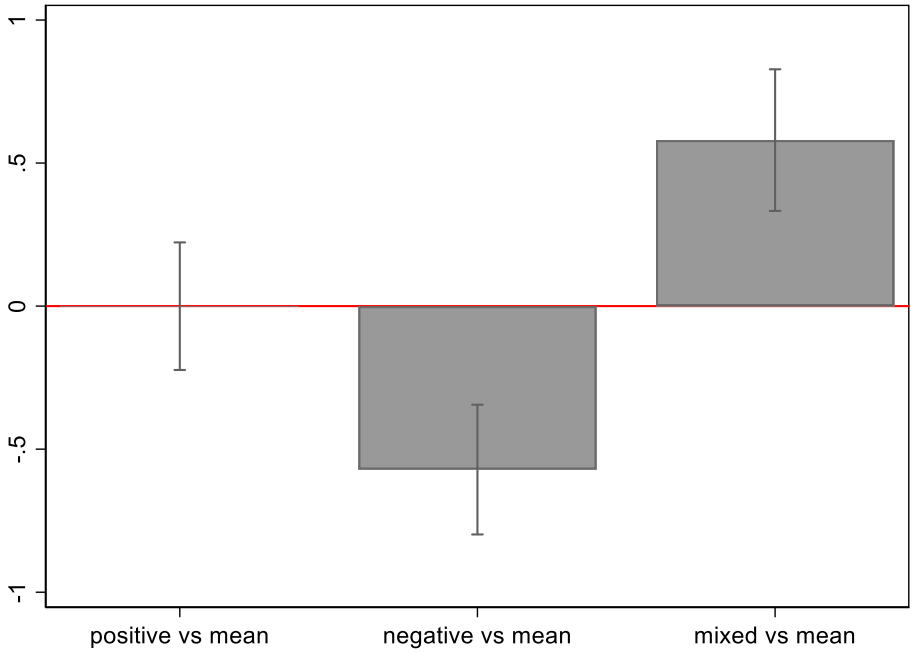
Experiments 2-3	
Positive valence	**Negative valence**
contented [zufriedengestellt]	melancholic [melancholisch]
hopeful [hoffnungsvoll]	despairing [verzweifelt]
satisfied [zufrieden]	unsatisfied [unzufrieden]
happy [glücklich]	sad [traurig]
cheerful [heiter]	blue [schwermütig]
joyful [freudig]	down [niedergeschlagen]

[50] own developed measurement items

Appendix 4.4: Comparison to Weighted Grand Mean (Experiment 1)

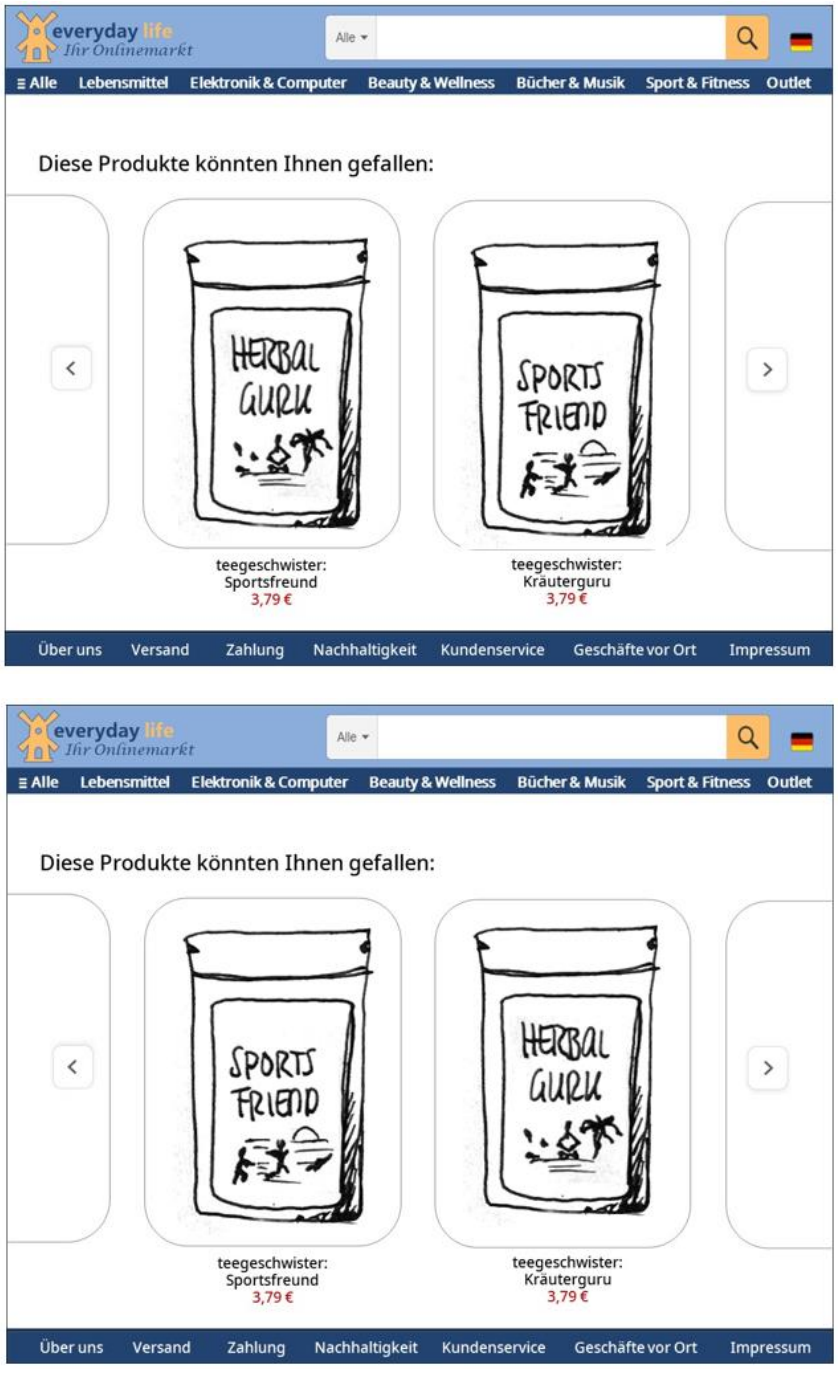
We compared the three emotional impulse conditions to the weighted grand mean across conditions: While participants exposed to positive emotional impulses did not differ from the weighted grand mean in their product preferences (M_{pos} = -.00, SE = .11, p > .90), participants exposed to negative emotional impulses evinced a significantly higher preference for high-arousal products (M_{neg} = -.57, SE = .12, p < .001), while participants exposed to mixed-emotional impulses evinced a significantly higher preference for low-arousal products (M_{mix} = .58, SE = .13, p < .001; see Figure A4-2).

Figure A4-2. Comparisons to weighted grand mean of low-arousal product preference (Experiment 1)



Appendix 4.5: Recommendation Display (Experiment 2)

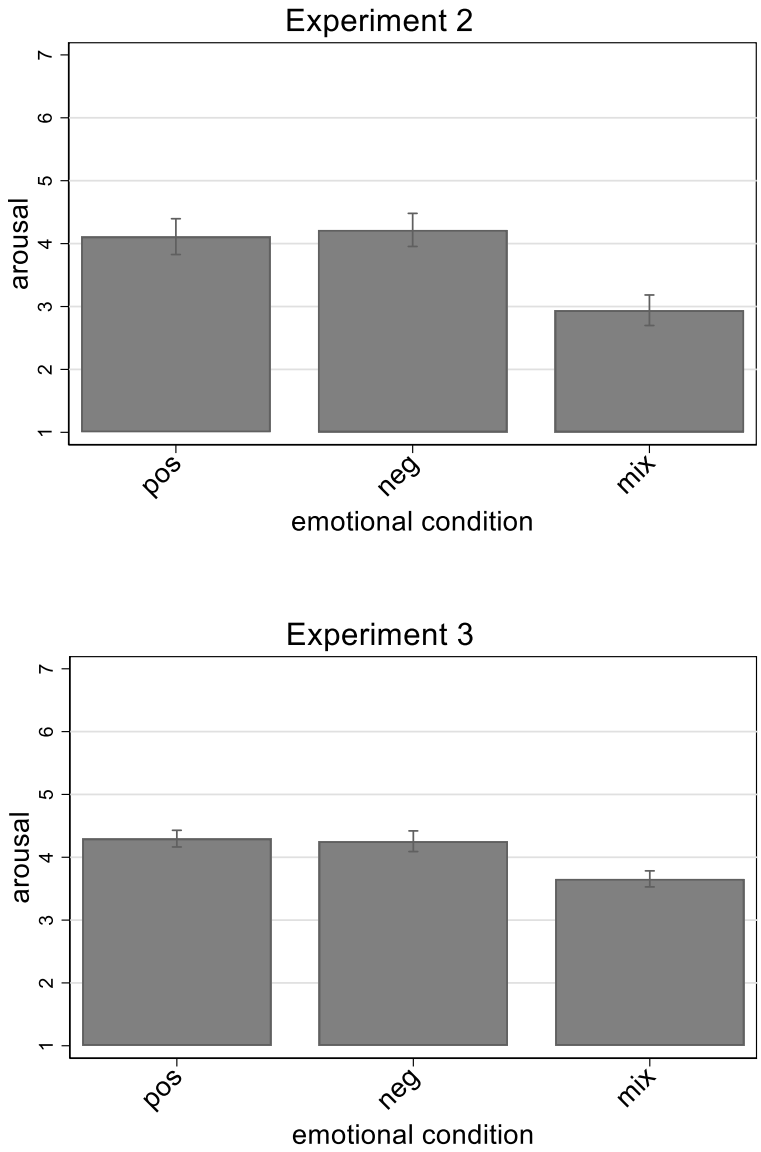
Figure A4-3. Recommendation display (Experiment 2)



NOTE. — For copyright reasons, this representation shows drawings of the products instead of the original image material. The stimuli used in the studies showed actual photos. Some German terms are translated into English. German translation of presentation text: “You might like these products:”

Appendix 4.6: Music-Related Arousal (Experiments 2 & 3)

Figure A4-4. Music-related arousal per emotional impulses (Experiments 2 and 3)

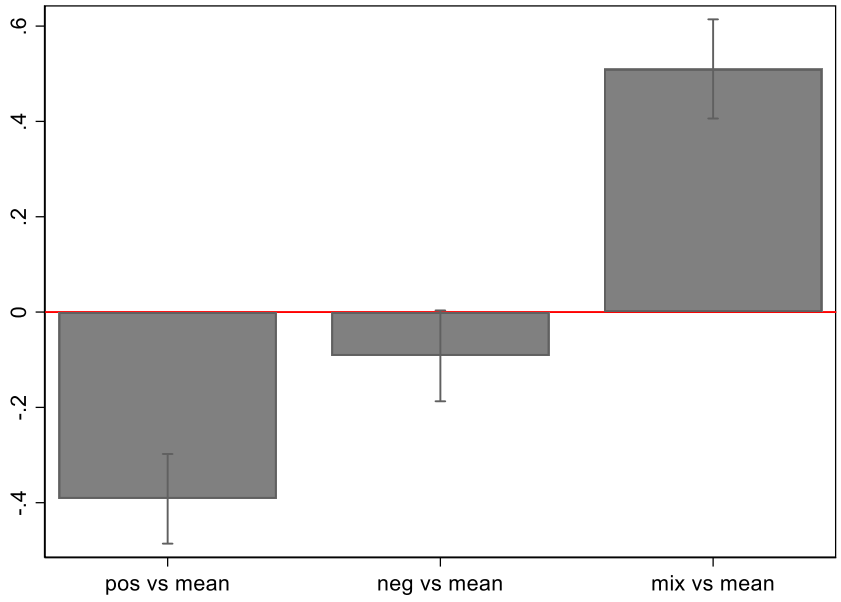


NOTE. — Both models are based on estimates of linear regression models using robust standard errors and regressing two dummy-coded variables of positive and negative emotional impulses (0 = absent, 1 = present; baseline: mixed emotional impulses) on music-related arousal, measured in Experiment 2 as "How activated does the music make you feel? [stimulating-relaxing, exciting-calming, arousing-unarousing" and in Experiment 3 as "How arousing does this piece of music sound? [very passive - very active; very low energy - very high energy; very mellow - very fired up".

Appendix 4.7: Comparison to Weighted Grand Mean (Experiment 2)

We compared the three emotional impulse conditions to the weighted grand mean across conditions: While participants exposed to negative emotional impulses did not differ from the weighted grand mean in their probability of choosing low-arousal products (M_{neg} = -.09, SE = .12, p > .40), participants exposed to positive emotional impulses chose *high-arousal products* significantly more (M_{pos} = -.39, SE = .12, p < .001), while participants exposed to mixed-emotional impulses chose *low-arousal products* significantly more (M_{mix} = .51, SE = .13, p < .001; see Figure A4-5).

Figure A4-5. Comparisons to weighted grand mean of low-arousal product preference (Experiment 2)



Appendix 4.8: Arousal Product Pretests 2-4

The following pretests identify two unrelated, random products for each product category. These random products are intended to have two attributes: First, they should belong to different categories than the respective low- and high-arousal focal products. Second, they should be neither perceived as high- nor as low-arousing (i.e., they should be higher in evoked arousal than the low-arousal focal product, and lower in evoked arousal than the focal high-arousal product).

We conducted three pretests, in which we presented the low- and high-arousal products, as well as a selection of unrelated products to participants. We obtained ratings of arousal in the same as in Pretest 1 (Cronbach's $\alpha > .60$ [Pretest 2], >.73 [Pretest 3], >.70 [Pretest 4]). For five of the six product categories that were used in the previous Experiments 1 and 2 (i.e., tea, bath supplement, book, cookbook, workout video), we successfully identified two random products (i.e., high-arousal product > random product > low-arousal product; see Table A4.1-3 for results). As we did not succeed in identifying two random products that were both significantly higher and respectively lower in evoked arousal than the two focal products of the category "voucher to a swimming pool", we substituted this product category with the product category "drink" that has been used as stimulus material in prior research in a related context (Di Muro & Murray, 2012).

Participants were recruited from Prolific and consisted of participants fluent in German (using tablet or desktop devices), who did not participate in the previous studies of the project.

Sample 1 [Pretest 2]. We recruited 107 participants, out of which 106 completed the study (M_{age} = 33.0, SD_{age} = 11.0; 54 female, 51 male, 1 diverse). Participants evaluated one of two sets, each of which contained 15 products, randomized in order of presentation (i.e., low- and high-arousal products of three of the six product categories, as well as nine potential random products).

Sample 2 [Pretest 3]. We recruited 55 participants, out of which 54 completed the study (M_{age} = 29.5, SD_{age} = 10.0; 29 female, 24 male, 1 diverse). All participants evaluated the same set of 25 products, containing low- and high-arousal products of three categories (i.e., book,

cookbook, voucher to a swimming pool), as well as 19 potential random products, randomized in order of presentation.

Sample 3 [Pretest 4]. We recruited 57 participants, out of which 54 completed the study. Another observation was discarded due to a redundant ID code, leading to a final sample of 53 participants (M_{age} = 29.0, SD_{age} = 9.6; 24 female, 28 male, 1 diverse). All participants evaluated the same set of 12 products, containing low- and high-arousal products of the categories "voucher to a swimming pool" and "drink", as well as eight potential random products, randomized in order of presentation.

Table A4-3. Comparison of low- versus high-arousal product pairs with random products (Pretests 2-4)

					Category 1: Tea		
Product	n	M (SD)	product	n	M (SD)	t-statistic	study, statistical test
LA	59	1.75 (1.03)	HA	59	.66 (1.41)	6.00***	S1, paired t-test
			RP1	47	1.29 (1.02)	2.27*	S1, two-sample t-test
			RP2	59	1.11 (1.19)	4.55***	S1, paired t-test
HA	59	.66 (1.41)	RP1	47	1.29 (1.02)	-2.59*	S1, two-sample t-test
			RP2	59	1.11 (1.19)	-2.19*	S1, paired t-test
RP1	47	1.29 (1.02)	RP2	59	1.11 (1.19)	.08, n.s.	S1, two-sample t-test
					Category 2: Bath Supplement		
Product	n	M (SD)	product	n	M (SD)	t-statistic	study, statistical test
LA	47	1.35 (1.32)	HA	47	-.37 (1.67)	5.94***	S1, paired t-test
			RP1	59	.84 (1.11)	2.17*	S1, two-sample t-test
			RP2	47	.89 (1.41)	2.03*	S1, paired t-test
HA	47	-.37 (1.67)	RP1	59	.84 (1.11)	-4.47***	S1, two-sample t-test
			RP2	47	.89 (1.41)	-4.66***	S1, paired t-test
RP1	59	.84 (1.11)	RP2	47	.89 (1.41)	-.21, n.s.	S1, two-sample t-test
					Category 3: Book		
Product	n	M (SD)	product	n	M (SD)	t-statistic	study, statistical test
LA	54	.57 (1.17)	HA	54	-.60 (1.15)	6.79***	S2, paired t-test
			RP1	54	.15 (1.03)	2.29*	S2, paired t-test
			RP2	54	-.07 (1.40)	2.64*	S2, paired t-test
HA	54	-.60 (1.15)	RP1	54	.15 (1.03)	-4.19***	S2, paired t-test
			RP2	54	-.07 (1.40)	-2.09*	S2, paired t-test
RP1	54	.15 (1.03)	RP2	54	-.07 (1.40)	-1.10, n.s.	S2, paired t-test

Category 4: Cookbook							
Product	n	M (SD)	product	n	mean	t	study, statistical test
LA	54	.62 (1.27)	HA	54	-.39 (1.30)	5.74***	S2, paired t-test
			RP1	54	.06 (1.08)	2.88**	S2, paired t-test
			RP2	54	.15 (1.16)	2.66*	S2, paired t-test
HA	54	-.39 (1.30)	RP1	54	.06 (1.08)	-2.34*	S2, paired t-test
			RP2	54	.15 (1.16)	-2.30*	S2, paired t-test
RP1	54	.06 (1.08)	RP2	54	.15 (1.16)	-.47, n.s.	S2, paired t-test
Category 5: Workout Video							
Product	n	M (SD)	product	n	M (SD)	t-statistic	study, statistical test
LA	47	.99 (1.24)	HA	47	-1.27 (1.11)	9.65***	S1, paired t-test
			RP1	47	.41 (1.40)	2.56*	S1, paired t-test
			RP2	59	.40 (1.32)	-2.33*	S1, two-sample t-test
HA	47	-1.27 (1.11)	RP1	47	.41 (1.40)	-6.41***	S1, paired t-test
			RP2	59	.40 (1.32)	-6.95***	S1, two-sample t-test
RP1	47	.41 (1.40)	RP2	59	.40 (1.32)	.04, n.s.	S1, two-sample t-test
Category 6: Drinks							
Product	n	M (SD)	product	n	M (SD)	t-statistic	study, statistical test
LA	53	.30 (1.33)	HA	53	-1.18 (1.19)	5.68***	S3, paired t-test
			RP1	53	-.34 (1.23)	2.42*	S3, paired t-test
			RP2	53	-.51 (1.14)	3.27**	S3, paired t-test
HA	53	-1.18 (1.19)	RP1	53	-.34 (1.23)	-4.19***	S3, paired t-test
			RP2	53	-.51 (1.14)	-3.15**	S3, paired t-test
RP1	53	-.34 (1.23)	RP2	53	-.51 (1.14)	.87, n.s.	S3, paired t-test

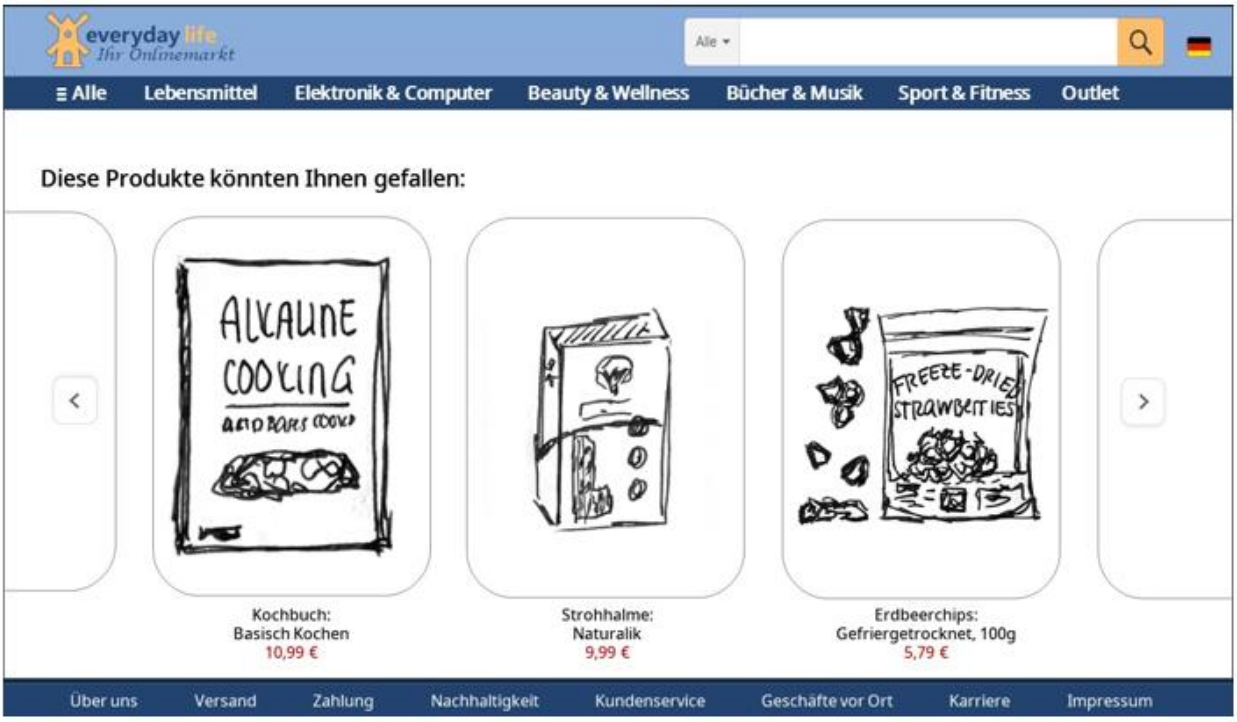
NOTE. — LA = low-arousal; HA = high-arousal; RP1 = random product 1; RP2 = random product 2; S1 = sample; S2 = sample 2; S3 = sample 3; *** $p < .001$, ** $p < .01$, * $p < .05$.

Appendix 4.9: Recommendation Display (Experiment 3)

Figure A4-6. Recommendation display (Experiment 3)

Contrast framing = present, first version of random product

Contrast framing = present, second version of random product

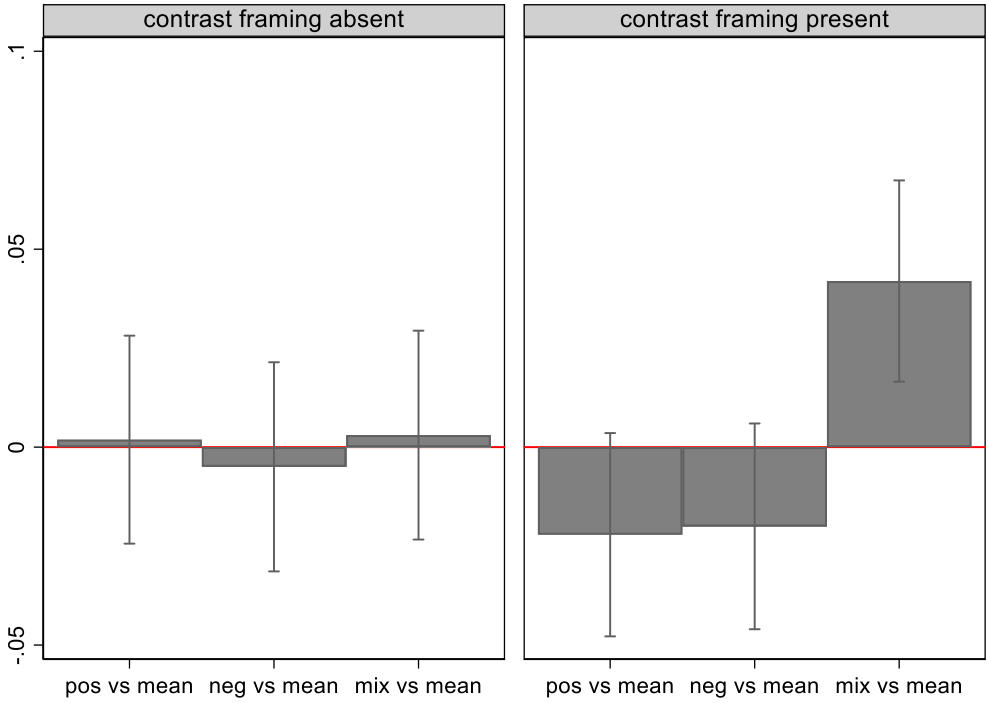


Contrast framing = absent, both versions of the random product included

NOTE. — For copyright reasons, this representation shows drawings of the products instead of the original image material. The stimuli used in the studies showed actual photos. Some German terms are translated into English. German translation of instruction: “You might like these products:”

Appendix 4.10: Comparison to Weighted Grand Mean (Experiment 3)

Figure A4-7. Comparison to weighted grand mean (Experiment 3)



NOTE. — Comparisons to weighted grand mean of low-arousal product choice

Appendix 4.11: Path Coefficients of Mediation Analysis (Experiment 3)

Table A4-5. Path coefficients of mediation analysis, Model 1 (including music-related arousal as covariate)

Independent Variable	Dependent Variable	Mediating Variable	95% CI	coef	SE
Relative Direct Effects					
pos impulses	low-arousal choice		[-.43, -.02]	-.22	.11
neg impulses	low-arousal choice		[-.48, -.06]	-.27	.11
Relative Indirect Effects					
pos impulses	low-arousal choice	ME experience	[-.01, .08]	.03	.02
neg impulses	low-arousal choice	ME experience	[-.02, .09]	.04	.03
pos impulses	low-arousal choice	affective ambiguity	[-.08, -.01]	-.04	.02
neg impulses	low-arousal choice	affective ambiguity	[-.03, .03]	-.00	.01
pos impulses	low-arousal choice	ME experience, affective ambiguity	[-.05 -.01]	-.03	.01
neg impulses	low-arousal choice	ME experience, affective ambiguity	[-.06, -.01]	-.04	.01

Table A4-6. Path coefficients of mediation analysis, Model 2 (not including music-related arousal as covariate)

Independent Variable	Dependent Variable	Mediating Variable	95% CI	coef	SE
Relative Direct Effects					
pos impulses	low-arousal choice		[-.37, .03]	-.17	.10
neg impulses	low-arousal choice		[-.43, -.02]	-.23	.10
Relative Indirect Effects					
pos impulses	low-arousal choice	ME experience	[-.01, .06]	.02	.02
neg impulses	low-arousal choice	ME experience	[-.02, .07]	.03	.02
pos impulses	low-arousal choice	affective ambiguity	[-.04, .02]	-.01	.02
neg impulses	low-arousal choice	affective ambiguity	[-.00, .07]	.03	.02
pos impulses	low-arousal choice	ME experience, affective ambiguity	[-.06, -.02]	-.04	.01
neg impulses	low-arousal choice	ME experience, affective ambiguity	[-.07, -.02]	-.04	.01

Appendix 4.12: Consumer Research on Mixed Emotions

Table A4-7. Consumer research on mixed emotions

Paper	Finding	ME as Predicting Factor	Comparison of Manipulated ME to a Reference Condition	Product Preference as Outcome Variable	Consideration of Product Arousal
Barford et al. (2018)	Individuals high in openness/intellect showed higher mixed emotional appraisals of visual artworks.	No	No	No	No
Bartsch et al. (2010)	Individuals high in need for affect showed higher mixed emotional experiences and more positive meta-emotions of drama or horror movies.	No	No	No	No
Kramer et al. (2009)	Bicultural (i.e., Asian-American) individuals responded more positively towards an ambivalent ad when evincing low levels of cultural conflictedness paired with the presence of a coping frame.	No	No	No	No
Miao (2011)	In a scenario around buying unhealthy food, mixed emotions (both on cognitive and affective levels) were outcomes of impulse buying.	No	No	Yes	No
Aaker et al. (2008)	Longitudinal experiments showed that individuals tended to underestimate the intensity of experienced ME when recalling the respective experiences (i.e., memory decay effect).	No	Yes	No	No
Berrios et al. (2018a)	A longitudinal study showed that in the context of goal conflict, ME mediated the effect of perceived conflict on self-control efforts.	Yes	No	No	No
Ruth et al. (2002)	Critical-incident studies showed that appraisals of (imagined) consumption experiences were related to consumption emotions. This relationship was more ambiguous under ME:	Yes	No	No	No
Huang et al. (2018)	Two surveys showed that consumers' cognitive conflicts predicted ME, which predicted mobile shopping cart abandonment.	Yes	No	No	No
Reinders et al. (2020)	A survey of an online panel showed that ambivalent feelings towards personalized nutrition advice were associated with lower intentions to use such advice.	Yes	No	No	No

Ramanathan and Williams (2007)	In the context of food indulgence, both impulsive and prudent individuals experienced ME. However, there were differences in ME composition amongst the two groups (with respect to hedonic vs. self-conscious emotions). Moreover, prudent individuals tended to make utilitarian choices in subsequent consumption decisions.	Yes	No	Yes	No
Quach et al. (2021)	Two experiments with different consumer products stimulated mixed emotions via ad narratives. The effect of mixed emotions in brand narratives on positive WOM was moderated by narrative person (i.e., ME appeals were more effective under third-person narration).	Yes	Yes	No	No
Homer (2021)	In a charity context, ME (i.e., sadness and hope induced by video appeals) motivated charitable giving, moderated by cognitive load (i.e., ME appeals were more effective under lower cognitive load).	Yes	Yes	No	No
Williams and Aaker (2002)	Consumers with a lower propensity to accept duality showed more negative attitudes towards appeals with ME (e.g., an ad of a moving company) due to experienced discomfort.	Yes	Yes	No	No
Bee and Madrigal (2013)	Anticipatory ME, arising from reviews including both desirable and undesirable information (i.e., about a restaurant or vacation resort) predicted consumer discomfort with respect to future consumption.	Yes	Yes	Yes (S2)	No
Hong and Lee (2010)	Mixed emotional ads (e.g., of a photo frame) evoked feelings of discomfort and consequently less favorable responses for consumers construing information at a low level, compared to high-level construal.	Yes	Yes	Yes (S5)	No
Septianto (2021)	ME (i.e., poignancy) increased preferences for self-made products, mediated by openness to learning, as well as a fresh start mindset.	Yes	Yes	Yes	No
Hamby and Russell (2022)	Activated ambivalence among consumers of risky products (e.g., energy drinks; e-cigarettes) increased their interest and usage intentions of these products, moderated by salience of social norms.	Yes	Yes	Yes	No
Current research	ME affected consumption choices towards low-arousal products, moderated by the presence of arousal faming.	Yes	Yes	Yes	Yes

NOTE. — ME: mixed emotions/mixed emotional impulses.

Appendix 4.13: Measures Taken in All Studies

The list below includes all measures taken during the studies reported in this chapter. A solid circle indicates measures reported in the manuscript. An unfilled circle denotes measures taken but not reported on in the manuscript. These measures access mostly the potential control variables or address potential underlying mechanisms on an exploratory basis.

Pretest 1-4

Arousal quality of product *(assessed for each presented product)*

English source/translation	Original
What is your personal perception of this product?	Wie ist Ihre persönliche Wahrnehmung dieses Produkts?
Please rate the product based on the following properties: • -3 stimulating; 3 relaxing • -3 exciting; 3 calming • -3 arousing; 3 unarousing	Bitte bewerten Sie das Produkt anhand der folgenden Eigenschaften: • -3 stimulierend; 3 entspannend • -3 aufregend; 3 beruhigend • -3 erregend; 3 nicht erregend

(adopted from Di Muro & Murray, 2012)

Demographics

English source/translation	Original
• What is your gender? [female, male, diverse] • What is your age? [open measure]	• Welchem Geschlecht ordnen Sie sich zu? [weiblich, männlich, divers] • Welches Alter haben Sie? [open measure]

Experiment 1: Preferences between product pairs

Audio check

Translation	Original
• Who was talking in the audio sample? [two men; two women; a child] • What was the content about? [music, a weather report; traffic news; a cookery program]	• Wer hat in diesem Audio-Beispiel gesprochen? [zwei Frauen; zwei Männer; ein Kind] • Was war der Inhalt dieses Audio-Beispiels? [Musik, ein Wetterbericht; Verkehrsnachrichten; eine Kochsendung]

Product preferences *(obtained for each recommendation display while listening to the music)*

Translation	Original
Which [product name] do you prefer at this moment, and how much? [1; very much the product on the left; 5 undecided; 9 very much the product on the right]	Welches [Produktname] bevorzugen Sie in diesem Moment, und wie sehr? [1; sehr das linke Produkt; 5 unentschieden; 9 sehr das rechte Produkt]

Emotional experience *(obtained after listening to the music)*

Translation	Original
• How cheerful did the music make you feel? • How joyful did the music make you feel? • How delighted did the music make you feel? • How good did the music make you feel? • How pleased did the music make you feel? • How positive did the music make you feel? • How sad did the music make you feel? • How gloomy did the music make you feel? • How down did the music make you feel? • How bad did the music make you feel? • How displeased did the music make you feel? • How negative did the music make you feel? [1 = not at all, 4 = moderately, 7 = strongly]	• Wie fröhlich stimmte Sie die Musik? • Wie freudig stimmte Sie die Musik? • Wie erfreut stimmte Sie die Musik? • Wie gut stimmte Sie die Musik? • Wie angenehm stimmte Sie die Musik? • Wie positiv stimmte Sie die Musik? • Wie traurig stimmte Sie die Musik? • Wie düster stimmte Sie die Musik? • Wie niedergeschlagen stimmte Sie die Musik? • Wie schlecht stimmte Sie die Musik? • Wie unangenehm stimmte Sie die Musik? • Wie negativ stimmte Sie die Musik? [1 = überhaupt nicht, 4 = mäßig, 7 = stark]

adapted from Patrick et al. (2007), Mantel and Kellaris (2003); Garg et al. (2005)

Affective judgment

Translation	Original
• How SAD does the music SOUND? • How HAPPY does the music SOUND? [1 not at all; 4 moderately; 7 extremely]	• Wie fröhlich KLANG das Musikstück? • Wie traurig KLANG das Musikstück? [1 = überhaupt nicht, 4 = mäßig, 7 = stark]

adopted from Hunter et al. (2010, 2011)

Tolerance of Ambiguity

Translation	Original
We are now interested in what your impression is of things that are vague or ambiguous. ○ I prefer jobs where the task to be accomplished is clear. ○ I get frustrated when people ask me to do tasks that are poorly defined. ○ I feel that teachers or supervisors who give vague assignments provide a chance to show initiative. [1 = strongly disagree; 7 = strongly agree]	Wir sind nun daran interessiert, wie Sie zu Dingen stehen, die vage oder zweideutig sind. ○ Ich bevorzuge Arbeiten, bei denen die zu erledigende Aufgabe klar ist. ○ Ich bin frustriert, wenn man mir Aufgaben stellt, die nicht klar definiert sind. ○ Ich habe das Gefühl, dass Lehrer oder Vorgesetzte, die unklare Aufgaben stellen, mir die Möglichkeit geben, Initiative zu zeigen. [1 = Stimme überhaupt nicht zu; 7 = Stimme voll und ganz zu]

adopted from Moreau et al. (2016)

Demographics

English source/translation	Original
• What is your gender? [female, male, diverse] • What is your age? [open measure]	• Welchem Geschlecht ordnen Sie sich zu? [weiblich, männlich, divers] • Welches Alter haben Sie? [open measure]

Experiment 2: Scenario-based choice

Audio check & attention check

Translation	Original
• Who was talking in the audio sample? [two men; two women; a child] • What was the content about? [music, a weather report; traffic news; a cookery program] • Please do not click on the scale points labelled 1 to 7, but leave this question blank. This is an attention test. [1 not at all; 7 fully]	• Wer hat in diesem Audio-Beispiel gesprochen? [zwei Frauen; zwei Männer; ein Kind] • Was war der Inhalt dieses Audio-Beispiels? [Musik, ein Wetterbericht; Verkehrsnachrichten; eine Kochsendung] • Bitte klicken Sie nicht auf die Skalenpunkte, die mit 1 bis 7 beschriftet sind, sondern lassen Sie diese Frage leer. Dies ist ein Aufmerksamkeitstest. [1 überhaupt nicht; 7 voll und ganz]

Emotional experience *(obtained while listening to the music)*

Translation	Original
• How down does the music make you feel? • How cheerful does the music make you feel? • How blue does the music make you feel? • How sad does the music make you feel? • How joyful does the music make you feel? • How happy does the music make you feel? • How despairing does the music make you feel? • How melancholic does the music make you feel? • How unsatisfied does the music make you feel? • How hopeful does the music make you feel? • How contented does the music make you feel? • How down does the music make you feel? [1 = not at all; 4 = moderately; 7 = strongly]	• Wie niedergeschlagen lässt die Musik Sie fühlen? • Wie heiter lässt die Musik Sie fühlen? • Wie schwermütig lässt die Musik Sie fühlen? • Wie traurig lässt die Musik Sie fühlen? • Wie freudig lässt die Musik Sie fühlen? • Wie glücklich lässt die Musik Sie fühlen? • Wie verzweifelt lässt die Musik Sie fühlen? • Wie melancholisch lässt die Musik Sie fühlen? • Wie unzufrieden lässt die Musik Sie fühlen? • Wie zufrieden lässt die Musik Sie fühlen? • Wie hoffnungsvoll lässt die Musik Sie fühlen? • Wie zufriedengestellt lässt die Musik Sie fühlen? [1 = überhaupt nicht; 4 = mäßig; 7 = stark]

adapted from Patrick et al. (2007), Mantel and Kellaris (2003), and Garg et al. (2005)

Music-related arousal *(obtained while listening to the music)*

Translation	Original
How activated does the music make you feel? • -3 relayed; 3 stimulated • -3 calm; 3 excited • -3 unaroused; 3 aroused	Wie aktiviert lässt die Musik Sie fühlen? • -3 entspannt; 3 stimuliert • -3 beruhigt; 3 aufgeregt • -3 nicht erregt; 3 erregt

adapted from Di Muro and Murray (2012)

Product choice *(obtained for each recommendation display while listening to the music)*

Translation	Original
Which of the two product recommendations do you select? [six times, choice between two recommended products]	Welche der beiden Produktempfehlungen klicken Sie an? [six times, choice between two recommended products]

Situational self-awareness (private subscale) *(obtained after listening to the music)*

Translation	Original
While I was dealing with the product recommendations... ○ … I was conscious of my inner feelings ○ … I was reflective about my life. ○ … I was aware of my innermost thoughts. [1 = not at all; 4 = moderately; 7 = strongly]	Während ich mich mit den Produktempfehlungen beschäftigt habe… ○ … war ich meiner inneren Gefühle gewahr. ○ … habe ich über mein Leben nachgedacht. ○ … war ich mir meiner innersten Gedanken bewusst. [1 = überhaupt nicht; 4 = mäßig; 7 = stark]

adapted from Govern and Marsch (2001)

Perceived informativeness of feelings

Translation	Original
To what extent do you agree with the following two statements? ○ When evaluating the brand, I relied on my feelings and emotions ○ I thought my feelings and emotions were important for my evaluation of the brand. [1 = not at all; 4 = moderately; 7 = strongly]	Inwiefern stimmen Sie den beiden folgenden Aussagen zu? ○ Während ich die Produktempfehlungen ausgewählt habe, habe ich mich auf meine Gefühle und Emotionen verlassen. ○ Ich dachte, dass meine Gefühle und Emotionen wichtig für meine Auswahl der Produktempfehlungen waren. [1 = überhaupt nicht; 4 = mäßig; 7 = stark]

adopted from Bosmans and Baumgartner (2005)

Psychological warmth

Translation	Original
Now please think back to the product recommendations you have just selected. ○ Overall, how much did the products you selected make you feel cold or warm? [1 the products gave me a cold feeling; 7 the products gave me a warm feeling]	Bitte denken Sie nun zurück an die Produktempfehlungen, die Sie gerade eben ausgewählt haben. ○ Wie sehr haben Ihnen die von Ihnen ausgewählten Produkte insgesamt ein kaltes bzw. warmes Gefühl gegeben? [1 die Produkte geben mir ein kaltes Gefühl; 7 die Produkte gaben mir ein warmes Gefühl]

adapted from Hong and Sun (2012)

Intrinsic Cognitive Load

English source/translation	Original
○ How much mental and physical activity was required? That is, was the learning task easy (simple, forgiving) or demanding (exacting or complex)? [1 easy; 7 demanding]	○ Wie viel geistige und körperliche Aktivität war für diese Auswahl erforderlich? Das heißt, war dieser Prozess für Sie leicht (einfach, versöhnlich) oder anspruchsvoll (fordernd oder komplex)? [1 einfach; 7 anspruchsvoll]

adapted from L. Lin and Atkinson (2011)

Affect regulation goals

English source/translation	Original
To what extent do you agree with the following two statements about the background to your product selection? ○ My selection of the different product recommendations was based on the fact that I wanted to cheer myself up. ○ My choice of different product recommendations was based on the fact that I wanted to maintain the same state of mind I was in at that moment. [1 = not at all; 4 = moderately; 7 = strongly]	Inwiefern stimmen Sie den beiden folgenden Aussagen über die Hintergründe Ihrer Produktauswahl zu? ○ Meine Auswahl der verschiedenen Produktempfehlungen war darin begründet, dass ich mich aufmuntern wollte. ○ Meine Auswahl der verschiedenen Produktempfehlungen war darin begründet, dass ich denselben Gemütszustand beibehalten wollte, in dem ich mich in jenem Moment befand. [1 = überhaupt nicht; 4 = mäßig; 7 = stark]

adapted from J. B. Cohen and Andrade (2004)

Regulatory focus

English source/translation	Original
What would you prefer at the moment?	Was würden Sie im Moment bevorzugen?
○ -3 do what is right; 3 do whatever I want ○ -3 take a trip around the world; 3 pay back my loans ○ -3 go wherever my heart takes me; 3 do whatever it takes for me to keep my promises	○ -3 tun, was richtig ist; 3 tun, was ich will ○ -3 eine Reise um die Welt machen; 3meine Schulden zurückzahlen ○ -3 dorthin gehen, wohin mein Herz mich trägt; 3 alles zu tun, was nötig ist, um meine Versprechen einzuhalten

adapted from Pham and Avnet (2004)

Usage frequency of product categories

English source/translation	Original
What role do the following products play in your everyday life? • How often do you normally read guidebooks in your everyday life? • How often do you normally use shower balls in your everyday life? • How often do you usually cook from cookery books in your everyday life? • How often do you usually do sports with training videos in your everyday life? • How often do you usually visit swimming pools in your daily life? • How often do you usually drink tea in your everyday life? [1 = never; 7 = very often]	Welche Rolle spielen die folgenden Produkte in Ihrem Alltag? • Wie oft lesen Sie normalerweise Ratgeber in Ihrem Alltag? • Wie oft nutzen Sie normalerweise Duschkugeln in Ihrem Alltag? • Wie oft kochen Sie normalerweise nach Kochbüchern in Ihrem Alltag? • Wie oft machen Sie normalerweise Sport mit Trainings-Videos in Ihrem Alltag? • Wie oft besuchen Sie normalerweise Schwimmbäder in Ihrem Alltag? • Wie oft trinken Sie normalerweise Tee in Ihrem Alltag? [1 = niemals; 7 = sehr oft]

adapted from Cowley (2008)

Demographics

English source/translation	Original
• What is your gender? [female, male, diverse] • What is your age? [open measure]	• Welchem Geschlecht ordnen Sie sich zu? [weiblich, männlich, divers] • Welches Alter haben Sie? [open measure]

Experiment 3: Moderation through contrast framing

Audio check & attention check

Translation	Original
• Who was talking in the audio sample? [two men; two women; a child] • What was the content about? [music, a weather report; traffic news; a cookery program] • Please do not click on the scale points labelled 1 to 7, but leave this question blank. This is an attention test. [1 not at all; 7 fully]	• Wer hat in diesem Audio-Beispiel gesprochen? [zwei Frauen; zwei Männer; ein Kind] • Was war der Inhalt dieses Audio-Beispiels? [Musik, ein Wetterbericht; Verkehrsnachrichten; eine Kochsendung] • Bitte klicken Sie nicht auf die Skalenpunkte, die mit 1 bis 7 beschriftet sind, sondern lassen Sie diese Frage leer. Dies ist ein Aufmerksamkeitstest. [1 überhaupt nicht; 7 voll und ganz]

Emotional experience *(obtained while listening to the music)*

Translation	Original
• How down does the music make you feel? • How cheerful does the music make you feel? • How blue does the music make you feel? • How sad does the music make you feel? • How joyful does the music make you feel? • How happy does the music make you feel? • How despairing does the music make you feel? • How melancholic does the music make you feel? • How unsatisfied does the music make you feel? • How hopeful does the music make you feel? • How contented does the music make you feel? • How down does the music make you feel?	• Wie niedergeschlagen lässt die Musik Sie fühlen? • Wie heiter lässt die Musik Sie fühlen? • Wie schwermütig lässt die Musik Sie fühlen? • Wie traurig lässt die Musik Sie fühlen? • Wie freudig lässt die Musik Sie fühlen? • Wie glücklich lässt die Musik Sie fühlen? • Wie verzweifelt lässt die Musik Sie fühlen? • Wie melancholisch lässt die Musik Sie fühlen? • Wie unzufrieden lässt die Musik Sie fühlen? • Wie zufrieden lässt die Musik Sie fühlen? • Wie hoffnungsvoll lässt die Musik Sie fühlen? • Wie zufriedengestellt lässt die Musik Sie fühlen?
[1 = not at all; 4 = moderately; 7 = strongly]	[1 = überhaupt nicht; 4 = mäßig; 7 = stark]

adapted from Patrick et al. (2007), Mantel and Kellaris (2003), and Garg et al. (2005)

Music-related arousal *(obtained while listening to the music)*

Translation	Original
How exciting does the piece of music sound? • -3 very passive; 3 very active • -3 very mellow; 3 very fired up • -3 very low energy; 3 very high energy	Wie erregend klingt das Musikstück? • -3 sehr passiv; 3 sehr aktiv • -3 sehr geringe Energie; 3 sehr hohe Energie • -3 sehr sanft; 3 sehr aufgedreht

adapted from Berger and Milkman (2012)

Experience of emotional contrast *(obtained while listening to the music)*

Translation	Original
• To what extent are you feeling a combination of different emotions at the same time? • To what extent are you feeling contrasting emotions? • To what extent are you feeling a mixture of emotions? • To what extent are you feeling different emotions at the same time? ○ How tense do you feel at this moment? [1 = not at all; 4 = moderately; 7 = strongly]	• Wie sehr fühlen Sie eine Kombination verschiedener Emotionen zur gleichen Zeit? • Wie sehr empfinden Sie Emotionen, die sich kontrastieren? • Wie sehr empfinden Sie verschiedene Emotionen zur gleichen Zeit? • Wie sehr fühlen Sie eine Mischung von Emotionen? ○ Wie sehr fühlen Sie sich angespannt in diesem Moment? [1 = überhaupt nicht; 4 = mäßig; 7 = stark]

adapted from Berrios et al. (2015b) and Oceja and Carrera (2009)

Product choice *(obtained for each recommendation display, while listening to the music)*

Translation	Original
Which of the three product recommendations do you select? [six times, choice between three recommended products]	Welche der drei Produktempfehlungen klicken Sie an? [six times, choice between three recommended products]

Choice difficulty *(after listening to the music)*

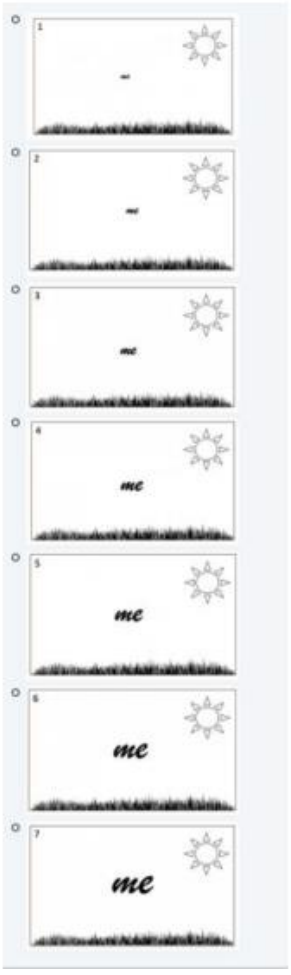
Translation	Original
In the following, we are interested in how you found the task of deciding in favor of one of the products.	Im Folgenden sind wir daran interessiert, wie Sie die Aufgabe empfunden haben, sich für eines der Produkte zu entscheiden.

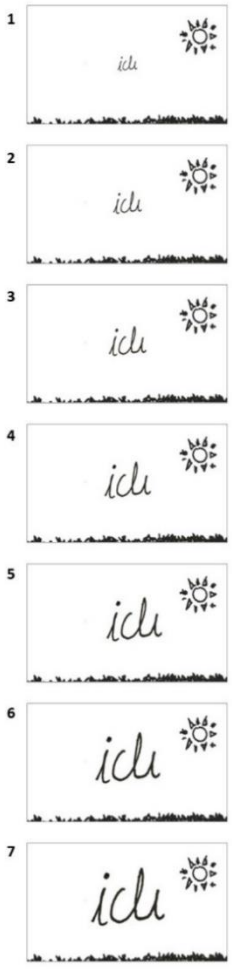
○ How easy was the choice to make? ○ How difficult was the choice to make? [1 Not at all; 7 Very]	○ Wie leicht sind Ihnen die Entscheidungen für die Produkte gefallen? ○ Wie schwierig war es für Sie, die Entscheidungen für die Produkte zu treffen? [1 Überhaupt nicht; 7 Sehr]

adopted from Rahinel et al. (2021)

Smallness-of-self

Translation	Original
Please imagine that you are signing a drawing. Which of the following signatures would be very similar to your own? Please select the picture that seems most appropriate to you.	Bitte stellen Sie sich vor, Sie würden eine Zeichnung unterschreiben. Welche der folgenden Unterschriften würde Ihrer eigenen sehr ähnlich sein? Bitte wählen Sie das Bild aus, das Ihnen am passendsten erscheint.





adopted from Wang et al. (2023)

Optimum Stimulation Level

Translation	Original
To what extent do the following statements generally apply to you?	In welchem Maße treffen die folgenden Aussagen ganz im Allgemeinen auf Sie zu?
○ I am continually seeking new ideas and experiences. ○ I like meeting people who give me new ideas. ○ People view me as quite an unpredictable person. ○ I like a job that offers change and variety. ○ I prefer an unpredictable life full of change to a routine one. ○ I like surprises. ○ Designs and patterns should be bold and exciting. ○ When things get boring, I like to find new and unfamiliar experiences. ○ I am interested in new and varied art forms. ○ Sometimes, I like to stir up excitement.	○ Ich bin laufend auf der Suche nach neuen Ideen und Erfahrungen. ○ Ich treffe gerne Menschen, die mich auf neue Ideen bringen. ○ Die Leute halten mich für eine ziemlich unberechenbare Person. ○ Ich mag einen Job, der Abwechslung und Vielfalt bietet. ○ Ich ziehe ein unvorhersehbares, abwechslungsreiches Leben der Routine vor. ○ Ich mag Überraschungen. ○ Designs und Muster sollten mutig und aufregend sein. ○ Wenn es langweilig wird, suche ich gerne nach neuen und ungewohnten Erfahrungen. ○ Ich interessiere mich für neue und vielfältige Kunstformen. ○ Manchmal mag ich es, Aufregung zu verursachen.
[1 Not at all; 7 Very]	[1 überhaupt nicht; 7 sehr]

adopted from Batra and Ghoshal (2017)

Usage frequency of product categories

English source/translation	Original
Finally, we are interested in what role the following products play in your everyday life.	Zuletzt sind wir daran interessiert, welche Rolle die folgenden Produkte in Ihrem Alltag spielen.
• How often do you normally read guidebooks in your everyday life? • How often do you normally use shower balls in your everyday life? • How often do you usually cook from cookery books in your everyday life? • How often do you usually exercise with training videos in your everyday life? • How often do you usually drink tea in your everyday life?	• Wie oft lesen Sie normalerweise Ratgeber in Ihrem Alltag? • Wie oft nutzen Sie normalerweise Duschkugeln in Ihrem Alltag? • Wie oft kochen Sie normalerweise nach Kochbüchern in Ihrem Alltag? • Wie oft machen Sie normalerweise Sport mit Trainings-Videos in Ihrem Alltag? • Wie oft trinken Sie normalerweise Tee in Ihrem Alltag?

English source/translation	Original
• How often do you usually drink soft drinks in your everyday life? [1 = never; 7 = very often]	• Wie oft trinken Sie normalerweise Erfrischungsgetränke in Ihrem Alltag? [1 = niemals; 7 = sehr oft]

adapted from Cowley (2008)

Demographics

English source/translation	Original
• What is your gender? [female, male, diverse] • What is your age? [open measure]	• Welchem Geschlecht ordnen Sie sich zu? [weiblich, männlich, divers] • Welches Alter haben Sie? [open measure]

Chapter 5
Conclusion

Mixed emotions accompany individuals throughout their daily lives and often constitute parts of marketing communications (Larsen et al., 2017a; Williams & Aaker, 2002). While there still is comparatively little research compared to, for instance, purely positive and negative emotions, the interest in the study of mixed emotions is rising (see Chapter 2.1). This dissertation set out to contribute to this research by investigating the role of mixed emotions in consumer psychology and decision making.

In the first part, it presented a systematic literature review of empirical studies that quantitatively measured mixed emotions. On this basis, a taxonomy of mixed emotion measurement approaches was developed. In detail, this taxonomy categorized existing measurement approaches on three levels that referred to the object of investigation, the conceptualization of mixed emotions, and their quantification. Moreover, a meta-analytic comparison of the two most frequently used measurement approaches was conducted, documenting that construct-specific approaches were associated with higher scores of measured mixed emotions compared to valence-compositional approaches. These differences were observed both with regard to absolute levels of measured mixed emotions and with regard to differences in measured mixed emotions between mixed and other emotional reference conditions. In sum, emotion researchers might find in this chapter a comprehensive reference guide for synthesizing and comparing existing mixed emotions research, as well as for guiding the selection of an emotion measurement approach in their own work.

In the second part, this dissertation presented a methodological contribution to the body of emotion elicitation procedures: In an interdisciplinary approach, novel music stimuli were developed, with which positive, negative, and mixed emotional impulses can be induced in experiments. These music stimuli were developed through a research-derived composition concept that assured them to be as controlled as possible: Compositionally, all three stimuli are based on the same underlying musical foundation, but incorporate idiosyncratic musical parameters to elicit the respective emotional impulse. Through this procedure, risks of potential confounds through familiarity or heterogeneity could be diminished. Two pre-registered experiments empirically validated the controlled music stimuli: They documented that the stimuli reliably evoked the intended emotional impulses and were comparable to a set of reference stimuli. This research furthermore indicated that the controlled stimuli might be better suited to discriminate between the negative and mixed emotional conditions in

terms of evoked mixed emotional impulses. In sum, emotion researchers might find in the controlled music stimuli useful stimulus material for harnessing the potential of music in eliciting (mixed) emotional impulses, while diminishing risks of confounds.

In the third part of this dissertation, the developed music stimuli were put into practice: Through eliciting emotional impulses through the controlled music stimuli, this chapter investigated the role of consumer emotions as personalization input factors. In detail, three pre-registered experiments documented that the experience of mixed emotional impulses increased consumer preferences for low-arousal products along different product categories. This research contributes insights into the information value of mixed emotions: It provided evidence that mixed emotions instilled compensatory responses in consumers, which might be oriented towards releasing states of experienced tension. Moreover, it documented a practically relevant boundary condition of this effect: the presence of *contrast framing* in the recommendation set architecture. In sum, this research shows that mixed emotions give rise to distinct consumer preferences and that a contrasting, non-target product in the recommendation-set architecture can affect these preferences.

Through these three parts, this dissertation offers conceptual, methodological, and empirical insights into the field of mixed emotion research. With technological advancements in emotion inference and prediction (e.g., in the context of Big Data; Matz & Netzer, 2017), the role of emotion might become increasingly prominent in individuals' lives, and in particular, in consumption contexts. On this basis, an understanding of how (mixed) emotions shape consumers' perception, thinking, and decision making is crucial. In detail, it is crucial for (at least) three different stakeholder groups: for policymakers (to safeguard consumers and ensure a democratically legitimized use of emotion data), for marketers (to enhance the customer experience and better cater to consumers' needs), and for individuals like ourselves (to understand how we are affected by our emotions).

This dissertation set out to contribute a piece to this understanding and to offer conceptual and methodological contributions aimed at facilitating and encouraging further research into the phenomenon of mixed emotions.

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