UNIVERSITÄT TRIER

The Formation of Ambivalent Attitudes: Evidence From Experimental Research

Dissertation thesis submitted for the degree

Doctor rerum naturalium (Dr. rer. nat.)

Submitted by	Lena Hahn, M. Sc. Psychology
Place, date of submission	Trier, November 8th, 2023
Dissertation reviewers	Prof. Dr. Eva Walther
	Dr. Benjamin Buttlar

Dissertationsort Trier

Table of Contents

Acknowledgments

First, I’d like to thank Prof. Dr. Eva Walther for advising my thesis and giving me the freedom and guidance to develop my research, which gave me a unique opportunity to grow not only as a researcher but also as a person.

Next, I’d like to thank Dr. Benjamin Buttlar. Not only for being my second PhD supervisor but also for awakening my love for research when he supervised my research internship and unwaveringly supporting me from day one. Thank you for your patience, support, and guidance.

Additionally, I’d like to thank my colleagues, the many students I’d had the privilege to teach in my seminars, supervise during their thesis, and work with as student assistants. Without the fruitful discussions, their help in designing the studies and data collection, this thesis would not have been possible. Namely, I’d like to mention: Katharina Abad Borger, Dr. Katarina Blask, Helen Boeder, Luca Cammarota, So Ehmk, Alicia Holler, Gil Konz, Anna Lambrich, Marc Latz, Selina Meurisch, Luisa Sabel, Christa Willems, and Alina Zumkley.

A special thanks should also be given to my friends who helped me keep a work-live balance. Thank you, Dr. Thomas Simacek, for taking walk-breaks with me, Elisabeth and Simon Baer, for the workout sessions, sending encouraging messages and sweets, and Markus Raphael Besser and Marie Prunkl-Haberkorn, for sending relaxation dream trips via voice message.

Additionally, I’d like to thank the awesome early career researchers I was able to connect with digitally and at conferences. Namely, I’d like to thank Anna Becker, Dr. Jana Berkessel, Valentin Emslander, Fiona Kazarovytska, Dr. Jens Lange, Dr. Dorothee Mischkowski, and Kiara Roth.

This thesis greatly benefitted from the language and content feedback of my proofreaders. Thank you, Dr. Tarini Singh, and Dr. Georg Halbeisen, for your support, constructive and detailed feedback, and your patience. Additionally, I am also very thankful that you always have an open ear for me, for your advice and that you helped me improve my programming skills.

Last but by no means least, I’d like to thank my family. Specifically, I’d like to thank my parents, Renate and Matthias Hahn, and my brother, Benedikt Hahn, for their unwavering belief in me, their infinite support, and their unconditional love.

Abstract

When humans encounter attitude objects (e.g., other people, objects, or constructs), they evaluate them. Often, these evaluations are based on attitudes. Whereas most research focuses on univalent (i.e., only positive or only negative) attitude formation, little research exists on ambivalent (i.e., simultaneously positive and negative) attitude formation. Following a general introduction into ambivalence, I present three original manuscripts investigating ambivalent attitude formation. The first manuscript addresses ambivalent attitude formation from previously univalent attitudes. The results indicate that responding to a univalent attitude object incongruently leads to ambivalence measured via mouse tracking but not ambivalence measured via self-report. The second manuscript addresses whether the same number of positive and negative statements presented block-wise in an impression formation task leads to ambivalence. The third manuscript also used an impression formation task and addresses the question of whether randomly presenting the same number of positive and negative statements leads to ambivalence. Additionally, the effect of block size of the same valent statements is investigated. The results of the last two manuscripts indicate that presenting all statements of one valence and then all statements of the opposite valence leads to ambivalence measured via self-report and mouse tracking. Finally, I discuss implications for attitude theory and research as well as future research directions.

Introduction

In 1935, Allport declared attitudes as "the most distinctive and indispensable concept in contemporary social psychology" (p. 798). Attitudes are often conceptualized as bipolar and unidimensional (Ferguson & Fukukura, 2012). For example, Fazio (1986) defines attitudes as a unidimensional summary evaluation of a stimulus. According to this definition, attitudes can be univalent positive (i.e., only positive), univalent negative (i.e., only negative), or neutral (i.e., neither negative nor positive). However, the world surrounding us is not black or white, good or bad, positive or negative. Many things can have positive and negative aspects, and research has demonstrated that people can simultaneously have strong positive and strong negative associations towards the same attitude object (e.g., Thompson et al., 1995). This is usually called ambivalence (van Harreveld et al., 2015). People can be ambivalent to, for example, unhealthy food (Norris et al., 2019), meat (Buttlar et al., 2023), plastic (Hahn et al., 2021), physical exercise (Sparks et al., 2004), water pipe use (Mays et al., 2020), drug use (Hohman et al., 2014), organ donation (Contiero & Wilson, 2019), or romantic relationships (Zoppolat et al., 2023). The emerging field of ambivalence research focuses on the affective, cognitive, and behavioral consequences of ambivalence (van Harreveld et al., 2015). For example, research shows that people procrastinate and postpone decisions regarding an ambivalent object (van Harreveld, van der Pligt, et al., 2009), people use biased information processing (Nordgren et al., 2006), or compensatory order perception like increased conspiracy belief to resolve ambivalence (van Harreveld et al., 2014). Additionally, higher ambivalence has been associated with lower well-being (Zoppolat et al., 2023). However, the central question of how ambivalent attitudes form has received little attention in previous research.

To close this research gap, the dissertation at hand aims to investigate ambivalent attitude formation. Therefore, I will first define ambivalence, distinguish it from other constructs, and describe how ambivalence has been measured in previous research. Next, I will highlight the basic assumption of many attitude models, introduce the Meta-cognitive Model of Attitudes (Petty et al., 2007), and review previous research on ambivalent attitude formation. Based on this, I will present three manuscripts empirically investigating ambivalent attitude formation. Finally, I will summarize the results and highlight implications and directions for future research.

Defining Ambivalence

To understand ambivalent attitude formation, it is crucial to understand what ambivalence is. Even though different definitions of ambivalence exist (e.g., Eagly & Chaiken, 1993; Gardner, 1987; Thompson et al., 1995; Wegener et al., 1995), they all have two distinctive features in common: (1) an ambivalent attitude object is associated with positive and negative aspects, and (2) these aspects can but do not have to be simultaneously relevant (van Harreveld et al., 2015). The first feature of the associative structure is referred to as structural (Berger et al., 2019), objective (van Harreveld et al., 2015), or potential ambivalence (Kaplan, 1972; van Harreveld, van der Pligt, et al., 2009). The positive and negative associations can result from conflicting affective reactions or conflicting cognitions (i.e., intracomponent ambivalence) or conflicting affective reactions and cognitions (i.e., intercomponent ambivalence; van Harreveld et al., 2009).

The second feature is referred to as subjective (Priester & Petty, 1996, 2001; van Harreveld et al., 2015) or felt ambivalence (van Harreveld, van der Pligt, et al., 2009). Felt ambivalence emerges when an attitude object's positive and negative associations are simultaneously salient. Specifically, felt ambivalence is the experienced conflict resulting from the positive and negative associations (Priester & Petty, 1996). Theory proposes that potential ambivalence can exist without eliciting felt ambivalence, but felt ambivalence can not exist without potential ambivalence (van Harreveld et al., 2015; van Harreveld, van der Pligt, et al., 2009). The fundamental question in ambivalent attitude formation research pertains to potential ambivalence. That is, how does an attitude object gain positive and negative associations.

Distinguishing Ambivalence From Other Constructs

Even though ambivalence and ambiguity are often used synonymously in everyday life, there are significant differences. Ambiguity describes a state where an attitude object cannot be categorized because of a lack of cues (Budner, 1962). This lack of cues can be due to the novelty of the object or when different cues lead to different interpretations (Budner, 1962). For example, the word ‘bat’ is ambiguous. Without any other cues, ‘bat’ cannot be clearly categorized. On the one hand, a ‘bat’ can be a piece of sports equipment. On the other hand, a ‘bat’ can be a nocturnal animal. Without cues that indicate sport or animal, ‘bat’ can not be clearly categorized. Additionally, when something is ambiguous, people know they are missing information (Ghirardato et al., 2004). In contrast, people struggle to categorize ambivalent attitude objects because they are associated with positive and negative aspects (e.g., Eagly & Chaiken, 1993; Kaplan, 1972; Wegener et al., 1995) and not due to lack of information.

Another concept that is related to ambivalence is dissonance. Ambivalence, as well as dissonance, should lead to discomfort (Festinger, 1957). However, dissonance has been conceptualized as inconsistency between two cognitions (Gawronski, 2012). Specifically, Festinger (1957) proposed that two cognitions are dissonant if one is the opposite of the other. Additionally, dissonance has been conceptualized as post-decisional, whereas ambivalence is pre-decisional (van Harreveld, Rutjens, et al., 2009). Furthermore, ambivalence can be caused by conflicting cognitions but also between conflicting affective reactions or between cognitions and affective reactions (van Harreveld, van der Pligt, et al., 2009).

Lastly, ambivalence must be distinguished from neutrality. Because neutrality is characterized by neither strong positive nor strong negative associations (Cacioppo et al., 1997), neutrality never leads to the experience of conflict. In contrast, ambivalence is characterized by simultaneously strong positive and strong negative associations and can lead to conflict (e.g., van Harreveld et al., 2015; van Harreveld, van der Pligt, et al., 2009).

Determining Ambivalence

Even though the differentiation between ambivalence and neutrality is essential, these attitudes can not be distinguished by the often-used bipolar valence scale to measure attitude (Cacioppo et al., 1997; Kaplan, 1972). On a bipolar valence scale from negative to positive, a rating in the middle of the scale might indicate neutrality, but it might also indicate ambivalence. To overcome this limitation, potential ambivalence has been captured by measuring positivity and negativity separately with unipolar scales (Kaplan, 1972; Thompson et al., 1995). Based on the definition of ambivalence as simultaneously strong positive and negative associations, the higher the potential ambivalence, the higher the positivity and negativity rating. Often, these ratings are combined into an index. The Similarity Intesinty Model Index (SIM-Index) is recommended (Thompson et al., 1995). This SIM-Index corrects the intensity of the components (i.e., [Positivity + Negativity]/2) by the polarization (i.e., |Positivity – Negativity|). Hence, ambivalence is high intensity and low polarizations (i.e., high ratings on the positivity and negativity scale). Even though neutrality also results in low polarization, neutrality is also characterized by low intensity (i.e., low ratings on the positivity and negativity scale). Finally, univalence is characterized by high intensity and high polarization (i.e., high ratings on one of the scales and low ratings on the other scale).

Felt ambivalence has previously been measured consistently with the tripartite model of attitudes (Ostrom, 1969). That is, people indicated how mixed (i.e., cognitive component), indecisive (i.e., behavioral component), and conflicted (i.e., affective component) they feel (Priester & Petty, 1996). Additionally, a one-item version measuring mixed thoughts and/or feelings regarding the object has previously been used (Schneider et al., 2015; Schneider &

Mattes, 2021). Whereas ambivalent attitude objects lead to high ratings in felt ambivalence, univalence, and neutrality lead to low ratings.

In contrast to the previously described direct self-reported attitude measures, there are also indirect measures. Some indirect measures have also been called implicit measures (Van Dessel et al., 2020). However, what they measure is often unclear (e.g., traits or states, conscious or unconscious representation; e.g., Brownstein et al., 2019). Hence, it has been proposed to classify these measures as indirect measures and describe them on a behavioral level (Van Dessel et al., 2020). For reasons of consistency, I will use the term direct measure for self-report measures or measures that have been described as deliberate or explicit. Additionally, I will consistently use the term indirect measure for measures described as automatic or implicit.

Similar to direct self-report measures, indirect attitude measures struggle to differentiate neutrality and ambivalence. There are two indirect measures validated to capture ambivalence. First, there is the Ambivalent Primes Paradigm (Berger et al., 2019). This method is based on the classic Evaluative Priming Paradigm (Fazio et al., 1986). The basic assumption is that if a preceding stimulus (i.e., prime) has the same valence as the target stimulus (i.e., congruent trial), reaction times should be faster than when the prime has the opposing valence as the target stimulus (i.e., incongruent trial). The basic idea of the Ambivalent Primes Paradigm is that confrontation with an ambivalent attitude object leads to activation of the positive and negative associations. Therefore, reaction times in trials with an ambivalent prime are slower than when the valence of the prime and target are the same (Berger et al., 2019). However, this paradigm sometimes fails to show the basic effect of faster reaction times in congruent compared to incongruent trials, let alone capture ambivalence (see Berger, 2020 Section IV - Experiment 1).

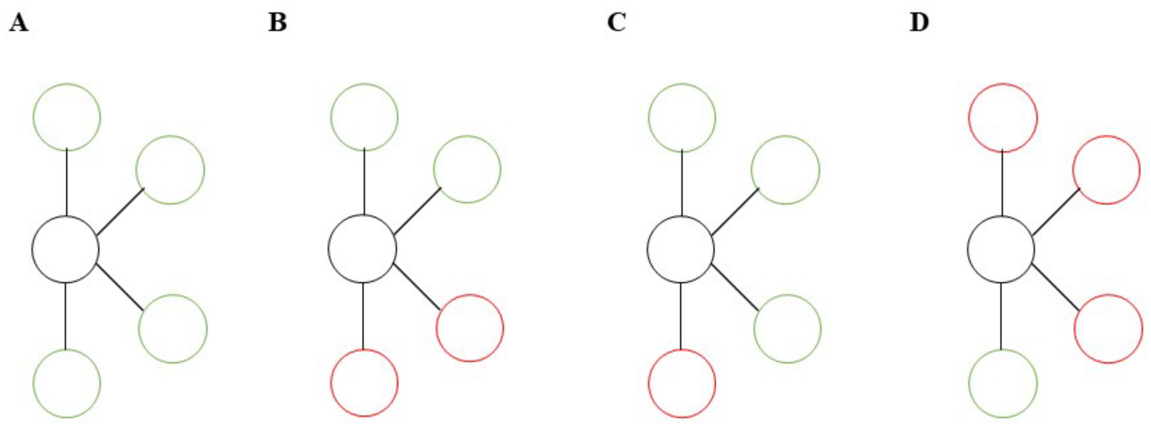
The second validated indirect ambivalence measure is mouse tracking (Schneider et al., 2015; Schneider & Mattes, 2021). Mouse tracking uses the fact that the opposing associations are salient when people have to evaluate the ambivalent attitude object. Precisely, in a mouse tracking task to capture ambivalence, people categorize an ambivalent attitude object as positive or negative. Because people have to decide on this task, they should experience conflict as the positive and negative aspects should be salient. Hence, the trajectory of the mouse response to an ambivalent attitude object should have more pull to the non-chosen response than the trajectory of the mouse response to a univalent attitude object. Mouse tracking has previously been used as an ambivalence measure (Buttlar et al., 2021; Buttlar & Walther, 2018; Hahn et al., 2021), is considered a valid measure of ambivalence (e.g., Schneider & Mattes, 2021; Sipilä et al., 2018), and can differentiate between ambivalent, neutral and univalent attitude objects (Schneider et al., 2015; Schneider & Mattes, 2021). In contrast to the self-reported measures which are influenced by introspection, ambivalence measured via mouse tracking should not be influenced as strongly by this as direct measures (Schneider et al., 2015).

Basic Assumption of many Attitude Models

The content of attitude models ranges from how attitudes form and change (Petty et al., 2007), to what their structure is (Dalege et al., 2018), to how they influence behavior (Fazio, 1990). However, a lot of attitude models propose that attitude objects are represented as associative structures in memory (Dalege et al., 2018; Fazio, 1990; Gawronski & Bodenhausen, 2006; McConnell & Rydell, 2014; Petty et al., 2007). Each attitude model makes specific assumptions. For example, whether a summary evaluation is stored in memory (e.g., Fazio, 2007) or every single evaluative element (Dalege et al., 2018), or if the link between the attitude object and the evaluative element is merely associative (Gawronski & Bodenhausen, 2006) or an interaction (Dalege et al., 2018). However, many attitude objects have the same basic assumption in common. That is, the assumption that an attitude object has an associative structure in memory (see Figure 1 Panel A). Given that people hold ambivalent attitudes to objects that have positive and negative aspects, an attitude object that is associated with positive and negative elements should elicit ambivalence (Dalege et al., 2016; see Figure 1 Panel B). Therefore, adding an inconsistent association to a univalent attitude object might be the minimum requirement for ambivalence. Hence, adding a negative association to a univalent positive attitude object (see Figure 1 Panel C) or adding a positive association to a univalent negative attitude object (see Figure 1 Panel D) should lead to ambivalence.

Figure 1

Depiction of Associative Attitude Structures in Memory



Note. The black circle is the attitude object, green circles are positive evaluative elements, red circles are negative evaluative elements, black lines connecting the circles indicate associaiton. Panel A depicts a univalent attitude, panel B depicts an ambivalent attitude. Panel C depicts an ambivalent attitude when an association with a negative evaluative element is added to a univalent positive attitude, and Panel D depicts an ambivalent attitude when an association with a positive evaluative element is added to a univalent negative attitude.

The Meta-Cognitive Model (MCM) of Attitudes (Petty et al., 2007)

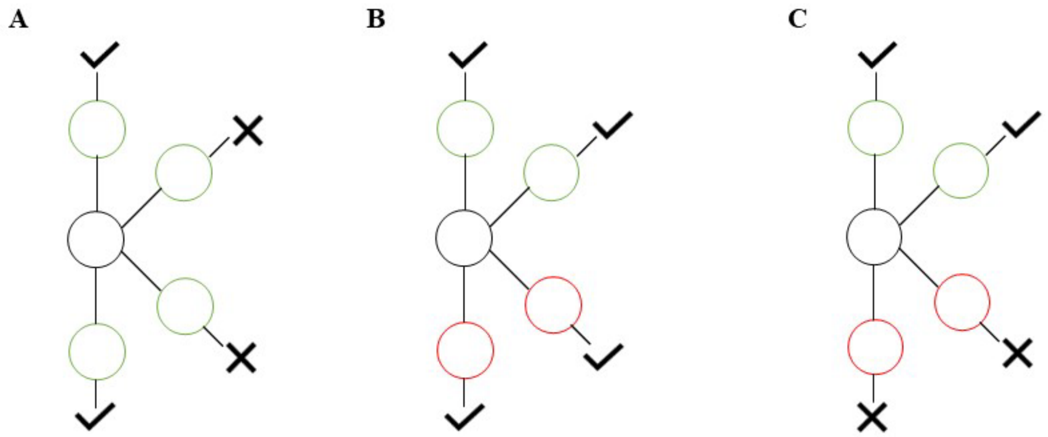
The MCM was developed to explain the discrepancy between direct and indirect attitude measures following attitude change manipulation (Petty & Briñol, 2006). Like many other attitude models (Dalege et al., 2018; Fazio, 1990; Gawronski & Bodenhausen, 2006; McConnell & Rydell, 2014), the basic assumption is that an attitude object has evaluative associations in memory. These evaluative associations can be global (e.g., negative) or more specific (e.g., intelligent), and they can be of opposing valence (Petty et al., 2007). Hence, according to the MCM, an attitude object can have positive and negative evaluative associations. For example, your colleague Alex can be funny and disorganized.

Going beyond other attitude models (Dalege et al., 2018; Fazio, 1990; Gawronski & Bodenhausen, 2006; McConnell & Rydell, 2014), the MCM proposes that the evaluative associations can be linked to validating meta-cognitions (e.g., true/false, yes/no, accept/reject; see Figure 2 Panel A). If there is no validity information, it is expected to be true (Petty et al., 2012). Not only can the validity information come from consistency analysis (i.e., validity tag), but it can also be indicated by other factors like ease of retrieval or confidence. Because retrieving the validity information is effortful and takes time, it only influences direct but not indirect attitude measures (Petty et al., 2007). Whereas the validity information is irrelevant when an attitude object has only evaluative associations of one valence, it is relevant when an attitude object has evaluative associations of opposing valence.

If an attitude object has positive and negative evaluative associations, there are two possible cases: (1) same validity information (Figure 2 Panel B) or (2) opposing validity information (Figure 2 Panel C). In the first case, when the validity information of the positive and negative associations is the same (e.g., both true or both false), then direct and indirect attitude measures should indicate ambivalence. However, the MCM also proposes that validity information can influence direct attitude measures like potential and felt ambivalence differently. That is when the validity information is not due to consistency analysis but through doubt. For example, if the information of one valence is from a credible source and the information of the opposing valence is from a noncredible source. In this case, neither evaluative association would be rejected, leading to potential ambivalence. However, because one information has higher credibility, felt ambivalence would be lower than when information had the same credibility (DeMarree et al., 2015; Petty et al., 2012).

Figure 2

Depiction of the Associative Structure in Memory as Predicted by the Meta-cognitive Model of Attitudes (Petty et al., 2007)



Note. The black circle is the attitude object, the green circles indicate positive evaluative elements, and the red circles indicate negative evaluative elements. Check marks indicate that the evaluative association is true, and cross indicates that the evaluative association is false. Black lines indicate the link between the stored information. Panel A depicts a univalent positive attitude with differing validity information. Panel B depicts an ambivalent attitude that should result in ambivalence on direct and indirect attitude measures. Panel C depicts an ambivalent attitude that results in ambivalence on indirect but not direct attitude measures.

The second possible case is when the validity information of the positive and negative associations is opposing (e.g., one true and one false). In this case, the indirect attitude measure should indicate ambivalence, and the direct attitude measure should indicate univalence. For example, when someone has a negative attitude toward flu vaccination, but receives information about the benefits of flu vaccination. There are two possibilities. First, the old attitude is rejected (e.g., negative aspects of flu vaccination), and the new attitude is endorsed (e.g., benefits of flu vaccination). According to the MCM, the old evaluative association remains. However, it is tagged as false. Hence, indirect attitude measures should indicate ambivalence because the attitude object has evaluative associations of opposing valence. In contrast, there should not be ambivalence in direct attitude measures, as the validity information is retrieved (i.e., the old attitude is rejected). In this case, the direct attitude measures depict attitude change faster than the indirect attitude measures. This particular case of the MCM is called 'past attitudes are still there' and is supported by empirical results (Petty et al., 2006). The second possibility is that the new evaluative associations are rejected (e.g., benefits of flu vaccination), and the old evaluative associations are still endorsed (e.g., negative aspects of flu vaccination). In this case, the indirect attitude measures depict change before the direct attitude measures.

In sum, the MCM surpasses other attitude models because it explicitly acknowledges ambivalent attitudes and predicts when and why direct and indirect attitude measures dissociate. Whereas the 'past attitudes are still there' case (Petty et al., 2006) and the influence of credibility on felt ambivalence (DeMarree et al., 2015) has been empirically tested and supported, the basic assumption that attitude objects that have opposing evaluative associations with the same validity information lead to ambivalence on direct and indirect attitude measures has yet to be tested. These opposing evaluative associations can either be formed consecutively (e.g., first positive evaluative associations and then negative evaluative associations) or interspersed (e.g., randomly intermixed). Hence, blocked as well as interspersed presentation of opposing information without any indication of different validity information should lead to ambivalence on direct and indirect attitude measures.

Evidence for Ambivalent Attitude Formation

Research that explains attitude formation often without cues on validity information is Evaluative Conditioning (EC) research. In a typical EC procedure, a neutral stimulus (CS) is repeatedly paired with one stimulus or multiple stimuli of the same valence (US; for reviews, see De Houwer et al., 2001; Walther et al., 2005). Through this repeated co-occurrence, the CS gains the valence of the paired stimulus (De Houwer, 2007). For instance, a neutral picture (i.e., CS) will be evaluated more positively after it has been repeatedly paired with a positive picture or multiple positive pictures (i.e., US). Not only can pictures be used as stimuli, but EC has been shown with visual, verbal, taste, auditory, or odor US (for a meta-analysis, see Hofmann et al., 2010). Because the CS are merely paired with the US, validity information for all stimuli should be the same.

The MCM (Petty et al., 2007) would predict ambivalence when a CS is paired with positive and negative US. Indeed, Glaser et al. (2018) repeatedly paired a CS with a compound US of a positive and negative picture. They found evidence for potential and felt ambivalence. However, when they corrected for multiple comparisons, some critical comparisons did not reach significance. Similarly, Berger (2020) found weak evidence for ambivalent attitude formation if a CS was paired with a positive and a negative US picture. Additionally, evidence for ambivalent attitude formation was more substantial when one US was visual (i.e., a picture) and one US was auditive (i.e., a sound). However, even when there was relatively strong evidence for ambivalence in direct attitude measures, there was limited evidence for ambivalence in indirect attitude measures.

Further evidence that pairing positive and negative aspects with an attitude object leads to ambivalence is brought forward by Béna et al. (2023). In their studies, they used relational EC procedures. In relational EC, the CS is not merely paired with the US, but the relation between the CS and the US is specified. For example, a CS starts/causes/loves/loathes a US. Béna et al. (2023) demonstrated that a CS that loathed or prevented a positive US elicited higher felt ambivalence than a CS that loathed or prevented a negative US. On indirect attitude measures, the evidence for ambivalence was inconsistent.

Similarly to relational EC, impression formation paradigms pair a name or a picture of a target individual (i.e., CS) with information about this individual (i.e., US). For example, Priester and Petty (1996) used an impression formation paradigm to systematically investigate the influence of the amount of positive and negative information. They found that felt ambivalence increased with the amount of counter-attitudinal information.

In sum, evidence for the MCM (Petty et al., 2007) prediction that attitude objects with positive and negative evaluative associations with the same validity information lead to ambivalence on direct and indirect attitude measures is mixed. There are four major critiques of previous research. First, the interpretation and comparison of the research results are impaired as some studies only measure felt ambivalence but not potential ambivalence (Béna et al., 2023). Even though potential ambivalence should be a prerequisite for felt ambivalence, the correlation between potential and felt ambivalence is moderate (e.g., range of *r*s = .36 - .52; Priester & Petty, 1996). Because felt ambivalence can be influenced by situational (e.g., Nohlen et al., 2016) and personality (e.g., Newby-Clark et al., 2002) factors, it is not clear if an ambivalent attitude is formed when only felt ambivalence is measured. Second, some studies only use direct measures (Glaser et al., 2018; Priester & Petty, 1996). Based on the assumptions of the MCM (Petty et al., 2007), it is possible that the direct measures do not indicate ambivalence, but the indirect measures indicate ambivalence. Additionally, direct measures can be influenced by the introspective ability of the respondent (Schneider et al., 2015). Hence, only using direct measures might lead to the oversight of ambivalence. Third, some studies use unvalidated indirect measures (Glaser et al., 2018) or indirect measures with poor reliability (Berger, 2020). Without validation of a measurement instrument, it is unclear what it measures. Furthermore, even some validated indirect ambivalence measures might be unreliable. For instance, previous studies used the Ambivalent Primes Paradigm as indirect measure (Berger, 2020). Fourth, some stimuli used as US in conditioning studies (Berger, 2020; Glaser et al., 2018) might inherently be ambivalent (Schneider et al., 2016). Therefore, the interpretation of these study results is limited, as the effects might not be due to the pairing of a neutral stimulus with a positive and negative stimulus but due to the pairing of a neutral stimulus with a univalent and an ambivalent stimulus. In sum, a systematic investigation of ambivalent attitude formation using direct and indirect measures is missing.

The Present Dissertation

To overcome this research gap, I will present the studies I conducted during my PhD, systematically investigating the formation of ambivalent attitudes. On the assumption that an attitude object has an underlying associative structure (Dalege et al., 2018; Fazio, 1990; Gawronski & Bodenhausen, 2006; McConnell & Rydell, 2014; Petty et al., 2007), the studies in the first manuscript, test the idea that adding an unaligned association (i.e., counter-attitudinal association) to a mostly aligned attitude (i.e., univalent attitude) leads to ambivalence. Because attitude elements can include behavior (Dalege et al., 2016), attitude-inconsistent behavior should result in an unaligned association and, therefore, in ambivalence.

The second and third manuscripts are based on the predictions of the MCM (Petty et al., 2007). Specifically, in the second manuscript, the procedure is kept close to other studies testing the prediction of the MCM (Petty et al., 2006). That is, the opposing information is presented blockwise. Additionally, the opposing information is presented without any indication of validity information. Therefore, direct and indirect attitude measures should indicate ambivalence. The third manuscript presents a stricter test of the MCM's prediction that attitude objects associated with positive and negative information and the same validity information lead to ambivalence on direct and indirect attitude measures (Petty et al., 2007). That is, the first two studies of this manuscript compare interspersed information presentation to univalent control conditions, and the third study systematically tests the influence of block-size of information presentation (i.e., interspersed vs. different block-sizes) on direct and indirect attitude measures.

Original Manuscripts

The original manuscripts are the basis of this dissertation. Every manuscript can be viewed as a standalone and thus has its own introduction, discussion, and references. The manuscripts are presented in the order they are discussed in the present thesis.

The Genesis of Ambivalent Attitudes:

Does Forced Incongruent Behavior Lead to Ambivalence

Lena Hahn & Eva Walther

Trier University

Abstract

Attitudes are a crucial construct because they are a major predictor of behavior. However, attitudes go well beyond simple liking and disliking (i.e., univalence). Research and introspection suggest that attitudes can be simultaneously positive and negative (i.e., ambivalent). While there is evidence of the consequences of ambivalence, little is known about the necessary and sufficient conditions that produce attitudinal ambivalence. In a forced-choice paradigm, participants were forced to respond incongruently (e.g., negative to a positive picture) and congruently (e.g., positive to a positive picture) to different univalent pictures. Then, ambivalence towards all pictures was measured using mouse tracking. In the four studies, we found that ambivalence was greater towards pictures from the incongruent block than those from the congruent block. We find evidence that this effect is independent of the induction method (i.e., button press vs. mouse tracking), valence, and picture content (i.e., human vs. animal). However, we failed to find evidence for ambivalence measured via self-report. We discuss possible explanations and avenues for future research.

Keywords: Ambivalence, Mouse tracking, Forced Choice

Introduction

People are often forced to behave in a manner that is against their attitudes. For example, many people do not like paying taxes; however, due to legal restrictions, most people have to and pay taxes. Hence, people are forced to exhibit behavior that is incongruent with their attitudes. We propose that the incongruency between attitude and behavior can lead to attitudinal ambivalence.

Ambivalence is the simultaneous association of opposing evaluations towards one attitude object (van Harreveld et al., 2015). Research differentiates between potential and felt ambivalence (Kaplan, 1972; Priester & Petty, 1996). Whereas potential ambivalence is the structure of opposing evaluations and is captured by measuring positivity and negativity separately (Thompson et al., 1995), felt ambivalence is the experienced conflict and is captured by measuring the mixed feelings (Priester & Petty, 1996).

Going beyond self-report, the experience of ambivalence can also manifest in body movement. For example, Schneider et al. (2013) measured side-to-side body movement of participants. They found that participants in an ambivalent condition showed more side-to-side movement than those in a univalent condition. Another method to capture conflict in body movement is mouse tracking (Schneider et al., 2015; Schneider & Mattes, 2021). In mouse tracking, the mouse movement is captured online while participants categorize an object. Decisions concerning an ambivalent object lead to more pull towards the non-chosen response, whereas decisions concerning a univalent or neutral object lead to less pull (Schneider et al., 2015; Schneider & Mattes, 2021). Because the experience of conflict is aversive, people use coping strategies such as biased information processing (Nordgren et al., 2006) or decision delay (van Harreveld et al., 2009) to resolve this conflict.

Many attitude theories (Dalege et al., 2016, 2018; Fazio, 2007; Gawronski & Bodenhausen, 2006; Petty et al., 2007) propose that an associative structure in memory underlies attitudes. Hence, there should be potential ambivalence if the associative structure consists of positive and negative evaluative elements. For example, the Causal Attitude Network model (Dalege et al., 2016) proposes that attitude objects are connected to evaluative reactions, which can be feelings, beliefs, or behaviors. Felt ambivalence arises if the opposing associations are salient (e.g., when people ponder a decision; van Harreveld et al., 2009). For example, people might not like to pay their taxes. However, they also know that tax income is used to improve public infrastructure. Thus, paying taxes might lead to potential ambivalence, and when people ponder the decision to pay taxes, these opposing evaluations might lead to the experience of ambivalence (i.e., felt ambivalence).

In line with this, previous research has induced ambivalence by connecting an attitude object with positive and negative information. For example, in previous studies, participants had to read a newspaper article that described positive as well as negative aspects of a given topic (Nordgren et al., 2006). In other studies, participants freely chose a topic they felt ambivalent about and listed positive as well as negative aspects of the topic (Schneider et al., 2013; van Harreveld et al., 2014). Additionally, research also shows that pairing positive and negative stimuli with a previously neutral (neither positive nor negative) attitude object might lead to ambivalence (Durso et al., 2021; Glaser et al., 2018). Béna et al. (2023) used an evaluative conditioning paradigm to investigate ambivalence. In their studies, fictitious alien species either loved something negative or loathed something positive. Compared to a control condition (i.e., alien species love something positive or alien species loathe something negative), the ambivalent condition resulted in higher felt ambivalence. Thus, simply pairing positive and negative with something neutral should lead to ambivalence. However, these studies start with a neutral attitude object.

The Present Investigation

Going beyond previous research, we propose that adding an attitude inconsistent element to a univalent attitude should lead to ambivalence. Previous research has shown that influencing one attitude element can change the associative structure underlying the attitude (Chambon et al., 2022). In the present investigation, however, we do not try to influence an existing attitude element but create a new association of opposing valence. Because evaluative elements can be behaviors (e.g., Dalege et al., 2016), attitude incongruent responses to a univalent attitude object should lead to a new association that is of opposing valence. Therefore, in the present investigation, participants are confronted with univalent pictures and must repeatedly respond in a manner incongruent with their attitude in the experimental condition and respond in a manner congruent with their attitude in the control condition. Because the pictures are univalent but are repeatedly paired with the opposing valence, they should gain a degree of ambivalence.

In all studies, we demonstrate that repeatedly responding incongruently to the univalent attitude object leads to more pull towards the non-chosen response in mouse tracking. Studies 2-4 show that this effect is independent of the induction method. Study 3 and Study 4 demonstrate that the effect is independent of the content of the picture.

Study 1

Study 1 was designed to test whether repeatedly responding incongruently to a univalent attitude object will lead to higher ambivalence. The study was an online study and programmed with Enterprise Feedback Suite Survey from Tivian XI. An adapted version of Mathur and Reichling's (2019) online mouse tracking for Enterprise Feedback Suite Survey (Buttlar et al., 2023; Puteri et al., 2022) was used to implement mouse tracking.

Method

Participants and Design

The online survey was distributed via the participant management system of the university and social networks. University student participants received partial course credit for their participation. A total of N = 129 people participated in the study. Due to missing values after implementing the exclusion criteria of reaction time (Median +/- 2.5 * Median Absolute Deviation; Leys et al., 2013), three participants were excluded. Thus, all analyses were performed with the final sample of N = 126 (M_{age}= 24.33 years, SD = 9.2, range = 18 to 71, 88 females, 38 males). A 2 (Congruency: congruent vs. incongruent) x 2 (Valence: positive vs. negative) x 2 (Allocation of Response: left positive vs. left negative) x 2 (Order: first congruent vs. first incongruent) within-between design was implemented. All post-hoc pairwise comparisons were Bonferroni corrected.

Procedure

After receiving information about the study procedure and duration, participants gave informed consent to the study procedure, data processing, and data storage. Next, they indicated whether they used a tower PC or laptop and a computer mouse. If participants did not use a computer mouse, they were thanked for their interest and informed that they could only participate when they used a computer mouse. Participants using a computer mouse first received general instructions regarding the study and mouse tracking. They were instructed that they would have to evaluate pictures in a manner congruent or incongruent with their own attitude and that they should read the instructions carefully.

The experiment consisted of three blocks. The first two blocks were the induction, and the last block was the dependent variable measure. The induction blocks consisted of practice and then the experimental trials. All participants completed the congruent and the incongruent blocks. However, the order of the induction blocks was counterbalanced between participants.

Thus, approximately half of the participants first completed the congruent block followed by the incongruent block, and the other half completed the incongruent block followed by the congruent block.

Instructions were adapted from Hütter and Sweldens (2018). For the congruent block, the instruction was that participants should answer congruent with their own attitude. That is, they should evaluate a picture positively if they perceive it as positive. Conversely, they should evaluate a picture negatively if they perceive it as negative. For the incongruent block, the instruction was that participants should answer incongruent with their own attitude. That is, they should evaluate a picture positively if they perceive it as negative. Conversely, they should evaluate a picture negatively if they perceive it as positive. Practice trials followed these initial instructions. In the practice trials, participants evaluated two positive and two negative pictures of humans (Postzich et al., 2016). After the practice trials, participants read a reminder of the instructions. The experimental trials consisted of five positive and five negative pictures presented six times in a randomized order. After half the trials, a reminder of the instructions was presented again. We used different pictures for the congruent and incongruent blocks. Thus, we used a total of 10 positive animal pictures and 10 negative animal pictures from the animal images database (Possidónio et al., 2019). To ensure univalence, the mean validation rating for valence had to be larger than five for positive pictures and smaller than three for negative pictures (scale from 1 very negative to 7 very positive; Possidónio et al., 2019).

After the two induction blocks, participants received the information that they would see all the pictures again. However, this time, they should rate all pictures consistent with their own attitude. Participants evaluated all pictures twice. Afterward, they answered demographic questions and could leave comments about the study.

Measures

We used an online implementation of the Mousetracker paradigm (Mathur & Reichling, 2019) adapted for Enterprise Feedback Suite Survey (Buttlar et al., 2023; Puteri et al., 2022). Before the mouse tracking, participants received general instructions about mouse tracking. They were instructed to first click the start button in the bottom middle of the screen and then move the computer mouse to one of the response buttons in the top left or top right corner of the screen. The allocation of the response buttons was counterbalanced between participants. Thus, half of the participants had positive in the top left corner and negative in the top right, and the other half had negative in the top left corner and positive in the top right.

Additionally, they were informed (1) that they should only start moving the mouse when the page was fully loaded and (2) that they should move the mouse immediately after the page was loaded, even if they have not yet fully decided on their response. Participants were instructed to try to follow the feedback even if they found it challenging to find the right timing. The feedback was presented when (1) participants started too early when they moved the mouse before the picture was fully loaded, and (2) participants started too late when they did not move the mouse in the first 1500 ms after the picture was fully loaded. Participants were instructed to put the browser window in full-screen mode when a mouse tracking block was initiated. The full-screen mode should ensure that the 925 x 675-pixel area in which the stimulus presentation and mouse tracking took place was fully displayed on the screen.

With mouse tracking, it is possible to record the movement of the computer mouse to the response button. Whereas univalence is indicated by a relatively straight line to the chosen response button, ambivalence is characterized by a curved line. Thus, ambivalent responses should lead to more pull to the non-chosen response button (Schneider et al., 2015; Schneider & Mattes, 2021). Therefore, the dependent variable is the maximum horizontal deviation (xDev) of the participants' mouse movement and an ideal trajectory (i.e., a perfect straight line from the start button to the chosen response). Hence, in the third block, we expect a bigger xDev for pictures previously in the incongruent block than those in the congruent block.

Results

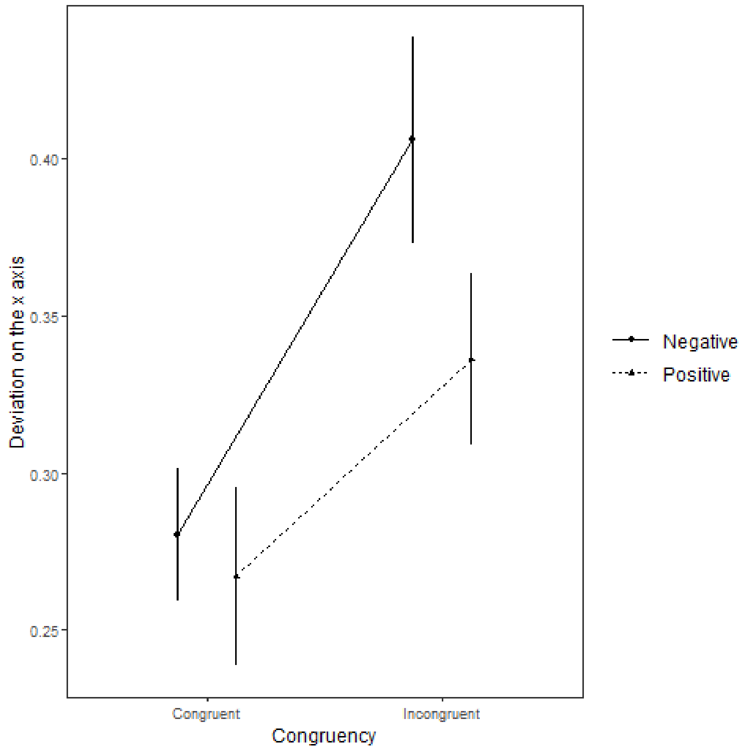
To investigate if forced incongruent responses led to higher horizontal deviation, a 2 (Congruency: congruent vs. incongruent) x 2 (Valence: positive vs. negative) x 2 (Allocation of Response: left positive vs. left negative) x 2 (Order: first congruent vs. first incongruent) analysis of variance (ANOVA) with repeated measurement on the first two factors was performed. The main effect of Congruency was significant, $F(1, 122) = 47.72$, $p < .001$, $\eta^2_p = .28$. Consistent with our hypothesis, pictures from the incongruent block ($M = 0.37$, $SE = .02$) had higher xDev than those from the congruent block ($M = 0.27$, $SE = .01$).

Additionally, the interaction of Congruency and Order was significant, $F(1, 122) = 6.58$, $p = .012$, $\eta^2_p = .05$. Bonferroni corrected pairwise comparisons revealed that pictures to which participants responded incongruently elicited higher xDev than pictures to which participants responded congruently for first congruent ($p < .001$; $M_{congruent} = .25$, $SE_{congruent} = .02$; $M_{incongruent} = .38$, $SE_{incongruent} = .03$) as well as for first incongruent ($p = .018$; $M_{congruent} = .3$, $SE_{congruent} = .02$; $M_{incongruent} = .36$, $SE_{incongruent} = .03$). Additionally, the xDev for congruent in the first congruent order was significantly lower than incongruent in the first incongruent condition ($p = .011$). Hence, order influences the magnitude of the congruency effect. Thus, the horizontal deviation was highest when the incongruent induction was immediately before the mouse tracking block in which participants evaluated all pictures.

Additionally, the main effect of Valence was significant, $F(1, 122) = 7.11$, $p = .009$, $\eta^2_p = .06$, indicating that negative pictures ($M = .34$, $SE = .02$) had higher xDev compared to positive pictures ($M = .3$, $SE = .01$). This main effect was qualified by the interaction of Congruency and Valence, $F(1, 122) = 5.7$, $p = .019$, $\eta^2_p = .05$. Congruent negative and congruent positive did not differ significantly ($p > .05$). All other comparisons were significant ($ps < .05$). This indicates that pictures that participants had responded incongruently to elicited higher xDev compared to pictures that participants had responded congruently to for negative pictures ($M_{congruent} = .28$, $SE_{congruent} = .02$; $M_{incongruent} = .41$, $SE_{incongruent} = .02$) as well as positive pictures ($M_{congruent} = .24$, $SE_{congruent} = .02$; $M_{incongruent} = .34$, $SE_{incongruent} = .02$). Hence, the magnitude of the effect was higher for the negative pictures (see Figure 1). There were no other significant main effects or interactions ($ps > .05$)

Figure 1

Depiction of Interaction of Congruency and Valence with x Deviation as Dependent Variable



Note. Error bars depict within error.

Discussion

The first study demonstrates that repeatedly responding incongruently to a univalent picture can lead to higher horizontal deviation, which might indicate ambivalence. However, this study has two limitations. First, the pictures were not randomly assigned to the congruency condition. Even though the pictures had similar valence ratings, this might have influenced the results. Second, the method of induction and measurement of the dependent variable were the same. Hence, we might not have induced ambivalence, but participants merely learned the hand movement. To rule out these limitations, we conducted Study 2.

Study 2

In the second study, we randomized the assignment of positive and negative pictures to congruency conditions. We manipulated whether the response format in the induction was mouse tracking or if it was button press. Additionally, we included a second measurement timepoint to investigate if the effect was stable over one week. Furthermore, this second study was a laboratory study and pre-registered. We programmed the study in OpenSesame version 3.3.11 (Mathôt et al., 2012) and used the mousetrap plugin (Kieslich & Henninger, 2017) to implement mouse tracking.

Method

Participants and Design

As pre-registered, we terminated data collection on July 1st, 2022. Of the 37 people participating in the measurement of Time 1, 29 also participated in Time 2. Due to a computer error while running the program, two participants were excluded. These exclusions led to a final sample of N = 27 participants (M_{age}= 21.77 years, SD = 2.14, range = 19 to 27, one did not indicate age; 18 females, 6 males, 3 did not indicate; three participants indicated they had arachnophobia, none had ophidiophobia and none had murophobia). A 2 (Congruency: congruent vs. incongruent) x 2 (Time: Time 1 vs. Time 2) x 2 (Valence: positive vs. negative) x 2 (Induction: mouse tracking vs. button press) within-between design was implemented. Please note that the allocation of response and order were dropped from the analysis due to the small sample size. All post-hoc pairwise comparisons were Bonferroni corrected.

Procedure

The study took place at a group laboratory at Trier University. A total of six participants could participate at the same time. The workplaces were divided with partition walls. When participants entered the laboratory, they were seated at a desk with a computer monitor, mouse, and QWERTZ keyboard. Participants first gave informed consent to the study procedure and data processing.

The instructions and procedure were essentially the same as in Study 1, with five deviations. First, approximately half of the participants had to respond with button press in the induction blocks. The response buttons were s and l. Participants were instructed to put their left index finger on the s key and their right index finger on the l key. The response side was counterbalanced between participants. If participants took over 3000 ms to respond, they were instructed to respond faster. Second, in mouse tracking, participants had to initiate movement within the first 1000ms, and the started too early alert was not necessary as the pictures appeared immediately after participants clicked the start button. Third, we doubled the number of stimuli. That is, participants responded to 10 positive and 10 negative animal pictures in the congruent and incongruent induction, resulting in 40 pictures. Additionally, each picture was presented three times in the mouse tracking for the dependent variable measure. Fourth, participants completed the Trait Ambivalence Scale (Schneider et al., 2020) at the end of the study and indicated if they had arachnophobia, ophidiophobia, or murophobia. We do not report these analyses because Trait Ambivalence did not influence the results. Fifth, participants were invited for a second measurement approximately one week later to test the stability of the effect. At Time 2, participants only completed the dependent variable measure. Hence, participants only completed the third block of Time 1 again.

Measures

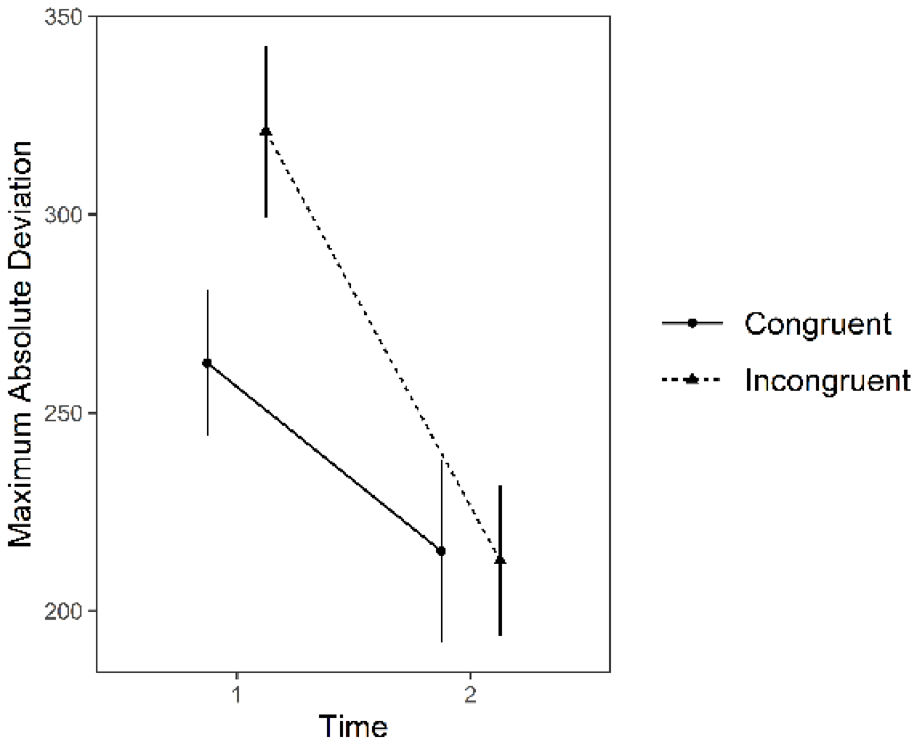
The laboratory study allowed us to calculate the dependent variable used in the validation study of mouse tracking as an ambivalence measure (Schneider et al., 2015). Whereas in Study 1, only the deviation on the x-axis was used as a dependent variable, we used the maximum absolute deviation (MAD) in the current study. That is the maximum absolute perpendicular deviation of the perfect straight line from the start to the chosen response button (Schneider et al., 2015). Additionally, the trajectories were time normalized to ensure the same number of measurements for each trajectory. We changed to this indicator in the current study as well as the following studies, as this is how mouse tracking was validated as an ambivalence measure (Schneider et al., 2015; Schneider & Mattes, 2021). As in Study 1 and pre-registered, we used Median +/- 2.5 * Median Absolute Deviation of reaction times to exclude outliers (Leys et al., 2013).

Results

To investigate (1) if forced incongruent answers lead to more ambivalence compared to congruent answers, (2) if there is an effect of the response format in the induction phase, and (3) if the congruency effect is stable over one week, a 2 (Congruency: congruent vs. incongruent) x 2 (Time: Time 1 vs. Time 2) x 2 (Valence: positive vs. negative) x 2 (Induction: mouse tracking vs. button press) ANOVA with repeated measurement on the first three factors was performed. Consistent with our hypothesis, we found that pictures that were in the incongruent block had a higher MAD ($M = 255$, $SE = 27.4$) compared to pictures that were in the congruent block ($M = 234$, $SE = 29.0$), $F(1, 25) = 5.76$, $p = .024$, $\eta^2_p = .19$. Additionally, we found a main effect of Time, $F(1, 25) = 37.54$, $p < .001$, $\eta^2_p = .6$, indicating higher MAD at measurement Time 1 (*M* = 282, *SE* = 27.6) compared to one week later (*M* = 207, *SE* = 29.5).

Figure 2

Depiction of Interaction between Congruency and Time



Note. Error bars depict within error.

The interaction of Congruency and Time was also significant, $F(1, 25) = 5.57$, $p = .026$, $\eta^2_p = .18$. Pairwise comparisons revealed that the congruency effect only held for measurement Time 1. That is, pictures from the incongruent induction had higher MAD compared to the congruent induction at measurement point Time 1 ($p = .015$; $M_{congruent} = 260$, $SE_{congruent} = 29$; $M_{incongruent} = 304$, $SE_{incongruent} = 27.7$) but not at Time 2 ($p > .05$; $M_{congruent} = 209$, $SE_{congruent} = 31.1$; $M_{incongruent} = 206$, $SE_{incongruent} = 29.3$). All other pairwise comparisons were significant, indicating a significant decrease in MAD from Time 1 to Time 2 in the congruent as well as the incongruent condition (see Figure 2). Thus, the congruency effect is unstable over the course of one week, and even the MAD of the pictures in the congruent condition decreases. All other effects were not significant (ps > .05). No other main effects or interactions were significant (ps > .05). This indicates that the induction method did not influence the results.

Discussion

In Study 2, we again find that when participants previously categorized pictures incongruent with their attitude, they showed a higher pull towards the non-chosen response than when participants categorized pictures congruent with their attitude. This effect was not stable over one week. However, it seems independent of the response mode of induction. The results should be interpreted carefully as the sample size is relatively low. Even though the assignment of pictures to congruency condition was randomized, we cannot rule out that this effect only applies to animal pictures.

Study 3

To overcome the limitation of the small sample size and to generalize the effect to other picture content, we conducted Study 3. Additionally, we wanted to demonstrate that the effect is also depicted in self-reported measures of ambivalence. We propose that the pictures in the incongruent block have higher potential and felt ambivalence compared to the pictures in the congruent block. The study was again implemented with OpenSesame version 3.3.11 (Mathôt et al., 2012), and the mousetrap plugin (Kieslich & Henninger, 2017) was used for mouse tracking. The study was pre-registered.

Methods

Participants and Design

Inconsistent with the pre-registration, we collected data until the end of the term to get as close to the planned sample size (N = 120) as possible. We recruited N = 111 participants

(M_{age} = 21.66 years, *SD* = 3.35, range = 18 to 36, two did not indicate age; 90 females, 13 males, eight did not indicate; two did not indicate if they had murophobia, 13 ophidiophobia, 25 participants had arachnophobia). A 2 (Congruency: congruent vs. incongruent) x 2 (Picture: human vs. animal) x 2 (Valence: positive vs. negative) x 2 (Induction: mouse tracking vs. button press) x 2 (Allocation of Response: left positive vs. left negative) x 2 (Order: first congruent vs. first incongruent) design was implemented. All post hoc pairwise comparisons were Bonferroni corrected.

Procedure

The procedure and instructions were the same as in Study 2, with three exceptions. First, participants completed the Trait Ambivalence Scale (Schneider et al., 2020), the Need for Cognitive Closure Scale (Schlink & Walther, 2007), and the 6 Facets Reactivated F Scale (Heidemeyer et al., 2021). We measured participants' Trait Ambivalence and Need for Cognitive Closure to test them as possible moderators of the effect. However, we did not report them because they did not influence the results. The 6 Facets Reactivated F scale was implemented as a buffer to make the research goal less obvious. Second, besides the 40 animal pictures (Possidónio et al., 2019), we used 20 positive and 20 negative human pictures (Postzich et al., 2016), resulting in 80 pictures. We added the pictures depicting humans to test whether the effect depends on picture content. In the practice trials, we used a happy and sad smiley to avoid priming with the target stimuli. Third, after completing the mouse tracking for the dependent measure, participants indicated positivity, negativity, and felt ambivalence towards the pictures. We implemented this change to demonstrate that the association to the opposing valence is not only captured in mouse tracking but also results in more positive and negative associations (i.e., potential ambivalence) and the experience of conflict (i.e., felt ambivalence).

Measures

Mouse tracking was implemented as in Study 2. As pre-registered, Median +/- 2.5 * Median Absolute Deviation of reaction times was used for outlier exclusion (Leys et al., 2013).

To capture potential ambivalence, participants indicated positivity and negativity separately. Participants rated the positivity [negativity] of the picture, ignoring the negative [positive] aspects on a slider. Only the endpoints were labeled not at all positive [negative] and maximally positive [negative]. The slider ranged from -100 to 100. We transformed the data so that all values were positive and calculated the similarity intensity model index (SIM-Index; Thompson et al., 1995): (Positivity + Negativity)/2 - |Positivity – Negativity|. Higher values on the SIM-Index indicate higher potential ambivalence.

Felt ambivalence was measured using a single item (Schneider et al., 2015). That is, participants indicated their mixed thoughts and feelings toward each picture. Responses were also indicated on a slider with only the endpoints labeled not at all (left) and maximally (right). The slider ranged from -100 to 100.

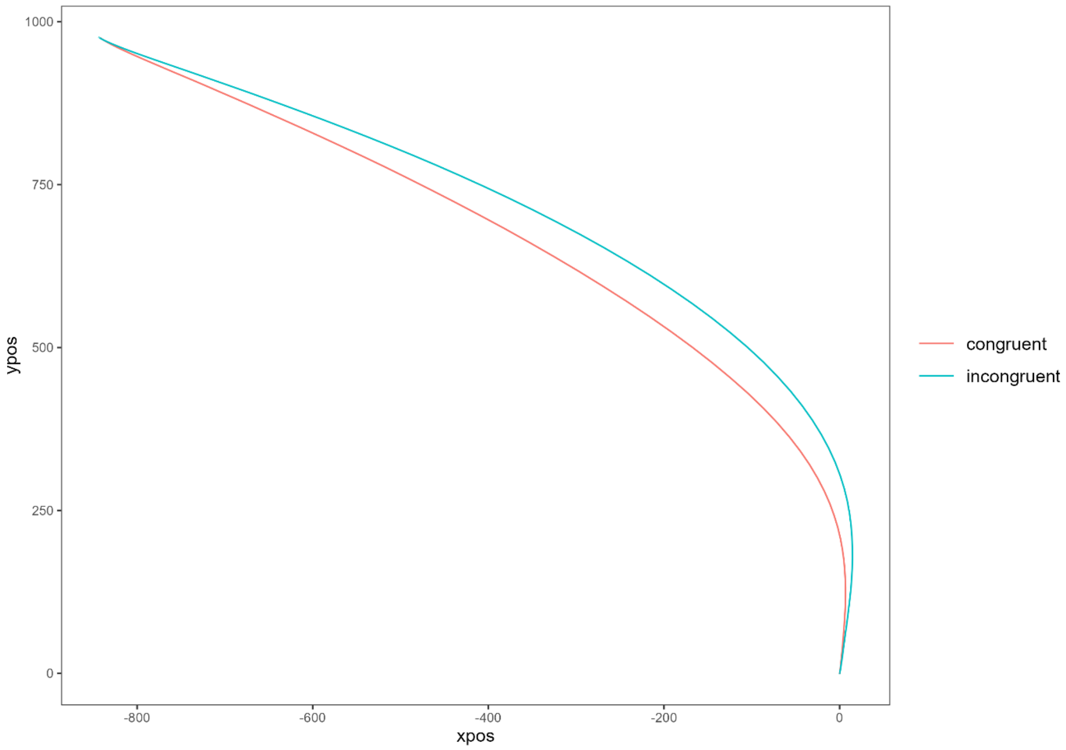
Results

A 2 (Congruency: congruent vs. incongruent) x 2 (Picture: human vs. animal) x 2 (Valence: positive vs. negative) x 2 (Induction: mouse tracking vs. button press) x 2 (Allocation of Response: left positive vs. left negative) x 2 (Order: first congruent vs. first incongruent) ANOVA with repeated measurement on the first three factors and MAD as the dependent variable was calculated. Consistent with the first two studies, results revealed a main effect of Congruency, $F(1, 103) = 96.17$, $p < .001$, $\eta^2_p = .48$. Pictures in the incongruent condition ($M = 321$, $SE = 13.2$) had significantly higher pull to the non-chosen response than pictures in the congruent condition ($M = 259$, $SE = 13.6$; see Figure 3).

Additionally, the interaction between Congruency and Induction was significant, $F(1, 103) = 9.59$, $p = .003$, $\eta^2_p = .09$. Pairwise comparisons revealed a significant difference between congruent and incongruent when the induction was via mouse tracking ($p < .001$; $M_{congruent} = 269$, $SE_{congruent} = 19.2$; $M_{incongruent} = 351$, $SE_{incongruent} = 18.6$) and button press ($p < .001$; $M_{congruent} = 248$, $SE_{congruent} = 19.4$; $M_{incongruent} = 291$, $SE_{incongruent} = 19.4$). Furthermore, incongruent mouse tracking had significantly higher MAD than congruent button press ($p = .001$; all other *p*s > .05). Hence, data indicate the congruency effect for button press and mouse tracking. However, the effect was larger when the induction was also via mouse tracking.

Figure 3

Depiction of the Average Mouse Trajectory by Congruency



Note. The red line depicts the average trajectory for congruent, and the blue line depicts the average trajectory for incongruent.

The interaction between Congruency and Picture was marginally significant, $F(1, 103) = 3.92$, $p = .050$, $\eta^2_p = .05$. Bonferroni corrected pairwise comparison indicated no differences between animal and human congruent ($p > .05$) as well as animal and human incongruent ($p > .05$). All other pairwise comparisons were significant (ps $< .001$). This indicates a congruency effect for animal as well as human pictures.

The Valence x Picture interaction was also significant, $F(1, 103) = 69.34$, $p < .001$, $\eta^2_p = .4$. Human negative ($M = 333$, $SE = 17.6$) had significantly higher MAD than human positive ($p < .001$; $M = 240$, $SE = 14.2$) as well as animal negative pictures ($p < .001$; $M = 273$, $SE = 15.6$). Additionally, animal positive ($M = 314$, $SE = 16.4$) was significantly higher than human positive pictures ($p < .001$). This indicates a larger discrepancy between positive and negative for pictures depicting humans compared to pictures depicting animals.

This interaction was qualified by the three-way interaction of Valence, Picture, and Congruency, $F(1, 103) = 14.77$, $p < .001$, $\eta^2_p = .13$. Data showed significantly higher MAD for incongruent compared to congruent conditions for animal negative ($p < .001$), animal positive ($p < .001$), human negative ($p < .001$), and human positive ($p = .03$). Additionally, pairwise comparisons revealed the same significant pairwise comparisons as the two-way interaction for congruent and incongruent (see Table 1 for Means and Standard Errors). Hence, data indicate that human negative had higher MAD than animal negative (ps $< .05$) and human positive (ps $< .05$). Animal positive had significantly higher MAD than human positive (ps $< .05$). Furthermore, congruent animal negative had significantly lower MAD than incongruent animal positive ($p < .001$) and incongruent human negative ($p < .001$). Congruent human positive had significantly lower MAD than incongruent animal negative ($p = .003$), incongruent animal positive ($p < .001$) and incongruent animal positive ($p < .001$). Congruent animal positive was significantly lower than incongruent human negative ($p <$

.001; all other *p*s > .05). In sum, we find the congruency effect for all pairings. However, the magnitude of the effect depends on the depicted content and the valence of the pictures.

Table 1

Means and Standard Error by Congruency, Picture, and Valence

		Congruency			
		Congruent		Incongruent	
Valence	Picture	*M*	*SE*	*M*	*SE*
Negative	Animal	247.99	15.88	297.42	16.82
	Human	296.89	18.31	368.66	18.67
Positive	Animal	267.17	17.08	361.10	17.60
	Human	222.71	15.71	257.83	14.62

Table 2

Means and Standard Error by Congruency, Order, Induction, and Valence

			Congruency			
			Congruent		Incongruent	
Order	Induction	Valence	*M*	*SE*	*M*	*SE*
Congruent first	Button press	Negative	254.22	32.25	278.03	32.79
		Positive	187.21	31.77	245.73	30.35
	Mouse tracking	Negative	295.16	31.64	403.14	32.18
		Positive	273.41	31.18	354.76	29.78
Incongruent first	Button press	Negative	269.50	31.64	317.83	32.18
		Positive	282.78	31.18	323.35	29.78
	Mouse tracking	Negative	270.88	31.64	333.16	32.18
		Positive	236.34	31.18	314.00	29.78

The Induction x Order x Congruency x Valence interaction was also significant, $F(1, 103) = 4.25$, $p = .042$, $\eta^2_p = .04$. When the incongruent induction preceded the congruent induction, the data only indicate the congruency effects for mouse tracking (*p*s < .001; see

Table 2 for Means and Standard Error). For button press, this effect was marginally significant for negative pictures (p = .08). When the congruent induction preceded the incongruent induction, the data again indicated the congruency effects for mouse tracking (ps < .001). However, this time, the effect was also significant for positive pictures in the button press condition (p = .024). Additionally, for mouse tracking, incongruent negative had significantly higher MAD than mouse tracking congruent positive (p = .004), incongruent positive button press (p = .016), congruent positive button press (p < .001), and congruent negative button press (p = .041). Additionally, mouse tracking incongruent positive had significantly higher MAD than button press congruent positive (p = .005). This indicates that the effect is larger for mouse tracking than button press and when the incongruent induction was immediately before the dependent variable measure.

The Induction x Allocation of Response x Order x Congruency x Valence interaction was significant, $F(1, 103) = 7.12$, $p = .009$, $\eta^2_p = .07$. When the incongruent induction preceded the congruent induction, the data only indicated a marginally significant congruency effect when the negative response was on the left side for positive pictures in mouse tracking (p < .001). When congruent preceded the incongruent induction, the data indicated a congruency effect when the negative response was on the left side for negative pictures in mouse tracking (p < .001) and when the positive response was on the left side for negative (p = .002) as well as positive pictures (p < .001) in mouse tracking. Additionally, incongruent negative pictures in mouse tracking with the negative response on the left side had significantly higher MAD than congruent positive pictures in button press with the positive response on the left side (p = .023; see Table 3 for Means and Standard Error).

Even though the interaction of Allocation of Response and Picture was significant, $F(1, 103) = 6.28$, $p = .014$, $\eta^2_p = .06$, pairwise comparisons did not reveal significant differences. All other main effects and interactions were not significant (ps > .05).

Table 3

Means and Standard Error by Congruency, Order, Allocation of Response, Induction, and Valence

				Congruency			
				Congruent		Incongruent	
Order	Allocation of Response	Induction	Valence	*M*	*SE*	*M*	*SE*
Congruent first	Left negative	Button press	Negative	250.04	46.44	264.17	47.22
			Positive	198.63	45.76	267.44	43.71
		Mouse tracking	Negative	304.50	44.75	420.43	45.50
			Positive	287.40	44.09	315.48	42.12
	Left positive	Button press	Negative	258.40	44.75	291.90	45.50
			Positive	175.80	44.09	224.01	42.12
		Mouse tracking	Negative	285.82	44.75	385.86	45.50
			Positive	259.43	44.09	394.04	42.12
Incongruent first	Left negative	Button press	Negative	281.93	44.75	330.97	45.50
			Positive	330.81	44.09	363.03	42.12
		Mouse tracking	Negative	249.59	44.75	300.92	45.50
			Positive	219.14	44.09	304.92	42.12
	Left positive	Button press	Negative	257.07	44.75	304.69	45.50
			Positive	234.75	44.09	283.68	42.12
		Mouse tracking	Negative	292.17	44.75	365.41	45.50
			Positive	253.55	44.09	323.09	42.12

Self-reported Ambivalence

A 2 (Congruency: congruent vs. incongruent) x 2 (Picture: human vs. animal) x 2 (Valence: positive vs. negative) x 2 (Induction: mouse tracking vs. button press) x 2 (Order: first congruent vs. first incongruent) ANOVA with repeated measurement on the first three factors and potential ambivalence as dependent variable revealed a main effect of Congruency, $F(1, 107) = 4.14$, $p = .044$, $\eta^2_p = .04$. Inconsistent with our hypothesis, pictures to which participants previously responded incongruent with their attitude ($M = -13.3$, $SE =$

4.45) had lower potential ambivalence than pictures to which participants answered congruent (M = -10.8, SE = 4.68).

The main effects of Valence, $F(1, 107) = 40.45$, $p < .001$, $\eta^2_p = .27$, and Picture were significant, $F(1, 107) = 97.75$, $p < .001$, $\eta^2_p = .48$. Negative pictures (M = 7.84, SE = 5.84) had higher potential ambivalence than positive pictures (M = -31.99, SE = 5.14). Animal pictures (M = 4.92, SE = 4.79) had higher potential ambivalence than human pictures (M = -29.06, SE = 4.89). All other main effects and interactions were not significant (ps > .05).

We calculated a 2 (Congruency: congruent vs. incongruent) x 2 (Picture: human vs. animal) x 2 (Valence: positive vs. negative) x 2 (Induction: mouse tracking vs. button press) x 2 (Order: first congruent vs. first incongruent) ANOVA with repeated measurement on the first three factors and felt ambivalence as the dependent variable. This analysis revealed that negative pictures (M = -50.7, SE = 3.11) had higher felt ambivalence than positive pictures (M = -77.4, SE = 2.05), $F(1, 107) = 61.12$, $p < .0019$, $\eta^2_p = .36$. Additionally, animal pictures (M = -60.2, SE = 2.46) had higher felt ambivalence than human pictures (M = -67.9, SE = 2.42), $F(1, 107) = 7.66$, $p = .007$, $\eta^2_p = .07$. Inconsistent with our hypothesis, the data did not indicate a main effect of Congruency, $F < 1$, $p > .05$. No other main effect or interaction was significant (ps > .05).

Discussion

In Study 3, we replicated the results for congruency in mouse tracking. Even though the effect differed in magnitude depending on some aspects (e.g., induction, picture content), it replicated consistently. Inconsistent with our hypothesis, we did not find the expected effects on the self-reported ambivalence measures. The effect was even in the opposite direction for potential ambivalence than predicted. It might be possible that people overcompensate on an explicit measure. This would be consistent with the psychological reactance theory (Brehm, 1966). According to this theory, people are motivated to restore their freedom when it is threatened. Hence, the forced responses in the incongruent induction block might have threatened participants' freedom. Participants might have rated the pictures from this block more extreme in the positivity and negativity scale to restore their freedom. However, it might also be possible that we did not find the predicted effect because the number of pictures (i.e., 80) was too high, and the effect is only short-lived.

Study 4

To rule out that we did not find the effect because the number of pictures was too high, we conducted Study 4. Furthermore, we wanted to generalize the effect on a non-student and non-German sample. Therefore, we collected a US American sample balanced on sex via Prolific Academic. To implement the same dependent variables in mouse tracking as in Study 2 and Study 3, we programmed the study with lab.js (Henninger et al., 2022). We used the mousetrap-web plugin to implement online mouse tracking (Henninger & Kieslich, 2020). The study was pre-registered.

Method

Participants and Design

A total of 290 participants clicked on the study link. We excluded four participants who contacted us via Prolific, indicating that they were confused by the study procedure, and participants who did not complete the study resulting in $N = 225$ (110 females, 114 males, one non-binary; $M_{age} = 41.2$, $SD_{age} = 13.05$, 18-75 years, 197 used a computer mouse, 26 a touchpad and two other input devices). As pre-registered and as in the previous studies, Median Absolute Deviation (Leys et al., 2013) was used for outlier exclusion which excluded six additional participants for mouse tracking analysis resulting in a final sample of $N = 219$ (108 females, 110 males, one non-binary; $M_{age} = 41.04$, $SD_{age} = 13.08$, 18-75 years, 191 used a computer mouse, 26 a touchpad and two other input devices). A 2 (Congruency: congruent vs. incongruent) x 2 (Picture: human vs. animal) x 2 (Valence: positive vs. negative) x 2

(Induction: mouse tracking vs. button press) x 2 (Allocation of Response: left positive vs. left negative) x 2 (Order: first congruent vs. first incongruent) within-between design was implemented. All post hoc comparisons were Bonferroni corrected.

Procedure and Measured

We reduced the number of pictures to 16. Hence, the congruent and incongruent induction each included two positive and two negative animal pictures (Possidónio et al., 2019) and two positive and two negative human pictures (Postzich et al., 2016). As in Study 1, a too-early and too-slow alert for mouse-tracking was implemented. All other measures were the same except that the sliders for positivity, negativity, and felt ambivalence ranged from 0 to 100.

Results

A 2 (Congruency: congruent vs. incongruent) x 2 (Picture: human vs. animal) x 2 (Valence: positive vs. negative) x 2 (Induction: mouse tracking vs. button press) x 2 (Allocation of Response: left positive vs. left negative) x 2 (Order: first congruent vs. first incongruent) ANOVA with repeated measurement on the first three factors and MAD as the dependent variable was calculated. The main effect of Congruency was significant, $F(1, 211) = 45.79$, $p < .001$, $\eta^2_p = .18$. Consistent with the previous studies, pictures that were previously responded incongruently to ($M = 180$, $SE = 9.19$) elicited higher MAD than those previously responded congruently to ($M = 136$, $SE = 7.78$; see Figure 4).

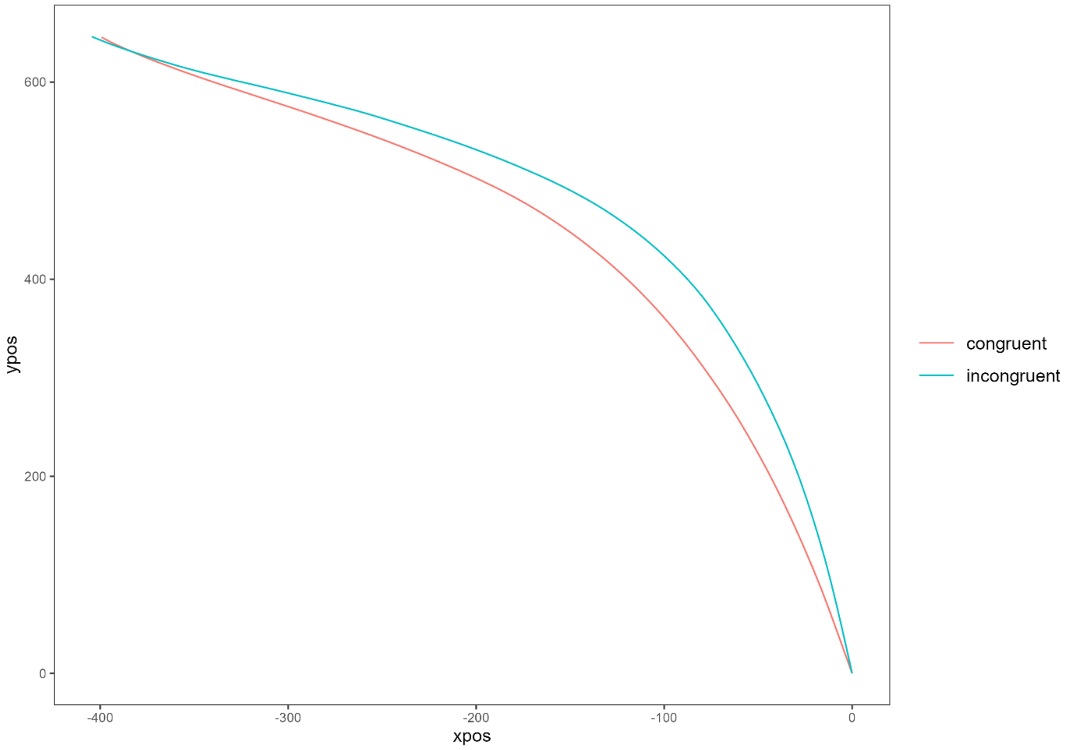
Furthermore, the main effect of Valence was significant, $F(1, 211) = 4.41$, $p = .037$, $\eta^2_p = .02$. Negative pictures ($M = 166$, $SE = 8.75$) elicited higher MAD than positive pictures ($M = 150$, $SE = 8.5$).

As in Study 3, the interaction of Valence and Picture was significant, $F(1, 211) = 37.24$, $p < .001$, $\eta^2_p = .15$. Human negative pictures ($M = 179$, $SE = 9.99$) had significantly higher MAD than human positive ($p < .001$; $M = 131$, $SE = 8.36$) and animal negative pictures

($p < .001$; $M = 152$, $SE = 8.73$). Additionally, human positive had significantly lower MAD than animal positive ($p < .001$; $M = 169$, $SE = 9.95$) and animal negative pictures ($p = .037$).

Figure 4

Depiction of the Average Mouse Trajectory by Congruency



Note. The red line depicts the average trajectory for congruent and the blue line depicts the average trajectory for incongruent.

The Picture x Congruency interaction was significant, $F(1, 211) = 4.35$, $p = .035$, $\eta^2_p = .02$. Data indicate the congruency effect for animal ($p < .001$; $M_{congruent} = 134$, $SE_{congruent} = 8.16$; $M_{incongruent} = 188$, $SE_{incongruent} = 10.18$) and human pictures ($p < .001$; $M_{congruent} = 138$, $SE_{congruent} = 8.37$; $M_{incongruent} = 173$, $SE_{incongruent} = 9.47$). Additionally, congruent animal had lower MAD than incongruent human ($p < .001$), and congruent human had significantly lower MAD than incongruent animal ($p < .001$).

Table 4

Means and Standard Error by Congruency, Picture, and Induction

		Congruency			
		Congruent		Incongruent	
Picture	Induction	*M*	*SE*	*M*	*SE*
Animal	Button press	137.27	12.36	175.95	15.40
	Mouse tracking	129.81	10.67	200.22	13.30
Human	Button press	135.25	12.67	176.48	14.33
	Mouse tracking	139.99	10.94	168.69	12.38

Furthermore, the interaction of Induction, Picture, and Congruency was significant, $F(1, 211) = 5.78$, $p = .017$, $\eta^2_p = .03$. When the induction was via mouse tracking, the congruency effect was significant for animal ($p < .001$) and marginally significant for human pictures ($p = .06$). When the induction was via button press, the congruency effect was significant for human pictures ($p = .004$) but not for animal pictures ($p = .131$). Additionally, within the button press induction, congruent animal pictures had lower MAD than incongruent human pictures ($p = .031$), and congruent human pictures had lower MAD than incongruent animal pictures ($p = .026$). Within the mouse tracking induction, congruent animal had lower MAD than incongruent human ($p = .005$), congruent human had lower MAD than incongruent animal ($p < .001$), incongruent animal had lower than incongruent human ($p = .018$). Furthermore, mouse tracking incongruent animal had higher MAD than congruent animal button press ($p = .018$) and congruent human button press ($p = .014$; see Table 4 for Means and Standard Errors). This indicates that for animal pictures, the congruency effect was higher for mouse tracking, and for human pictures, the congruency effect was higher for button press.

The interaction of Induction x Allocation of Response x Valence x Congruency was significant, $F(1, 211) = 7.26$, $p = .008$, $\eta^2_p = .03$. When negative was on the left side, the congruency effect was significant for button press and negative pictures ($p = .029$), for mouse tracking and negative pictures ($p = .038$), as well as mouse tracking and positive pictures ($p = .009$). For mouse tracking, incongruent negative pictures had higher MAD than congruent positive pictures ($p = .004$). Furthermore, incongruent negative button press had higher MAD than congruent mouse tracking positive ($p = .038$). When positive was on the left side, the congruency effect was significant for button press and positive pictures ($p = .045$), as well as mouse tracking and negative pictures ($p < .001$). Additionally, incongruent mouse tracking negative had higher MAD than congruent mouse tracking positive ($p = .004$) and congruent button press positive ($p = .004$; see Table 5 for Means and Standard Errors).

Table 5

Means and Standard Errors by Induction, Allocation of Response, Valence, and Picture

			Induction			
			Button press		Mouse tracking	
Allocation of Response	Valence	Picture	*M*	*SE*	*M*	*SE*
Left negative	Negative	Animal	147.07	17.00	163.39	16.69
		Human	203.01	19.45	167.24	19.09
	Positive	Animal	200.98	19.39	158.00	19.03
		Human	148.93	16.28	126.23	15.98
Left positive	Negative	Animal	135.25	20.22	163.15	15.56
		Human	154.62	23.14	190.40	17.81
	Positive	Animal	143.15	23.06	175.53	17.75
		Human	116.91	19.37	133.49	14.91

Finally, the Induction x Allocation of Response x Valence x Picture interaction was significant, $F(1, 211) = 5.14$, $p = .024$, $\eta^2_p = .02$. When negative was on the left side, button press human negative had significantly higher MAD than button press animal negative pictures ($p < .001$) and button press human positive ($p = .029$). Additionally, button press human positive had significantly lower mad than button press animal positive (p = .005). When the positive button was on the left side, mouse tracking human positive had significantly lower mad than mouse tracking human negative (p = .005) and mouse tracking animal positive (p = .024; see Table 6 for Means and Standard Errors). All other ps > .05. No other main effect or interaction was significant (ps > .05).

Table 6

Means and Standard Errors by Congruency, Allocation of Response, Valence, and Induction

			Congruency			
			Congruent		Incongruent	
Allocation of Response	Valence	Induction	*M*	*SE*	*M*	*SE*
Left negative	Negative	Button press	150.22	16.77	199.86	20.29
		Mouse tracking	141.58	16.46	189.05	19.91
	Positive	Button press	166.81	17.01	183.10	19.43
		Mouse tracking	114.61	16.69	169.62	19.07
Left positive	Negative	Button press	127.16	19.95	162.70	24.13
		Mouse tracking	146.80	15.35	206.75	18.57
	Positive	Button press	100.86	20.23	159.20	23.11
		Mouse tracking	136.62	15.57	172.40	17.79

Self-reported Ambivalence

For the self-reported measures, we calculated 2 (Congruency: congruent vs. incongruent) x 2 (Picture: human vs. animal) x 2 (Valence: positive vs. negative) x 2 (Induction: mouse tracking vs. button press) x 2 (Order: first congruent vs. first incongruent) ANOVAs. For potential ambivalence, we found a main effect of Valence, $F(1, 221) = 20.64$, $p < .001$, $\eta^2_p = .09$, and Picture, $F(1, 221) = 77.76$, $p < .001$, $\eta^2_p = .26$. Negative pictures (M = -17.5, SE = 1.46) had higher potential ambivalence than positive pictures (M = -25.2, SE =

1.59). Animal pictures (*M* = -14.9, *SE* = 1.52) had higher potential ambivalence than human pictures (*M* = -27.8, *SE* = 1.4).

The Picture x Valence interaction was also significant, $F(1, 221) = 42.8$, $p < .001$, $\eta^2_p = .16$. Human positive pictures (*M* = -36.5, *SE* = 1.63) had significantly lower potential ambivalence than human negative ($p < .001$; *M* = -19.1, *SE* = 1.79), animal negative ($p < .001$; *M* = -15.9, *SE* = 1.91) and animal positive pictures ($p < .001$; *M* = -14.0, *SE* = 2.03). All other pairwise comparisons were not significant (*p*s > .15). Additionally, the main effect of Order was significant, $F(1, 221) = 4.44$, $p = .036$, $\eta^2_p = .02$. When the congruent induction was before the incongruent induction (*M* = -24.0, *SE* = 1.86), potential ambivalence was lower than when the incongruent induction was before the congruent induction (*M* = -18.7, *SE* = 1.73). The interaction of Order, Valence, and Picture was significant, $F(1, 221) = 4.45$, $p = .036$, $\eta^2_p = .02$. Human positive pictures in the incongruent first and the congruent first condition had lower potential ambivalence than animal negative, animal positive, and human negative pictures independently of order (*p*s < .05).

The Order x Picture x Congruency interaction was significant, $F(1, 221) = 3.93$, $p = .049$, $\eta^2_p = .02$. This effect mirrored the main effect of picture. Generally, the human pictures had lower potential ambivalence than animal pictures. The congruent and incongruent conditions did not differ within picture content. No other main effect or interaction was significant (*p*s > .05).

The ANOVA with felt ambivalence as dependent variable revealed main effects of Valence, $F(1, 221) = 108.57$, $p < .001$, $\eta^2_p = .33$, and Picture, $F(1, 221) = 9.06$, $p = .003$, $\eta^2_p = .04$. Negative pictures (*M* = 33.4, *SE* = 1.57) had higher felt ambivalence than positive pictures (*M* = 13.2, *SE* = 0.97). Additionally, animal pictures (*M* = 25.4, *SE* = 1.31) had higher felt ambivalence than human pictures (*M* = 21.2, *SE* = 1.18). The main effects of Valence and Picture were qualified by the interaction of Valence and Picture, $F(1, 221) = 54.66$, $p < .001$,

$\eta^2_p = .2$. Negative human pictures (*M* = 35.3, *SE* = 2) elicited similarly high felt ambivalence to negative animal pictures ($p = .23$; *M* = 31.46, *SE* = 1.97). Positive human pictures (*M* = 7.19, *SE* = 1.03) had significantly lower felt ambivalence than positive animal pictures ($p < .001$; *M* = 19.25, *SE* = 1.47). Additionally, negative pictures elicited higher felt ambivalence than positive pictures (*p*s < .001). No other main effect or interaction was significant (*p*s > .05).

Discussion

Consistent with the previous studies, results indicate a congruency effect for mouse tracking. However, inconsistent with our hypothesis, we did not find a congruency effect on the self-reported ambivalence measures. Hence, repeatedly responding incongruently results in higher ambivalence measured via mouse tracking, but we do not find evidence that repeatedly responding incongruently results in higher potential and felt ambivalence measured via self-report.

General Discussion

In the present studies, we investigated if attitude-inconsistent behavior can lead to ambivalence. Therefore, participants responded congruently or incongruently to univalent pictures. Data consistently indicated that incongruent responses to pictures lead to higher pull to the non-chosen response in mouse tracking than congruent responses. We did not find evidence that this effect merely depends on the induction method. Study 3 only indicated that the magnitude of the effect is higher when the induction is also via mouse tracking. Inconsistent with our hypothesis, we did not find evidence for higher potential and felt ambivalence towards the pictures that were previously responded incongruently to compared to pictures that were previously responded congruently to. Hence, the picture might merely be associated with the opposing valence, or participants might have already resolved ambivalence when reporting the self-reported measures.

The Associative-Propositional Evaluation (APE-) Model (Gawronski & Bodenhausen, 2006) can explain the dissociation between the indirect (i.e., mouse tracking) and the direct (i.e., self-reported) attitude measures. According to the APE-Model, associative processes are automatic evaluative reactions, and propositional processes depend on propositional information that undergoes truth testing. Indirect measures reflect associative processes and direct measures reflect propositional processes. In the current studies, the pictures in the incongruent condition might only be associated with the opposing valence, which is reflected in mouse tracking. However, if participants explicitly report ambivalence, judgment-relevant propositions are tested for truth value. Thus, the attitude inconsistent association due to repeated incongruent responses might be discarded as false. Therefore, people might have already resolved their ambivalence and do not indicate ambivalence in the self-reported measures.

An alternative explanation might be that we did not induce ambivalence but dissonance. According to Festinger's (1957) definition, dissonance is if beliefs, knowledge, or behavior are inconsistent. Specifically, two elements are dissonant if one is the opposite of the other. For example, "x and y are dissonant if not-x follows from y" (Festinger, 1957, p. 3). Like ambivalence, dissonance is experienced as aversive, and people use coping strategies to reduce discomfort (for a review, see McGrath, 2017). The most commonly investigated dissonance reduction strategy is attitude change (e.g., Cooper, 2007). To induce cognitive dissonance, researchers ask participants to write an essay that is inconsistent with their attitude. For example, Gawronski and Strack (2004) compared a no essay to forced compliance and an induced compliance condition (i.e., participants voluntarily generated arguments against their attitude). They did not find changes in indirectly measured attitudes. However, they found the biggest changes in directly measured attitude in the induced compliance condition. The results are consistent with Festingers' (1957) Cognitive Dissonance Theory. That is, in the forced compliance condition, participants don't need to change their attitude because they have an explanation for their counter-attitudinal behavior (i.e., situational justification as they were instructed to generate counterarguments). In contrast, in the induced compliance condition, participants did not have a justification for their counter-attitudinal behavior as they chose to generate the counterarguments. Hence, participants in this condition changed their attitude more. Similarly, in the present investigation, participants were forced to behave against their attitude to some pictures. As participants had an explanation for their counter-attitudinal behavior, this might explain the null results on the self-reported measures.

We argue, however, that the current manipulation induces ambivalence and not dissonance based on two arguments. First, a differentiation between ambivalence and dissonance is that ambivalence is pre-decisional (i.e., without behavior commitment), and dissonance is post-decisional (i.e., with behavior commitment; van Harreveld et al., 2009). We resolved the previous behavior commitment by instructing participants to respond consistently with their attitude when measuring the dependent variable. Second, cognitive dissonance is between two cognitions and, therefore, relies mostly on propositional processes (Gawronski & Strack, 2004). In contrast, ambivalence can be between two cognitions, but it can also be between cognition and affect (van Harreveld et al., 2009). Based on this line of argument, attitude change to resolve dissonance is expected on direct attitude measures as they capture propositional processes but not on indirect attitude measures as they capture associative processes (Gawronski & Bodenhausen, 2006). However, we don't find differences in direct attitude measures (i.e., potential and felt ambivalence), but we find a difference in the indirect attitude measure (i.e., mouse tracking).

We found that human-positive pictures had significantly lowest ambivalence in mouse tracking. This might be due to the nature of human pictures. For example, even newborn babies prefer faces over other stimuli (for a review, see Pascalis & Kelly, 2009). Additionally, faces are processed differently than other stimuli (e.g., Robbins & McKone, 2007; Theeuwes & Van der Stigchel, 2006). This might explain the lowest ambivalence for positive human pictures. Hence, positive human pictures are recognized faster and can be categorized immediately.

Limitations and Future Research

One limitation is that we cannot exclude the effect might be due to dissonance and not ambivalence. Even though we argue that the effect is ambivalence and not dissonance, it would be useful if future research eliminates this alternative explanation. This might be achieved by adding an induced compliance condition (e.g., Gawronski & Strack, 2004). If participants change their attitude towards the pictures in the induced compliance condition more than in the forced compliance condition, this would indicate that the effect is dissonance and not ambivalence.

Additionally, stimulus-response binding (Frings et al., 2020) might explain the effect in mouse tracking. Even though the ambivalence effect we predicted might also be binding, as the picture should be bound with the opposing valence in the incongruent condition, it might also be possible that the response side was bound to the picture instead of the valence. Future studies should change the response side after the induction blocks to eliminate this alternative explanation. The results should reverse if the pictures were bound to the response side. That is, there should be a higher MAD in the congruent than in the incongruent condition.

In sum, we find incongruent responses to univalent pictures lead to more pull to the non-chosen response. However, several alternative explanations must be eliminated to call this effect ambivalence.

References

Béna, J., Mauclet, A., & Corneille, O. (2023). Does co-occurrence information influence evaluations beyond relational meaning? An investigation using self-reported and mouse-tracking measures of attitudinal ambivalence. *Journal of Experimental Psychology: General*, *152*(4), 968–992. https://doi.org/10.1037/xge0001308

Brehm, J. W. (1966). *A theory of psychological reactance*. Academic Press.

Buttlar, B., Pauer, S., Ruby, M. B., Chambon, M., Jimenez-Klingberg, A.-K., Scherf, J., & Scherrer, V. (2023). The Meat Ambivalence Questionnaire: Assessing domain-dpecific meat-related conflict in omnivores and veg*ans. *Collabra: Psychology*, *9*(1), 73236. https://doi.org/10.1525/collabra.73236

Chambon, M., Dalege, J., Waldorp, L. J., Maas, H. L. J. V. der, Borsboom, D., & van Harreveld, F. (2022). Tailored interventions into broad attitude networks towards the COVID-19 pandemic. *PLOS ONE*, *17*(10), e0276439. https://doi.org/10.1371/journal.pone.0276439

Cooper, J. M. (2007). *Cognitive Dissonance: 50 Years of a Classic Theory*. 1–216.

Dalege, J., Borsboom, D., van Harreveld, F., van den Berg, H., Conner, M., & van der Maas, H. L. J. (2016). Toward a formalized account of attitudes: The Causal Attitude Network (CAN) model. *Psychological Review*, *123*(1), 2–22. https://doi.org/10.1037/a0039802

Dalege, J., Borsboom, D., van Harreveld, F., & van der Maas, H. L. J. (2018). The Attitudinal Entropy (AE) Framework as a general theory of individual attitudes. *Psychological Inquiry*, *29*(4), 175–193. https://doi.org/10.1080/1047840X.2018.1537246

Durso, G. R. O., Petty, R. E., Briñol, P., Siev, J. J., Hinsenkamp, L. D., & Sawicki, V. (2021). Dampening affect via expectations: The case of ambivalence. *Journal of Personality and Social Psychology, 121*(6), 1172-1194. https://doi.org/10.1037/pspa0000248

Fazio, R. H. (2007). Attitudes as object–evaluation associations of varying strength. *Social Cognition*, *25*(5), Article 5. https://doi.org/10.1521/soco.2007.25.5.603

Festinger, L. (1957). *A theory of cognitive dissonance*. Stanford university press.

Frings, C., Hommel, B., Koch, I., Rothermund, K., Dignath, D., Giesen, C., Kiesel, A., Kunde, W., Mayr, S., Moeller, B., Möller, M., Pfister, R., & Philipp, A. (2020). Binding and retrieval in action control (BRAC). *Trends in Cognitive Sciences*, *24*(5), 375–387. https://doi.org/10.1016/j.tics.2020.02.004

Gawronski, B., & Bodenhausen, G. V. (2006). Associative and propositional processes in evaluation: An integrative review of implicit and explicit attitude change. *Psychological Bulletin*, *132*(5), 692–731. https://doi.org/10.1037/0033-2909.132.5.692

Gawronski, B., & Strack, F. (2004). On the propositional nature of cognitive consistency: Dissonance changes explicit, but not implicit attitudes. *Journal of Experimental Social Psychology*, *40*(4), 535–542. https://doi.org/10.1016/j.jesp.2003.10.005

Glaser, T., Woud, M. L., Labib Iskander, M., Schmalenstroth, V., & Vo, T. M. (2018). Positive, negative, or all relative? Evaluative conditioning of ambivalence. *Acta Psychologica*, *185*, 155–165. https://doi.org/10.1016/j.actpsy.2018.02.006

Heidemeyer, P., Wesser-Saalfrank, A., & Banse, R. (2021). *The 6 Facets Reactivated F (6FRF) Scale*.

Henninger, F., & Kieslich, P. J. (2020). *Mousetrap-Web: Mouse-tracking for the browser* [Manuscript in preparation.]. https://github.com/FelixHenninger/mousetrap-web/blob/master/manuscript/mousetrap-web.pdf

Henninger, F., Shevchenko, Y., Mertens, U. K., Kieslich, P. J., & Hilbig, B. E. (2022). lab.js: A free, open, online study builder. *Behavior Research Methods*, *54*(2), 556–573. https://doi.org/10.3758/s13428-019-01283-5

Hütter, M., & Sweldens, S. (2018). Dissociating controllable and uncontrollable effects of affective stimuli on attitudes and consumption. *Journal of Consumer Research*, *45*(2), 320–349. https://doi.org/10.1093/jcr/ucx124

Kaplan, K. J. (1972). On the ambivalence-indifference problem in attitude theory and measurement: A suggested modification of the semantic differential technique. *Psychological Bulletin*, *77*, 361–372. https://doi.org/10.1037/h0032590

Kieslich, P. J., & Henninger, F. (2017). Mousetrap: An integrated, open-source mouse-tracking package. *Behavior Research Methods*, *49*(5), Article 5. https://doi.org/10.3758/s13428-017-0900-z

Leys, C., Ley, C., Klein, O., Bernard, P., & Licata, L. (2013). Detecting outliers: Do not use standard deviation around the mean, use absolute deviation around the median. *Journal of Experimental Social Psychology*, *49*(4), Article 4. https://doi.org/10.1016/j.jesp.2013.03.013

Mathôt, S., Schreij, D., & Theeuwes, J. (2012). OpenSesame: An open-source, graphical experiment builder for the social sciences. *Behavior Research Methods*, *44*(2), 314–324. https://doi.org/10.3758/s13428-011-0168-7

Mathur, M. B., & Reichling, D. B. (2019). Open-source software for mouse-tracking in Qualtrics to measure category competition. *Behavior Research Methods*, *51*(5), Article 5. https://doi.org/10.3758/s13428-019-01258-6

McGrath, A. (2017). Dealing with dissonance: A review of cognitive dissonance reduction. *Social and Personality Psychology Compass*, *11*(12), e12362. https://doi.org/10.1111/spc3.12362

Nordgren, L. F., van Harreveld, F., & van der Pligt, J. (2006). Ambivalence, discomfort, and motivated information processing. *Journal of Experimental Social Psychology*, *42*(2), 252–258. https://doi.org/10.1016/j.jesp.2005.04.004

Pascalis, O., & Kelly, D. J. (2009). The origins of face processing in humans: Phylogeny and ontogeny. *Perspectives on Psychological Science*, *4*(2), 200–209. https://doi.org/10.1111/j.1745-6924.2009.01119.x

Petty, R. E., Briñol, P., & DeMarree, K. G. (2007). The Meta–Cognitive Model (MCM) of attitudes: Implications for attitude measurement, change, and strength. *Social Cognition*, *25*(5), Article 5. https://doi.org/10.1521/soco.2007.25.5.657

Possidónio, C., Graça, J., Piazza, J., & Prada, M. (2019). Animal Images Database: Validation of 120 images for human-animal studies. *Animals*, *9*(8), Article 8. https://doi.org/10.3390/ani9080475

Postzich, C., Blask, K., Frings, C., & Walther, E. (2016). Timeless: A large sample study on the temporal robustness of affective responses. *Frontiers in Psychology*, *7*, 841. https://doi.org/10.3389/fpsyg.2016.00841

Priester, J. R., & Petty, R. E. (1996). The gradual threshold model of ambivalence: Relating the positive and negative bases of attitudes to subjective ambivalence. *Journal of Personality and Social Psychology*, *71*(3), Article 3. https://doi.org/10.1037/0022-3514.71.3.431

Puteri, B., Buttlar, B., & Jahnke, B. (2022). Take it or leave it? Investigating the ambivalence and willingness to pay for suboptimal fruits and vegetables among organic consumers in Germany. *Frontiers in Sustainable Food Systems*, *6*. https://www.frontiersin.org/articles/10.3389/fsufs.2022.934954

Robbins, R., & McKone, E. (2007). No face-like processing for objects-of-expertise in three behavioural tasks. *Cognition*, *103*(1), 34–79. https://doi.org/10.1016/j.cognition.2006.02.008

Schlink, S., & Walther, E. (2007). Kurz und gut: Eine deutsche Kurzskala zur Erfassung des Bedürfnisses nach kognitiver Geschlossenheit. *Zeitschrift Für Sozialpsychologie*, *38*(3), Article 3. https://doi.org/10.1024/0044-3514.38.3.153

Schneider, I. K., Eerland, A., van Harreveld, F., Rotteveel, M., van der Pligt, J., van der Stoep, N., & Zwaan, R. A. (2013). One way and the other: The bidirectional relationship between ambivalence and body movement. *Psychological Science*, *24*(3), Article 3. https://doi.org/10.1177/0956797612457393

Schneider, I. K., & Mattes, A. (2021). Mix is different from nix: Mouse tracking differentiates ambivalence from neutrality. *Journal of Experimental Social Psychology*, *95*, 104106. https://doi.org/10.1016/j.jesp.2021.104106

Schneider, I. K., Novin, S., van Harreveld, F., & Genschow, O. (2020). Benefits of being ambivalent: The relationship between trait ambivalence and attribution biases. *The British Journal of Social Psychology,* 60(2), 570-586. https://doi.org/10.1111/bjso.12417

Schneider, I. K., van Harreveld, F., Rotteveel, M., Topolinski, S., van der Pligt, J., Schwarz, N., & Koole, S. L. (2015). The path of ambivalence: Tracing the pull of opposing evaluations using mouse trajectories. *Frontiers in Psychology*, *6*. https://doi.org/10.3389/fpsyg.2015.00996

Theeuwes, J., & Van der Stigchel, S. (2006). Faces capture attention: Evidence from inhibition of return. *Visual Cognition*, *13*(6), 657–665. https://doi.org/10.1080/13506280500410949

Thompson, M. M., Zanna, M., & Griffin, D. (1995). Let’s not be indifferent about (attitudinal) ambivalence. *Attitude Strength: Antecedents and Consequences*.

van Harreveld, F., Nohlen, H. U., & Schneider, I. K. (2015). Chapter Five - The ABC of ambivalence: Affective, behavioral, and cognitive consequences of attitudinal conflict. In J. M. Olson & M. P. Zanna (Eds.), *Advances in Experimental Social Psychology* (Vol. 52, pp. 285–324). Academic Press. https://doi.org/10.1016/bs.aesp.2015.01.002

van Harreveld, F., Rutjens, B. T., Schneider, I. K., Nohlen, H. U., & Keskinis, K. (2014). In doubt and disorderly: Ambivalence promotes compensatory perceptions of order.

Journal of Experimental Psychology: General, *143*, 1666–1676. https://doi.org/10.1037/a0036099

van Harreveld, F., van der Pligt, J., & de Liver, Y. N. (2009). The agony of ambivalence and ways to resolve it: Introducing the MAID Model. *Personality and Social Psychology Review*, *13*(1), Article 1. https://doi.org/10.1177/1088868308324518

Funding: This research received funding from the Research Fund by Trier University awarded to Lena Hahn and Eva Walther. The funders had no role in the study design, data collection and analysis, decision to publish, or manuscript preparation.

Declaration of conflicting interests: The authors declare no conflict of interest.

Institutional Review Board Statement: Study protocols of all experiments have been approved by the local ethics committee in an application for ethical clearance of Study 2 (EK Nr. 06/2022).

Informed Consent Statement: Participants gave informed consent to the study procedure and data processing prior to participation.

Data Sharing Statement: Upon publication preregistration, data, material, and syntax will be shared on the Open Science Framework.

Acknowledgments: We thank Helen Boeder for her help conducting Study 1, Verena Küpper for her help conducting Study 2, Lusia Sabel, Alicia Holler, So Ehmk, and Maja Wellemsen for their help collecting data for Study 3, and Luca Cammarota for his help with programming Study 4.

Author contributions

Lena Hahn: Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Software, Validation, Visualization, and Writing - original draft.

Eva Walther: Conceptualization, Funding acquisition, Methodology, Project administration, Resources, Supervision, and Validation.

Hidden in Plain Sight: Ambivalence in Impression Formation Tasks

Lena Hahn & Eva Walther

Trier University

Abstract

Ambivalence (i.e., simultaneously positive and negative evaluations) is omnipresent in our daily lives. Experiencing ambivalence can lead to downstream consequences (e.g., procrastination, biased information processing). Due to its downstream consequences, overlooking ambivalence threatens the unambiguous interpretation of research results. Previous research indicates that ambivalent attitudes emerge when a neutral attitude object is associated with positive and negative aspects. A classical research paradigm in which a neutral attitude object is paired with positive and negative information is impression formation. In impression formation tasks, face pictures are often first paired with positive statements and later with negative statements or vice versa. However, in this line of research, ambivalence is rarely acknowledged. We hypothesize that pairing face pictures with positive and negative statements should lead to higher ambivalence than when face pictures are paired with only positive or only negative statements. In an online and laboratory study, we consistently found that pairing face pictures with positive and negative statements leads to higher self-reported ambivalence as well as ambivalence measured via mouse tracking. Thus, the results indicate that ambivalence has previously been overlooked in impression formation research.

Keywords: Ambivalence, impression formation

Introduction

When we meet people, we are prone to forming an impression. Therefore, encountering a person who shows positive behavior, for example, a person who helps to find a missing dog, could lead to a positive impression of this person. In contrast, encountering a person who shows negative behavior, for example, a person who takes credit for someone else's work, could lead to a negative impression. However, people often show not only positive or only negative behavior but rather positive and negative behavior. Hence, impressions towards people might be more complex than univalence (i.e., only positive or only negative). They might be ambivalent (i.e., simultaneously positive and negative; van Harreveld et al., 2015). Whereas there is some research on the consequences of ambivalence (van Harreveld et al., 2009, 2015), little research exists about the formation of ambivalent attitudes.

To understand ambivalent attitude formation, it is crucial to differentiate between potential and felt ambivalence. Potential ambivalence encompasses the structure of positive and negative associations and does not necessarily lead to feelings of conflict (Kaplan, 1972; Thompson et al., 1995; van Harreveld et al., 2009). In contrast, felt ambivalence is the experience of conflict that results from the simultaneous accessibility of positive and negative associations (Priester & Petty, 1996; van Harreveld et al., 2015). Hence, pairing an attitude object with positive and negative information should lead to potential ambivalence. When the positive and negative associations are simultaneously accessible, then this should lead to felt ambivalence (van Harreveld et al., 2009).

That the pairing of an attitude object with positive and negative information should lead to ambivalence is even predicted by attitude models (e.g., Dalege et al., 2016; Petty et al., 2007), for example, the Attitudinal Entropy Framework (Dalege et al., 2018) or the Meta-cognitive Model of attitudes (Petty et al., 2007). There is preliminary empirical evidence that pairing a neutral attitude object with pictures consisting of a positive and negative half (Glaser et al., 2018) or with positive and negative words (Béna et al., 2023) leads to ambivalence. Hence, when we know a person helped search for a missing dog but also took credit for someone else's work, we should have at least potential ambivalence towards this person.

Ambivalence in Impression Formation Procedures

Similar to the above example, impression formation research often first pairs a target individual with univalent (e.g., positive) statements and then with counter-attitudinal (e.g., negative) statements (e.g., Fourakis & Cone, 2020; Rydell & McConnell, 2006). Procedures differ in whether participants are active or inactive. In active procedures, participants must judge whether the target person's behavior is characteristic or uncharacteristic, and they receive feedback on whether their judgment was correct (Rydell & McConnell, 2006). In an inactive procedure, participants merely read the target person's behavior (Fourakis & Cone, 2020). In both procedures, the target person is associated with positive and negative information, which should at least lead to potential ambivalence. Although impression formation studies often do not use measures that capture ambivalence, previous research findings indicate that ambivalence might play a role in impression formation. For example, Fourakis and Cone (2020) used an inactive impression formation task in which participants first read positive statements about a target and then negative statements or vice versa. A closer look at the means of the bipolar valence ratings reveals that they are less than 1 point away from the middle of the bipolar valence scale. Even though the midpoint of a bipolar valence scale cannot differentiate between neutrality and ambivalence, we find it very likely that impression formation procedures that pair targets with positive and negative statements lead to ambivalent attitudes.

Consistent with this assumption, Cacioppo et al. (1997) found that potential ambivalence was higher when a target name was presented with positive and negative statements than when a target name was only paired with statements of one valence. Similarly, Priester and Petty (1996) used impression formation to show that ambivalence also increases with increasing counter-attitudinal information. Other ambivalence research used such impression formation procedures to investigate boundary conditions of the experience of ambivalence by comparing two ambivalent conditions (e.g., DeMarree et al., 2015; Durso et al., 2021). Hence, whereas ambivalence research used impression formation tasks to induce ambivalence, impression formation research largely uses measures that cannot differentiate between ambivalence and neutrality.

The Present Investigation

The objective of the present investigation was to systematically investigate ambivalence in impression formation paradigms. Using an inactive impression formation procedure, we simply paired a picture of a target individual with univalent statements. In the univalent control conditions, participants viewed target pictures with statements of one valence (i.e., only positive or only negative information). In the ambivalent conditions, participants received initial statements of one valence (e.g., positive statements) in the first block and statements of the oppositive valence (e.g., negative statements) in the second block. In Study 1, we measured self-reported potential and felt ambivalence, and in Study 2, in addition to potential and felt ambivalence, participants completed a mouse-tracking task (Schneider et al., 2015; Schneider & Mattes, 2021).

With mouse tracking, it is possible to depict real-time processing of decision-making (Freeman & Ambady, 2010). Indeed, mouse tracking in a dichotomous decision task has been used as a behavioral measure of ambivalence (Schneider et al., 2015; Schneider & Mattes, 2021). When participants have to evaluate an ambivalent object, the mouse trajectory has more pull to the non-chosen response compared to a univalent attitude object. Researchers use mouse tracking as an ambivalence measure because it is less affected by social desirability or introspective ability (Schneider et al., 2015) than self-reported ambivalence. We hypothesize that face pictures paired with positive and negative statements elicit higher ambivalence than those paired with only positive or only negative statements.

Study 1

In Study 1, our objective was to demonstrate that receiving the same number of positive and negative statements about a target individual leads to higher potential and felt ambivalence compared to receiving only positive or only negative statements. Study 1 was an online study programmed with Enterprise Feedback Suite Survey from Tivian XI. The study was pre-registered.

Method

Participants and Design

As pre-registered, we terminated data collection on January 20th, 2022, resulting in a total of N = 115 participants (75 female, 39 male, one preferred not to indicate gender; M_{age} = 25.47, SD_{age} = 10.5, range 18 to 62 years; four high school degree, two secondary school, 86 A levels, 21 university degree and two other educational degrees). University students received partial course credit in exchange for participating; all other participants were not compensated. Participants received only positive, only negative, or positive and negative information about a male as well as a female target face, resulting in a 4 (Valence: univalent positive vs. univalent negative vs. ambivalent first positive vs. ambivalent first negative) x 2 (Sex of Target: male vs. female) within-participant design. We pre-registered the sex of the target as an additional factor because we expected to collect a balanced sample with about the same number of men and women. However, because we have more female participants than male participants and the effect of target sex could be due to the unbalanced sample, we dropped the factor sex of the target in the analysis. Hence, a one-factor (Valence: univalent positive vs. univalent negative vs. ambivalent first positive vs. ambivalent first negative) within-participant design was used for analysis. Wherever the assumption of Sphericity was violated, Greenhouse-Geisser correction was implemented. Bonferroni correction was used for pairwise comparisons.

Materials and Procedure

After participants gave informed consent to the study procedure and data processing, they indicated if they used a computer and a mouse. Only participants using a computer and a mouse could participate in the study. Participants who indicated that they used a mobile device (e.g., tablet or smartphone) without a computer mouse were thanked for their interest in the study and informed that they could only participate if they used a computer with a computer mouse.

Using the same cover story as Walther et al. (2009), participants were asked to imagine that they just started a new job at a company. Furthermore, they should imagine that they are interested in getting to know their new colleagues and that they will receive a picture of and information about them. In the following pages, participants viewed a face picture on the left with three statements on the right side of the screen. The experiment automatically advanced to the next page after seven seconds. On each page, the statements were of the same valence. Each picture was presented twice. In the univalent condition, the valence of the statements was the same; that is, the pictures in the univalent positive condition were presented twice with three different positive statements, and the pictures in the univalent negative condition were presented twice with three different negative statements. However, the pictures were presented with positive and negative statements in the ambivalent conditions. In the ambivalent first positive condition, the pictures were first presented with three positive statements and then with three negative statements. In the ambivalent first negative condition, the pictures were first presented with three negative statements and then with three positive statements.

In summary, the participants viewed eight pictures (four of male faces and four of female faces) twice with three statements each. Therefore, 48 statements (24 positive and 24 negative) were used. The statements were from Walther et al. (2009) and Durso et al. (2021), as well as generated and pretested to be univalent positive or univalent negative. The face pictures were from the Chicago Face database (Ma et al., 2015) with neutral facial expressions and of Caucasian males and females.

After the induction, a mouse-tracking procedure was employed. However, the data were not saved correctly due to a programming error. Thus, we do not further discuss mouse tracking in this study (see Study 2 for mouse tracking). Next, the participants indicated their positivity (How positive do you rate the person regardless of the negative aspects?, not at all positive – maximally positive) and negativity (How negative do you rate the person regardless of the positive aspects?, not at all negative – maximally negative) sequentially for each picture. Positivity and negativity were combined to an index of potential ambivalence using the similarity intensity model index (SIM-Index; Thompson et al., 1995): (positivity + negativity)/2 - | positivity – negativity |. Following these items, participants indicated their felt ambivalence (To what extent do you have conflicting thoughts and/or feelings about the depicted person?, not at all– maximally). All self-reported ambivalence was indicated on a slider ranging from 0 to 100 with only the endpoints labeled. For exploratory purposes, participants filled out the Trait Ambivalence Scale (Schneider et al., 2020) consisting of 10 items (e.g., My thoughts are often contradictory; 1 does not apply to me, 7 strongly applies to me) next. Because Trait Ambivalence did not influence the results, we did not report these analyses. Finally, participants answered demographic questions (i.e., gender, birth year, educational level), had the opportunity to leave a comment, and were thanked for their participation.

Results and Discussion

To investigate whether face pictures paired with positive and negative statements resulted in higher potential ambivalence compared to face pictures paired with only positive or only negative statements, we calculated a one-factor (Valence: univalent positive vs. univalent negative vs. ambivalent first positive vs. ambivalent first negative) repeated measure analysis of variance (ANOVA) with the SIM-Index as dependent variable. Analysis revealed a main effect of Valence, $F(2.78, 316.95) = 13.85$, $p < .001$, $\eta^2_p = .11$. Consistent with the hypothesis, the data showed that the ambivalent conditions (ambivalent first positive: $M = 15.48$, $SE = 2.56$; ambivalence first negative: $M = 11.35$, $SE = 2.53$) had significantly higher potential ambivalence compared to univalent conditions (ps < .03; univalent positive: $M = -1.74$, $SE = 2.55$; univalent negative: $M = 2.22$, $SE = 2.59$). Furthermore, the ambivalent conditions did not differ in their potential ambivalence ($p > .05$), and the univalent conditions did not differ in their potential ambivalence ($p > .05$).

We also calculated a one-factor (Valence: univalent positive vs. univalent negative vs. ambivalent first positive vs. ambivalent first negative) repeated measure ANOVA with felt ambivalence as dependent variable. In this analysis, the main effect of Valence was also significant, $F(2.95, 335.92) = 21.01$, $p < .001$, $\eta^2_p = .16$. Consistent with our hypothesis, we found that pictures paired with positive and negative statements (ambivalent first positive: $M = 47.8$, $SE = 2.17$; ambivalence first negative: $M = 46.8$, $SE = 2.34$) elicited significantly higher felt ambivalence compared to pictures paired with only positive statements (ps < .001; univalent positive: $M = 28$, $SE = 1.82$). Additionally, the ambivalent conditions did not differ in their ambivalence ($p > .05$). However, the ambivalent conditions did not have significantly higher felt ambivalence compared to the univalent negative condition (ps > .05; univalent negative: $M = 43.3$, $SE = 2.42$) and the univalent negative condition elicited significantly higher felt ambivalence compared to the univalent positive condition ($p < .001$).

The results of Study 1 indicate that pairing a individual with positive and negative statements might lead to higher ambivalence than pairing a person with only positive or negative statements. Specifically, the ambivalent conditions lead to higher potential ambivalence than both univalent conditions. Additionally, the ambivalent conditions had higher felt ambivalence than the univalent positive condition.

Study 2

The purpose of Study 2 was to replicate the results of Study 1 in the laboratory and extend them with an indirect attitude measure (i.e., mouse tracking). OpenSesame version 3.3.14 (Mathôt et al., 2012) was used to program the study, and the mousetrap plug-in was used to implement mouse tracking (Kieslich & Henninger, 2017). The study was pre-registered and approved by the ethics committee of the local university (EK Nr. 62/2022).

Methods

Participants and Design

A total of N = 100 (86 female, 12 male, one non-binary, one preferred not to indicate gender; M_{age} = 20.99, SD_{age} = 2.95, range 18 to 33 years, two participants did not indicate their age; 96 indicated that German was their native language) undergraduate students of the local university participated in the study in return for partial course credit. For self-reported ambivalence, the same one-factor (Valence: univalent positive vs. univalent negative vs. ambivalent first positive vs. ambivalent first negative) within-participant design as in Study 1 was used. However, for mouse tracking, the design was extended to a 4 (Valence: univalent positive vs. univalent negative vs. ambivalent positive first vs. ambivalent negative first) x 2 (Time: one vs. two) x 2 (Allocation of Response: left positive vs. left negative) mixed design. Because this sample was again unbalanced regarding the sex of participants, and thus, interpretation of the sex of target would be ambiguous, we dropped the sex of target from analysis. Where the assumption of Sphericity was violated, Greenhouse-Geisser correction was implemented. Bonferroni correction was used for pairwise comparisons.

Materials and Procedure

The procedure of Study 2 was similar to that of Study 1, however, we implemented some changes. First, this study was a laboratory study, and up to four participants could participate at the same time. Second, for exploratory purposes, in addition to the Trait Ambivalence Scale (Schneider et al., 2020), the Need for Cognitive Closure (Schlink & Walther, 2007) and the 6 Facets Reactivated F scale (Heidemeyer et al., 2021) were administered before the initial attitude induction. Trait Ambivalence and Need for Cognitive Closure were investigated as possible moderators of the effect. We do not report them because they did not affect the results. The 6 Facets Reactivated F scale was implemented as a buffer to make the research question less obvious. Third, in the attitude induction, every picture was presented with only a single statement on every page. Additionally, every picture was presented with eight rather than six statements. Furthermore, to ensure that we first induced a univalent attitude, the mouse tracking task was completed after the initial attitude induction and a second time after half of the pictures were shown with attitude consistent statements and the other half of the pictures were shown with counter-attitudinal statements. After the second mouse tracking potential and felt ambivalence were measured with the same questions as in Study 1, this time, however, the slider ranged from -100 to 100.

In mouse tracking, the movement of the mouse is captured as well as the response (i.e., click on positive or click on negative). Trials started with the presentation of a start button at the bottom of the screen and the response buttons in the upper corners of the screen. The response buttons were labeled positive and negative, and the response side was counterbalanced between participants; that is, half of the participants had positive in the upper left corner of the screen and negative in the upper right corner of the screen, and the other half of the participants had negative in the upper left corner of the screen and positive in the upper right corner of the screen. When participants clicked the start button, the mouse was centered at the bottom of the screen, and the picture appeared in the middle of the screen. Participants indicated their response by moving the mouse and clicking the response buttons. If participants took more than 1000ms to initialize mouse movement, the instruction “please respond faster” appeared for 2500ms in the center of the screen. Before completing the test trials, participants completed practice trials to familiarize themselves with the procedure. The practice trials consisted of two univalent positive and two univalent negative animal pictures (Possidónio et al., 2019). The eight face pictures were presented four times each in the test trials, resulting in 32 mouse tracking trials for each measurement time. As pre-registered Median Absolute Deviation was used to exclude outliers; that is, trials with response times greater than 2.5 times the median absolute deviation and trials with response times smaller than 2.5 times the median absolute deviation were excluded (Leys et al., 2013). These two criteria led to the exclusion of less than 8% of all mouse tracking trials. This led to missing values for three participants, which were excluded from the mouse tracking analysis. Therefore, the total sample for mouse tracking was $N = 97$ (83 females, 12 males, one non-binary, one preferred not to indicate gender; $M_{age} = 21.04$, $SD_{age} = 2.61$, range 18 to 33 years, two participants did not indicate their age; 93 indicated that German was their native language).

Whereas univalent attitudes should result in a relatively straight line from the start to the answer button, ambivalent attitudes should result in a more curved movement (Schneider et al., 2015; Schneider & Mattes, 2021). People should feel more pull to the non-selected response if they feel ambivalent. Thus, ambivalence was conceptualized as the maximum perpendicular deviation from the perfect straight line from the start to the response button (i.e., maximum absolute deviation). Thus, we would expect a higher maximum absolute deviation in the ambivalent conditions compared to the univalent conditions in the second measurement time. Following previous research (Schneider et al., 2015), time normalized trajectories were used to calculate the maximum absolute deviation. Besides the trajectory, the mouse tracking procedure also captures which response was indicated (positive vs. negative). Therefore, it is also possible to analyze the proportion of positive responses.

Results and Discussion

The one-factor (Valence: univalent positive vs. univalent negative vs. ambivalent first positive vs. ambivalent first negative) repeated measure ANOVA with potential ambivalence as dependent variable revealed a main effect of Valence, $F(2.48, 245.57) = 41.74$, $p < .001$, $\eta^2_p = .3$. Pairwise comparisons revealed significant differences between all comparisons (*p*s < .001) except for the ambivalent first positive and the ambivalent first negative condition ($p > .05$). That is, the ambivalent conditions had significantly higher potential ambivalence than the univalent positive and univalent negative condition, and the univalent negative condition had significantly higher potential ambivalence than the univalent positive condition (ambivalent first positive: $M = 42.14$, $SE = 6.21$; ambivalence first negative: $M = 40.13$, $SE = 6.07$; univalent positive: $M = -32.85$, $SE = 6.08$; univalent negative: $M = -1.51$, $SE = 6.71$).

The one-factor (Valence: univalent positive vs. univalent negative vs. ambivalent positive first vs. ambivalent negative first) repeated measure ANOVA with felt ambivalence as dependent variable revealed a main effect of Valence, $F(2.76, 273.47) = 101.2$, $p < .001$, $\eta^2_p = .51$. Similar to the potential ambivalence, the ambivalent conditions did not differ significantly from each other ($p > .05$). However, the ambivalent conditions had significantly higher felt ambivalence than univalent negative and univalent positive (*p*s < .001) and univalent negative had significantly higher felt ambivalence than univalent positive ($p = .001$; ambivalent first positive: $M = 7.43$, $SE = 4.59$; ambivalence first negative: $M = 0.55$, $SE = 4.84$; univalent positive: $M = -75.26$, $SE = 3.7$; univalent negative: $M = -56.38$, $SE = 4.64$).

Next, we calculated a 4 (Valence: univalent positive vs. univalent negative vs. ambivalent positive first vs. ambivalent negative first) x 2 (Time: one vs. two) x 2 (Allocation of Response: left positive vs. left negative) ANOVA with repeated measurement on first two factors and maximum absolute deviation as dependent variable. This analysis revealed a main effect of Time, $F(1, 98) = 6.7$, $p = .011$, $\eta^2_p = .06$, indicating a greater pull to the non-chosen response at Time 2 ($M = 144$, $SE = 10.8$) than at Time 1 ($M = 168$, $SE = 12.8$).

Furthermore, the main effect of Valence was significant, $F(2.71, 265.58) = 5.24$, $p = .002$, $\eta^2_p = .05$. The pairwise comparison revealed that ambivalent first positive resulted in a significantly higher pull to the non-chosen response than univalent negative ($p = .002$). Additionally, ambivalent first negative also resulted in more pull to the non-chosen response than univalent negative ($p = .002$). All other comparisons were not significant (ps > .13). This main effect of valence was qualified by the two-way interaction of Valence and Allocation of Response, $F(2.71, 265.58) = 2.86$, $p = .043$, $\eta^2_p = .03$. Similar to the main effect of valence, pairwise comparison revealed that univalent negative had a significantly lower pull to the non-chosen response than ambivalent first positive ($p < .001$), ambivalent first negative ($p < .001$), and univalent positive ($p = .032$) when the negative button was allocated on the left side and the positive button was allocated on the right side. However, there were no significant differences between valence conditions when the positive response was allocated on the left and negative on the right (ps > .05).

Importantly and consistent with our hypothesis, there was also a significant interaction of Time and Valence, $F(2.77, 271.45) = 4.88$, $p = .003$, $\eta^2_p = .05$. As expected, there were no significant differences between valence conditions at Time 1 (ps > .05; see Table 1 for Means and Standard Errors). At Time 2, univalent positive had a significantly higher pull toward the non-chosen response than univalent negative ($p = .016$). Additionally, univalent negative had significantly lower pull to the non-chosen response compared to ambivalent first positive ($p < .001$) and ambivalent first negative ($p = .009$) at Time 2. Univalent negative at Time 1 differed from ambivalent first positive at Time 2 (p = .004), and univalent positive at Time 1 significantly differed from ambivalent first positive at Time 2 (p = .027). Furthermore, ambivalent first positive at Time 1 and ambivalent first positive at Time 2 differ significantly (p = .041), indicating an increase in ambivalence from Time 1 to Time 2 in the ambivalent first positive condition. All other ps > .05. Thus, even though we find that the ambivalent conditions significantly differ from univalent negative at Time 2, the increase from Time 1 to Time 2 was only significant for ambivalent first positive. No other main effect or interaction was significant (ps > .05).

Table 1

Means and Standard Errors of Maximum Absolute Deviation by Time and Valence

	Time 1		Time 2	
Valence	*M*	*SE*	*M*	*SE*
Positive	138.97	12.42	180.38	17.14
Negative	137.86	15.69	117.07	13.68
Ambivalent first positive	142.35	13.01	198.13	17.82
Ambivalent first negative	157.60	14.77	174.55	17.83

In addition, we explored the proportion of positive responses in mouse tracking. The 4 (Valence: univalent positive vs. univalent negative vs. ambivalent first positive vs. ambivalent first negative) x 2 (Time: one vs. two) x 2 (Allocation of Response: left positive vs. left negative) ANOVA with repeated measurement of the first two factors revealed a main effect of Time, $F(1, 98) = 74.17$, $p < .001$, $\eta^2_p = .43$, and Valence, $F(2.41, 235.73) = 500.67$, $p < .001$, $\eta^2_p = .84$. At Time 1, there were significantly more positive responses than at Time 2 (Time 1: $M = 0.49$, $SE = 0.008$; Time 2: $M = 0.38$, $SE = 0.01$). For valence, we found that univalent positive had the highest proportion of positive responses, followed by ambivalent first positive which, in turn, was followed by ambivalent first negative; univalent negative had the lowest proportion of positive responses (ambivalent first positive: $M = 0.52$, $SE = 0.02$;

ambivalence first negative: *M* = 0.23, *SE* = 0.02; univalent positive: *M* = 0.93, *SE* = 0.02; univalent negative: *M* = 0.05, *SE* = 0.02). All pairwise comparisons were significant (*p*s < .001).

The interaction of Valence and Time was also significant, $F(2.09, 204.98) = 386.28$, $p < .001$, $\eta^2_p = .8$. Consistent with the hypothesis that at Time 1, only univalent attitude should be induced, we did not find significant differences between univalent positive and ambivalent first positive as well as univalent negative and ambivalent first negative (*p*s > .05). However, univalent negative and ambivalent first negative had a significantly lower proportion of positive responses than univalent positive and ambivalent first positive at Time 1 (*p*s < .001). The proportion of positive responses increased for univalent positive from Time 1 to Time 2 ($p = .007$). In contrast, the proportion of positive responses did not differ significantly for univalent negative from Time 1 to Time 2 ($p > .05$). The proportion of positive responses decreased for ambivalent first positive from Time 1 to Time 2 ($p < .001$). This decrease was so strong that ambivalent first positive at Time 2 did not differ significantly from univalent negative at Time 1 ($p > .05$) and ambivalent first negative at Time 1 ($p > .05$). The proportion of positive responses significantly increased for ambivalent first negative from Time 1 to Time 2 ($p < .001$), however, it also differed significantly from univalent positive at Time 1 ($p < .001$) and univalent positive at Time 2 ($p < .001$; see Table 2 for Means and Standard Errors).

Table 2

Means and Standard Errors of Proportion of Positive Response by Valence and Time

	Time 1		Time 2	
Valence	M	SE	M	SE
Positive	0.91	0.02	0.96	0.01
Negative	0.06	0.02	0.04	0.02
Ambivalent first positive	0.92	0.02	0.12	0.02
Ambivalent first negative	0.06	0.02	0.39	0.03

In sum, Study 2 replicated the results of Study 1 for potential and felt ambivalence. Additionally, in Study 2, a mouse tracking task was implemented. The results of the mouse tracking task indicate significantly higher pull to the non-chosen response for the ambivalent conditions than the univalent negative condition. However, the increase in pull to the non-chosen response from Time 1 to Time 2 was only significant for the ambivalent first positive condition.

General Discussion

Even though impression formation procedures are prime examples of how attitude theories (e.g., Dalege et al., 2018; Petty et al., 2007) propose that people form ambivalent attitudes, this has never been systematically investigated previously. In two studies, we found that face pictures that were previously paired with positive and negative information elicit higher potential and higher felt ambivalence than face pictures paired with information of one valence (i.e., only positive or only negative information). In Study 2, we also used mouse tracking as an indicator of experienced conflict. Partly confirming our hypothesis, data indicate that the pull towards the non-chosen response increased from Time 1 to Time 2 for the ambivalent first positive condition. However, for ambivalent first negative, the increase in pull from Time 1 to Time 2 was not significant. The exploratory results of the proportion of positive responses are consistent with this finding. Whereas the proportion of positive responses is below 25% in the ambivalent first positive condition at Time 2, it is also below 50% in the ambivalent first negative condition at Time 2.

This indicates that negative information had a greater impact on overall attitude than positive information and is consistent with previous research. Sanbonmatsu et al. (2015) attribute this effect to negative behavior having a lower base rate. That is, negative behavior is less frequent, and people do not expect negative behavior. Therefore, if negative behavior occurs, it has a greater impact on evaluation than positive behavior. In contrast, positive behavior is quite frequent, and therefore, people expect positive behavior. This might also explain why the univalent negative condition had the lowest pull to the non-chosen response, whereas the univalent positive condition did not differ from the ambivalent conditions.

That pairing a stranger with positive and negative information leads to ambivalence sheds new light on some impression formation studies. In light of the results of the present investigation, impression formation tasks that first present information of one valence and later counter-attitudinal information might not lead to complete attitude change but to ambivalence.

Future Research

As ambivalence leads to different consequences than univalence, mistaking an ambivalent attitude for a univalent attitude is problematic. According to our results, if, for example, a political candidate is paired with positive and negative information, this should lead to ambivalence. This ambivalence, in turn, can lead to compensatory behavior. Higher ambivalence can lead to discomfort (e.g., Nordgren et al., 2006), compensatory preference for order (van Harreveld et al., 2014), biased information processing (e.g., Clark et al., 2008), or a decrease in attitude-behavior consistency (Conner et al., 2002; for a meta-analysis, see Cooke & Sheeran, 2004). Thus, a political candidate paired with positive and negative information might not be voted for. Future research should, therefore, investigate the consequences of ambivalence in person perception.

Additionally, previous research indicates that not only the blocked presentation of information (i.e., first one valence and then the oppositive valence information) but also the simultaneous presentation of positive and negative aspects can lead to ambivalence. Béna et al. (2023) showed participants relational sentences. They found that if a fictitious alien species loved something negative or loathed something positive, participants had higher felt ambivalence compared to when a fictitious alien species loved something positive or loathed something negative. Hence, future research should investigate if a neutral individual who loves something negative leads to higher potential and felt ambivalence.

Limitations

One limitation is that even though the statements were pretested on potential and felt ambivalence and thus were univalent, they were not tested on other dimensions. Previous research demonstrated that, for example, morality is important at all stages of impression formation (Brambilla et al., 2021). Information about (im)moral behavior leads to an extremer (i.e., more negative or more positive) first impression than competence or sociability information (Brambilla et al., 2019). Furthermore, attitude-inconsistent moral information leads to greater impression change than inconsistent competence or sociability information (Brambilla et al., 2019). Because our statements were not tested for morality, some statements might have greater influence than other statements. As the statements were sampled randomly, this influence should also be random and thus only limitedly influence our results.

Another limitation of the results is the effect of the response side in Study 2. The allocation of the response button was counterbalanced between participants so that half of the participants had the positive response on the left side and the other half of the participants had the positive response on the right side. The interaction of response allocation with valence for maximum absolute deviation indicates that when negative was on the left-hand side and positive was on the right-hand side, the effects reflected the main effect of valence. However, the effects vanish when positive was on the left-hand side and negative was on the right-hand side. This might be due to the general association of negative with the left-hand side and positive with the right-hand side for right-handed individuals (Casasanto, 2009). Although we did not measure handedness, we expect the majority of the participants to be right-handed, as only approximately 10.6% of the population is left-handed (Papadatou-Pastou et al., 2020). Thus, when the allocation of the negative response was on the left-hand side and the positive response on the right-hand side, this should be more consistent with the implicit representation of negative and positive of most participants than when the positive response was on the left-hand side, and the negative response was on the right-hand side. Therefore, the pull to the non-chosen response would be more natural for participants in the condition in that the negative response button was allocated on the left side.

Conclusion

The present studies systematically investigate potential and felt ambivalence as well as experienced conflict measured via mouse tracking in an impression formation task. The results suggest that impression formation studies should consider ambivalence. Specifically, we found that an impression formation task can lead to ambivalence when the target individual is first paired with positive statements and next paired with negative statements or vice versa. Considering the affective, behavioral, and cognitive consequences of ambivalence, we propose that ambivalence should be ruled out for unambiguous interpretation of results.

References

Béna, J., Mauclet, A., & Corneille, O. (2023). Does co-occurrence information influence evaluations beyond relational meaning? An investigation using self-reported and mouse-tracking measures of attitudinal ambivalence. *Journal of Experimental Psychology: General*, *152*(4), 968–992. https://doi.org/10.1037/xge0001308

Brambilla, M., Carraro, L., Castelli, L., & Sacchi, S. (2019). Changing impressions: Moral character dominates impression updating. *Journal of Experimental Social Psychology*, *82*, 64–73. https://doi.org/10.1016/j.jesp.2019.01.003

Brambilla, M., Sacchi, S., Rusconi, P., & Goodwin, G. P. (2021). The primacy of morality in impression development: Theory, research, and future directions. In *Advances in Experimental Social Psychology* (Vol. 64, pp. 187–262). Elsevier. https://doi.org/10.1016/bs.aesp.2021.03.001

Cacioppo, J. T., Gardner, W. L., & Berntson, G. G. (1997). Beyond bipolar conceptualizations and measures: The case of attitudes and evaluative space. *Personality and Social Psychology Review*, *1*(1), 3–25. https://doi.org/10.1207/s15327957pspr0101_2

Casasanto, D. (2009). Embodiment of abstract concepts: Good and bad in right- and left-handers. *Journal of Experimental Psychology: General*, *138*(3), 351–367. https://doi.org/10.1037/a0015854

Clark, J. K., Wegener, D. T., & Fabrigar, L. R. (2008). Attitudinal ambivalence and message-based persuasion: Motivated processing of proattitudinal information and avoidance of counter-attitudinal information. *Personality and Social Psychology Bulletin*, *34*(4), 565–577. https://doi.org/10.1177/0146167207312527

Conner, M., Sparks, P., Povey, R., James, R., Shepherd, R., & Armitage, C. J. (2002). Moderator effects of attitudinal ambivalence on attitude–behaviour relationships. *European Journal of Social Psychology*, *32*(5), 705–718. https://doi.org/10.1002/ejsp.117

Cooke, R., & Sheeran, P. (2004). Moderation of cognition-intention and cognition-behaviour relations: A meta-analysis of properties of variables from the theory of planned behaviour. *British Journal of Social Psychology*, *43*(2), 159–186. https://doi.org/10.1348/0144666041501688

Dalege, J., Borsboom, D., van Harreveld, F., van den Berg, H., Conner, M., & van der Maas, H. L. J. (2016). Toward a formalized account of attitudes: The Causal Attitude Network (CAN) model. *Psychological Review*, *123*(1), Article 1. https://doi.org/10.1037/a0039802

Dalege, J., Borsboom, D., Van Harreveld, F., & Van Der Maas, H. L. J. (2018). The Attitudinal Entropy (AE) Framework as a general theory of individual attitudes. *Psychological Inquiry*, *29*(4), 175–193. https://doi.org/10.1080/1047840X.2018.1537246

DeMarree, K. G., Briñol, P., & Petty, R. E. (2015). Reducing subjective ambivalence by creating doubt: A metacognitive approach. *Social Psychological and Personality Science*, *6*(7), 731–739. https://doi.org/10.1177/1948550615581497

Durso, G. R. O., Petty, R. E., Briñol, P., Siev, J. J., Hinsenkamp, L. D., & Sawicki, V. (2021). Dampening affect via expectations: The case of ambivalence. *Journal of Personality and Social Psychology*, *121*(6), 1172-1194. https://doi.org/10.1037/pspa0000248

Fourakis, E., & Cone, J. (2020). Matters order: The role of information order on implicit impression formation. *Social Psychological and Personality Science*, *11*(1), Article 1. https://doi.org/10.1177/1948550619843930

Freeman, J. B., & Ambady, N. (2010). MouseTracker: Software for studying real-time mental processing using a computer mouse-tracking method. *Behavior Research Methods*, *42*(1), 226–241. https://doi.org/10.3758/BRM.42.1.226

Glaser, T., Woud, M. L., Labib Iskander, M., Schmalenstroth, V., & Vo, T. M. (2018). Positive, negative, or all relative? Evaluative conditioning of ambivalence. *Acta Psychologica*, *185*, 155–165. https://doi.org/10.1016/j.actpsy.2018.02.006

Heidemeyer, P., Wesser-Saalfrank, A., & Banse, R. (2021). *The 6 Facets Reactivated F (6FRF) Scale*.

Kaplan, K. J. (1972). On the ambivalence-indifference problem in attitude theory and measurement: A suggested modification of the semantic differential technique. *Psychological Bulletin*, *77*, 361–372. https://doi.org/10.1037/h0032590

Kieslich, P. J., & Henninger, F. (2017). Mousetrap: An integrated, open-source mouse-tracking package. *Behavior Research Methods*, *49*(5), Article 5. https://doi.org/10.3758/s13428-017-0900-z

Leys, C., Ley, C., Klein, O., Bernard, P., & Licata, L. (2013). Detecting outliers: Do not use standard deviation around the mean, use absolute deviation around the median. *Journal of Experimental Social Psychology*, *49*(4), Article 4. https://doi.org/10.1016/j.jesp.2013.03.013

Ma, D. S., Correll, J., & Wittenbrink, B. (2015). The Chicago face database: A free stimulus set of faces and norming data. *Behavior Research Methods*, *47*(4), Article 4. https://doi.org/10.3758/s13428-014-0532-5

Mathôt, S., Schreij, D., & Theeuwes, J. (2012). OpenSesame: An open-source, graphical experiment builder for the social sciences. *Behavior Research Methods*, *44*(2), 314–324. https://doi.org/10.3758/s13428-011-0168-7

Nordgren, L. F., van Harreveld, F., & van der Pligt, J. (2006). Ambivalence, discomfort, and motivated information processing. *Journal of Experimental Social Psychology*, *42*(2), 252–258. https://doi.org/10.1016/j.jesp.2005.04.004

Papadatou-Pastou, M., Ntolka, E., Schmitz, J., Martin, M., Munafò, M. R., Ocklenburg, S., & Paracchini, S. (2020). Human handedness: A meta-analysis. *Psychological Bulletin*, *146*(6), 481–524. https://doi.org/10.1037/bul0000229

Petty, R. E., Briñol, P., & DeMarree, K. G. (2007). The Meta–Cognitive Model (MCM) of attitudes: Implications for attitude measurement, change, and strength. *Social Cognition*, *25*(5), Article 5. https://doi.org/10.1521/soco.2007.25.5.657

Possidónio, C., Graça, J., Piazza, J., & Prada, M. (2019). Animal Images Database: Validation of 120 images for human-animal studies. *Animals*, *9*(8), Article 8. https://doi.org/10.3390/ani9080475

Priester, J. R., & Petty, R. E. (1996). The gradual threshold model of ambivalence: Relating the positive and negative bases of attitudes to subjective ambivalence. *Journal of Personality and Social Psychology*, *71*(3), Article 3. https://doi.org/10.1037/0022-3514.71.3.431

Rydell, R. J., & McConnell, A. R. (2006). Understanding implicit and explicit attitude change: A systems of reasoning analysis. *Journal of Personality and Social Psychology*, *91*, 995–1008. https://doi.org/10.1037/0022-3514.91.6.995

Sanbonmatsu, D. M., Mazur, D., Behrends, A. A., & Moore, S. M. (2015). The role of the baserate frequency of correspondent behavior and trait stereotypes in attribution: Building on Rothbart and Park (1986). *Social Cognition*, *33*(4), 255–283. https://doi.org/10.1521/soco.2015.33.4.255

Schlink, S., & Walther, E. (2007). Kurz und gut: Eine deutsche Kurzskala zur Erfassung des Bedürfnisses nach kognitiver Geschlossenheit. *Zeitschrift Für Sozialpsychologie*, *38*(3), Article 3. https://doi.org/10.1024/0044-3514.38.3.153

Schneider, I. K., & Mattes, A. (2021). Mix is different from nix: Mouse tracking differentiates ambivalence from neutrality. *Journal of Experimental Social Psychology*, *95*, 104106. https://doi.org/10.1016/j.jesp.2021.104106

Schneider, I. K., Novin, S., van Harreveld, F., & Genschow, O. (2020). Benefits of being ambivalent: The relationship between trait ambivalence and attribution biases. *The British Journal of Social Psychology,* 60(2), 507-586. https://doi.org/10.1111/bjso.12417

Schneider, I. K., van Harreveld, F., Rotteveel, M., Topolinski, S., van der Pligt, J., Schwarz, N., & Koole, S. L. (2015). The path of ambivalence: Tracing the pull of opposing evaluations using mouse trajectories. *Frontiers in Psychology*, *6*. https://doi.org/10.3389/fpsyg.2015.00996

Thompson, M. M., Zanna, M., & Griffin, D. (1995). Let's not be indifferent about (attitudinal) ambivalence. *Attitude Strength: Antecedents and Consequences*.

van Harreveld, F., Nohlen, H. U., & Schneider, I. K. (2015). Chapter Five - The ABC of ambivalence: Affective, behavioral, and cognitive consequences of attitudinal conflict. In J. M. Olson & M. P. Zanna (Eds.), *Advances in Experimental Social Psychology* (Vol. 52, pp. 285–324). Academic Press. https://doi.org/10.1016/bs.aesp.2015.01.002

van Harreveld, F., Rutjens, B. T., Schneider, I. K., Nohlen, H. U., & Keskinis, K. (2014). In doubt and disorderly: Ambivalence promotes compensatory perceptions of order. *Journal of Experimental Psychology: General*, *143*, 1666–1676. https://doi.org/10.1037/a0036099

van Harreveld, F., van der Pligt, J., & de Liver, Y. N. (2009). The agony of ambivalence and ways to resolve it: Introducing the MAID Model. *Personality and Social Psychology Review*, *13*(1), Article 1. https://doi.org/10.1177/1088868308324518

Walther, E., Gawronski, B., Blank, H., & Langer, T. (2009). Changing likes and dislikes through the back door: The US-revaluation effect. *Cognition and Emotion*, *23*(5), Article 5. https://doi.org/10.1080/02699930802212423

Funding: This research did not receive any funding.

Declaration of conflicting interests: The authors declare no conflict of interest.

Institutional Review Board Statement: The Study protocol of Study 1 was approved by the local ethics committee in the application for ethical clearance of Study 2 (EK Nr. 62/2022).

Informed Consent Statement: Participants gave informed consent to the study procedure and data processing before participating.

Data Sharing Statement: Upon publication preregistration, data, material, and syntax will be shared on the Open Science Framework.

Acknowledgments: We thank Laura Täubert and Anne Schmidt-Freydag for their help with the pilot study validating the statements and Elena Tiganj for her help conducting Study 2.

Author Contribution: Lena Hahn: Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Software, Validation, Visualization, and Writing - original draft.

Eva Walther: Conceptualization, Funding acquisition, Methodology, Project administration, Resources, Supervision, and Validation.

Always Assumed Never Tested: A Systematic Investigation of the Formation of Ambivalent Attitudes

Lena Hahn & Eva Walther

Trier University

Abstract

A cupcake, organ donation, and air traveling—all these attitude objects have in common that they can elicit ambivalence in many people. Ambivalence is the co-occurrence of positive and negative associations and has severe downstream consequences. Even though many attitude theories predict ambivalence if an attitude has positive and negative elements, previous research rarely tested this assumption. Drawing on the few studies that investigated the genesis of ambivalence, we used an impression formation task to randomly present the same number of positive and negative (i.e., ambivalent), or only positive (univalent positive control) or only negative (i.e., univalent negative control) statements. Consistent with the propositions of attitude models, we found higher self-reported ambivalence in the ambivalent condition compared to the control conditions in all studies. However, we did not consistently find higher ambivalence on an indirect ambivalence measure (i.e., mouse tracking). In Study 3, we tested if the block-size of statements of the same valence influences ambivalence. We discuss the results and implications for research.

Keywords: ambivalence, attitude formation, impression formation

Introduction

People immediately evaluate attitude objects upon confrontation. However, some attitude objects, such as unhealthy food (Norris et al., 2019), plastic (Hahn et al., 2021), or organ donation (Contiero & Wilson, 2019), elicit simultaneously positive and negative associations (i.e., ambivalence) instead of only positive or only negative associations (i.e., univalent). This structure of positive and negative associations is called potential ambivalence (Kaplan, 1972), and the experienced conflict resulting from the simultaneous accessibility of positive and negative associations is called felt ambivalence (Priester & Petty, 1996). Even though the downstream consequences of ambivalence on affect, behavior, and cognition are well established (van Harreveld et al., 2015), there is little research on the formation of ambivalent attitudes. However, understanding the formation of ambivalent attitudes will help to design interventions to help people overcome this evaluative conflict.

On a theoretical basis, many attitude theories (e.g., Dalege et al., 2018; Petty et al., 2007) are consistent in their explanation of the formation of ambivalence. They propose that if an attitude object is associated with positive and negative evaluative reactions, the attitude object elicits attitudinal ambivalence. For example, the Meta-cognitive Model of Attitudes (MCM; Petty et al., 2007) proposes that attitude objects are connected to evaluative associations in memory. For instance, chocolate can be associated with being tasty (i.e., positive evaluative association). Furthermore, these evaluative associations are tagged with validity information (e.g., true/false, yes/no, accept/reject). Hence, chocolate might be associated with being tasty, which is tagged as true. Additionally, the MCM proposes that the evaluative associations are automatically activated, and the validity information only influences attitude when people have time to retrieve it. Therefore, direct and indirect attitude measures might indicate different attitudes.

If an attitude object has opposing evaluative associations (e.g., chocolate being associated with being tasty as well as being unhealthy), the MCM proposes two possibilities. First, one of the evaluative associations might be tagged as invalid (e.g., chocolate-tasty-false). Thus, people change their attitude. This particular case of the MCM is called past attitudes are still there (Petty et al., 2006). Previous research investigating this particular case of the MCM and found that participants did not indicate higher ambivalence on self-reported measures, however, a more indirect measure indicated ambivalence. The second possibility the MCM proposes when an attitude object is associated with opposing evaluative associations is when both evaluative associations have the same validity tag (e.g., both true or both false). If this is the case, then people should indicate ambivalence on direct and indirect measures.

Preliminary evidence that ambivalent attitudes emerge when attitude objects are connected with positive and negative information is observed in Evaluative Conditioning studies. Evaluative Conditioning refers to the change in liking of a previously neutral stimulus (CS) in the direction of a valenced stimulus (US) due to repeated pairing (De Houwer, 2007). That is, if a CS was repeatedly paired with a positive US, then the CS is evaluated more positively. Because such procedures do not give validity information, the MCM (Petty et al., 2007) proposes ambivalence in direct and indirect attitude measures when a CS is paired with an ambivalent US or with positive and negative US. However, only a few Evaluative Conditioning studies exist that investigate this (Béna et al., 2023; Glaser et al., 2018). Glaser et al. (2018) used pictures consisting of positive and negative pictures combined together as ambivalent US. They investigated if the repeated pairing of a CS with these compound US leads to an ambivalent evaluation of the CS. They found initial evidence that EC might lead to the formation of ambivalent attitudes. However, when they accounted for alpha error accumulation, the critical comparisons were not significant.

Further evidence is provided by the studies by Béna et al. (2023). They investigated the genesis of ambivalence using a relational Evaluative Conditioning procedure. In relational Evaluative Conditioning procedures, the CS and US do not merely co-occur, but a relational link is specified. In their studies, for example, they found higher felt ambivalence when a fictitious alien species (i.e., CS) loved (i.e., relational link) a negative animal (i.e., US) than when a fictitious alien species loved a positive animal. This indicates that not only the mere co-occurrence can lead to ambivalence but also when one aspect is the relation between the CS and the US.

Additionally, there is evidence that impression formation tasks can lead to ambivalence (Cacioppo et al., 1997; Priester & Petty, 1996). For example, Cacioppo et al. (1997) first paired a name with six neutral statements and next with either six additional neutral statements, six additional positive statements, six additional negative statements, or three positive and three negative statements in random order. Consistent with the predictions of the MCM (Petty et al., 2007), they found higher ambivalence when the name was paired with three positive and three negative statements.

The previously reviewed studies provide mixed evidence for the prediction of the MCM that an attitude object that is paired with positive and negative aspects with the same validity information leads to ambivalence on direct and indirect measures (Petty et al., 2007). Several limitations further impair the interpretation and comparison of the studies. For example, some studies only used direct attitude measures (Cacioppo et al., 1997; Glaser et al., 2018; Priester & Petty, 1996) or only captured felt ambivalence (Béna et al., 2023). Hence, a systematic investigation of the formation of ambivalent attitudes using direct and indirect attitude measures is missing.

The Present Investigation

The present investigation, therefore, systematically tests whether pairing a neutral attitude object with positive and negative information without validity information leads to ambivalence. According to the MCM, direct and indirect attitude measures should indicate ambivalence when an attitude object has opposing evaluative associations with the same validity information (Petty et al., 2007). These previously reviewed findings provide preliminary evidence that ambivalent attitudes can emerge when the positive and negative associations are acquired (almost) simultaneously and without validity information. Going beyond previous research, we measured potential (Thompson et al., 1995) and felt ambivalence (Priester & Petty, 1996) with direct attitude measures and used a mouse tracking task as an indirect indicator of ambivalence (Schneider et al., 2015; Schneider & Mattes, 2021). Ambivalence measured via mouse tracking is less affected by introspective ability and social desirability as it depicts participants' movements while categorizing the attitude object (Schneider et al., 2015). Whereas participants move in a relatively straight line from the start point to the answer for a univalent attitude object, their mouse movement should have more pull to the non-chosen response option (i.e., a more curved line) for an ambivalent attitude object (Schneider et al., 2015; Schneider & Mattes, 2021).

We used an impression formation task to test the hypothesis that an attitude object with opposing evaluative associations with the same validity information leads to ambivalence. We implemented ambivalent, univalent positive, and univalent negative conditions. To this end, face pictures were paired with either positive, negative, or positive and negative statements. We hypothesize that pictures of faces that are randomly paired with positive and negative statements elicit higher potential and felt ambivalence as well as ambivalence measured via mouse tracking than pictures of faces that are paired with only positive or only negative statements.

Study 1

Study 1 was an online study programmed with Enterprise Feedback Suite Survey from Tivian XI. An adapted version of Mathur and Reichling's (2019) online mouse tracking for Enterprise Feedback Suite Survey (Buttlar et al., 2023; Puteri et al., 2022) was used to implement mouse tracking.

Method

Participants and Design

A total of $N = 121$ participants participated in the online study (86 female, 35 male; $M_{age} = 24.87$, $SD_{age} = 9.96$, range 18 to 65 years; one did not receive a high school diploma, two high school degree, six secondary school, 91 A-levels, 18 university degree and three other educational degrees). Due to outliers and missing values, the data of six participants was not included in the mouse tracking analysis, resulting in a total of $N = 115$ participants for these analyses (83 female, 32 male; $M_{age} = 24.69$, $SD_{age} = 10.06$, range 18 to 65 years; one did not receive a high school diploma, two high school degree, six secondary school, 88 A-levels, 15 university degree and three other educational degree). Students of the local university received partial course credit for their participation. All other participants could not be compensated. A one-factor (Valence: ambivalent vs. univalent positive vs. univalent negative) within-participant design was realized. For mouse tracking, the between factor of allocation of response button was added, resulting in a 3 (Valence: ambivalent vs. univalent positive vs. univalent negative) x 2 (Allocation of Response: left positive vs. left negative) mixed design. Post hoc comparisons were Bonferroni corrected, and where the assumption of Sphericity was violated, Greenhouse-Geisser correction was implemented.

Procedure

After giving informed consent, participants indicated whether they used a computer and a computer mouse. Only participants using a computer and a computer mouse could participate in the study. All other participants were thanked for their interest and informed that they could only participate if they used a computer and a computer mouse. Following the procedure of Walther et al. (2009), participants using a computer mouse were next instructed to imagine starting a new job, that they were interested in getting to know their new colleagues, and that they would receive information about their new colleagues. On the following pages, a picture was presented on the left side of the screen and a statement on the right side of the screen. After seven seconds, the slide automatically changed to the next slide. Six pictures (three of female and three of male) of Caucasian faces with neutral facial expressions and 36 (18 positive and 18 negative) statements were used. The pictures were from the Chicago Face Database (Ma et al., 2015). The statements were from previous studies (Durso et al., 2021; Walther et al., 2009) as well as self-generated and pretested to be univalent positive or univalent negative. The pictures and statements were randomly assigned to the conditions. For the univalent positive condition, a picture of a female face and a picture of a male face was paired with six positive statements. For the univalent negative condition, a picture of a female and a picture of a male face was paired with six negative statements. For the ambivalent condition, a picture of a female and a picture of a male face was paired with three positive and three negative statements.

After the impression formation phase, ambivalence via mouse tracking was measured. Participants were instructed to indicate their response by clicking on the positive or negative button in the screen's upper left or upper right corners. The response side was counterbalanced between participants. To familiarize participants with the procedure, participants completed five practice trials. Five pictures of Caucasian faces with neutral expressions were chosen from the Chicago Face Database (Ma et al., 2015) for the practice trials. Before the practice trials, participants were instructed to activate the full-screen mode. The mouse tracking procedure was in a 925x640 pixel grey bordered field in the middle of the screen. This was implemented to ensure that mouse tracking was independent of screen size, and even on smaller screens, the entire mouse tracking area was displayed without participants having to scroll.

A mouse tracking trial started when participants clicked the start button at the bottom center of the screen. Next, the target picture appeared, and participants had to move the mouse and click on one of the response buttons in the top corners of the screen. If participants did not initiate mouse movement after 1500ms, they got feedback to initiate it faster. If participants took longer than 7500ms to respond, they got feedback to respond faster. Additionally, participants received feedback if they moved the mouse before the picture was fully loaded and were asked to move the mouse only when the picture was fully loaded. Following Leys et al. (2013) recommendation, we excluded trials based on reaction times. That is, we excluded the median plus and minus 2.5, the Median Absolute Deviation. Trials in which feedback was provided were also excluded from analysis. This resulted in 18.82% of all trials being excluded. The dependent variable for mouse tracking was the horizontal deviation on the x-axis.

After participants completed the practice trials, they completed the test trials. In the test trials, each of the six pictures from the impression formation task was presented three times, resulting in 18 trials. Due to a programming error, one picture of a female face was presented twice, and another picture of a female face was presented four times. However, this should not bias the results because the pictures were randomly assigned to the conditions.

Following the mouse tracking, participants completed the self-reported ambivalence measures. The face pictures were presented in the middle of the screen for all questions. Under the picture, the question was presented, and below the question, the rating slider was presented. Participants indicated their response by moving the slider. The slider ranged from 0 to 100, but only the endpoints were labeled. Participants first reported positivity and negativity separately. For positivity (negativity), participants were asked to indicate "how positive (negative) they evaluated the person, independently from the negative (positive) aspects”. The endpoints of the slider were labeled “not at all positive (negative)” on the left and “very positive (negative)” on the right. The Similarity Intensity Model Index (SIM-Index) was used as an indicator of potential ambivalence (Thompson et al., 1995): (positivity + negativity)/2 - | positivity – negativity |. Higher SIM-Index values indicate higher potential ambivalence. Following positivity and negativity, participants indicated their felt ambivalence (“To what extent do you have conflicting thoughts and/or feelings toward the depicted person”). For this question, the left endpoint of the slider was labeled “not at all” and the right endpoint was labeled “maximally”.

After the self-reported ambivalence measures, participants completed the Trait Ambivalence Scale (Schneider et al., 2020) for exploratory purposes. We do not report the analysis of Trait Ambivalence because Trait Ambivalence did not influence the results. Finally, participants answered demographic questions (i.e., gender, age, education) and had the opportunity to leave a comment. On the final page, participants were thanked for their participation.

Results and Discussion

For mouse tracking, a 3 (Valence: ambivalent vs. univalent positive vs. univalent negative) x 2 (Allocation of Response: left positive vs. left negative) analysis of variance (ANOVA) with repeated measurement on the first factor and deviation on the x-axis as dependent variable revealed a main effect of Valence, $F(1.94, 205.56) = 6.3$, $p = .002$, $\eta^2_p = .06$. Consistent with the hypothesis that face pictures paired with positive and negative statements elicit higher ambivalence compared to face pictures paired with only negative statements, pairwise comparisons indicated that the ambivalent condition led to significantly larger deviation on the x-axis compared to the univalent negative condition ($p = .001$; ambivalent: $M = 0.48$, $SE = 0.03$; univalent negative: $M = 0.37$, $SE = 0.03$). However, the ambivalent condition did not significantly differ from the univalent positive condition ($p > .05$; univalent positive: $M = 0.43$, $SE = 0.04$), and the univalent positive condition did not differ from the univalent negative condition ($p > .05$). No other main effect or interaction was significant (ps > .77).

For potential ambivalence, a one-factor (Valence: ambivalent vs. univalent positive vs. univalent negative) repeated measure ANOVA was calculated. This analysis revealed a main effect of Valence, $F(1.76, 210.93) = 139.55$, $p < .001$, $\eta^2_p = .54$. Pairwise comparisons indicated that ambivalent had significantly higher potential ambivalence than univalent negative and univalent positive (ps < .001; ambivalent: $M = 23.8$, $SE = 2.57$; univalent negative: $M = -19.1$, $SE = 2.76$; univalent positive: $M = -26.2$, $SE = 2.81$). Additionally, univalent negative had significantly higher potential ambivalence than univalent positive ($p = .02$).

The one-factor (Valence: ambivalent vs. univalent positive vs. univalent negative) repeated measure ANOVA with felt ambivalence as dependent variable revealed a main effect of Valence, $F(1.92, 230.42) = 91.23$, $p < .001$, $\eta^2_p = .43$. Consistent with our hypothesis, pairwise comparisons revealed that face pictures that were paired with positive and negative statements elicited higher felt ambivalence than face pictures that were paired with only positive statements or only negative statements (ps < .001; ambivalent: $M = 57.1$, $SE = 2.00$; univalent negative: $M = 31.3$, $SE = 2.83$; univalent positive: $M = 16.3$, $SE = 2.12$). Additionally, pictures in the univalent negative condition elicited significantly higher felt ambivalence than pictures in the univalent positive condition ($p < .001$).

In sum, we found evidence that presenting the same number of positive and negative statements in a random order leads to higher ambivalence than presenting only negative statements. Specifically, this effect held for potential and felt ambivalence measured via self-report. For ambivalence measured via mouse tracking, the ambivalent condition had only higher deviation on the x-axis than the univalent negative condition but not the univalent positive condition.

Study 2

The second study aimed to replicate the results of Study 1 in the laboratory and eliminate the programming error. OpenSesame (Mathôt et al., 2012) was used to program the study, and the mousetrap plug-in (Kieslich & Henninger, 2017) was used to implement mouse-tracking. This study was pre-registered and approved by the ethics committee of the local university (EK Nr. 62/2022). We again hypothesize that pictures of faces paired with positive and negative statements elicit higher potential and felt ambivalence as well as ambivalence measured via mouse tracking than pictures of faces paired with only positive or only negative statements.

Method

Participants and Design

A total of $N = 101$ students of the local university participated in return for partial course credit (88 female, 11 male, one non-binary, one preferred not to indicate gender; M_{age} = 21.21, SD_{age} = 3.02, range 18 to 34 years; 97 indicated that German was their native language). Due to empty cells because of outliers, six participants were excluded from the mouse tracking analysis, resulting in a final sample of $N = 95$ in the mouse tracking analysis (82 female, 11 male, one non-binary, one preferred not to indicate gender; M_{age} = 21.28, SD_{age} = 3.07, range 18 to 34 years; 91 indicated that German was their native language). The same design as in Study 1 was implemented. That is, for the self-reported measures, a one-factor (Valence: ambivalent vs. univalent positive vs. univalent negative) within-participant design and for mouse tracking a 3 (Valence: ambivalent vs. univalent positive vs. univalent negative) x 2 (Allocation of Response: left positive vs. left negative) mixed design was realized. Please note that we expected to recruit a balanced sample and, therefore, pre-registered sex of target picture as an additional factor. We dropped this factor because effects can not be unambiguously interpreted due to the unbalanced sample. Where the assumption of Sphericity was violated, Greenhouse-Geisser correction was implemented. Pairwise comparisons were Bonferroni corrected.

Procedure

After participants consented to the study procedure and data processing, participants completed the Trait Ambivalence (Schneider et al., 2020), the Need for Cognitive Closure (Schlink & Walther, 2007), and the 6 Facets Reactivated F scale (Heidemeyer et al., 2021). Neither Trait Ambivalence nor Need for Cognitive Closure influenced the results. Therefore, we do not report them. The 6 Facets Reactivated F scale was implemented as a buffer task to disguise the research goal. The attitude induction procedure was the same as in Study 1, except that each picture was paired with eight statements. Participants only received feedback for mouse tracking when they took longer than 1000ms to initiate movement. Because some participants of Study 1 indicated that they were confused by the face pictures in the practice trials, we used two pictures of positive animals and two pictures of negative animals (Possidónio et al., 2019) in the practice trials. Additionally, each picture was presented four times in the test trials. As in Study 1, trials in which feedback was provided and with a Median plus and minus 2.5 times the Median Absolut Deviation in reaction times were excluded (9.69%; Leys et al., 2013). In contrast to Study 1, in which we used the deviation on the x-axis as dependent variable, we used the maximum absolute deviation (MAD) as dependent variable in the current study. The MAD is the maximum perpendicular deviation of the perfect straight line from the start to the chosen response and the actual trajectory (Freeman & Ambady, 2010). Additionally, whereas the raw mouse tracking data was used in Study 1, the mouse tracking data was time normalized in Study 2. This ensures that all trajectories have the same number of measurement times. These adaptations are in line with the studies validating mouse tracking as an ambivalence measure (Schneider et al., 2015;

Schneider & Mattes, 2021). Following the mouse tracking, positivity, negativity, and felt ambivalence were measured as in Study 1, except that the slider ranged from -100 to 100. Finally, participants answered demographic questions (i.e., gender, age, education, native language), were thanked and debriefed.

Results and Discussion

The 3 (Valence: ambivalent vs. univalent positive vs. univalent negative) x 2 (Allocation of Response: left positive vs. left negative) ANOVA with repeated measure on the first factor and MAD as dependent variables revealed no significant effects (*p*s > .316). Thus, in contrast to our hypothesis, we did not find that face pictures that were paired with positive and negative statements elicited higher pull to the non-chosen response than face pictures paired with only positive or only negative statements.

We calculated a one-factor (Valence: ambivalent vs. univalent positive vs. univalent negative) repeated measure ANOVA with potential ambivalence (i.e., SIM-Index) as dependent variable. The main effect of Valence condition was significant, $F(1.95, 194.77) = 44.43$, $p < .001$, $\eta^2_p = .31$. Consistent with our hypothesis, pairwise comparisons revealed that the pictures in the ambivalent condition had significantly higher potential ambivalence than the pictures in the univalent negative and the univalent positive condition (*p*s < .001; ambivalent: $M = 44.57$, $SE = 5.18$; univalent negative: $M = 9.64$, $SE = 6.41$; univalent positive: $M = -27.56$, $SE = 6.33$). Additionally, as in Study 1, univalent negative had higher potential ambivalence than univalent positive ($p < .001$).

The one-factor (Valence: ambivalent vs. univalent positive vs. univalent negative) repeated measure ANOVA with felt ambivalence as dependent variable revealed a main effect of Valence, $F(1.71, 170.87) = 105.1$, $p < .001$, $\eta^2_p = .51$. Consistent with our hypothesis, felt ambivalence was significantly higher in the ambivalent compared to the univalent negative and the univalent positive condition (*p*s < .001; ambivalent: $M = 9.38$, $SE = 4.33$; univalent negative: $M = -41.23$, $SE = 4.82$; univalent positive: $M = -67.97$, $SE = 3.8$). Additionally, the univalent negative condition elicited significantly higher felt ambivalence than the univalent positive condition ($p < .001$).

In sum, Study 2 replicated the results of Study 1 for the self-reported measures but not for ambivalence measured via mouse tracking. Taken together, the results of Study 1 and Study 2 indicate that randomly presenting the same number of positive and negative statements with a face picture can elicit ambivalence. However, because the presentation of positive and negative statements in the ambivalent condition was completely random, it was possible that the positive statements were presented first and then the negative statements. Even though this was very unlikely, we conducted Study 3 to systematically investigate if block-size of statements of one valence impacts ambivalence.

Study 3

The aim of Study 3 was to systematically investigate if the block-size of statement presentation influences ambivalence. Therefore, we added multiple conditions with different orders and block-size of statements of one valence while holding the number of positive and negative statements constant in the ambivalent conditions. As Study 3 was a laboratory study, we again used OpenSesame (Mathôt et al., 2012) and the mousetrap plug-in (Kieslich & Henninger, 2017) to implement the procedure. The study was pre-registered and approved by the ethics committee of the local university (EK Nr. 62/2022).

Method

Participants and Design

Consistent with the pre-registration, we terminated data collection at the end of the term, resulting in a total $N = 68$ participants (48 female, 19 male, one preferred not to indicate gender; $M_{age} = 23.05$, $SD_{age} = 2.7$, range 19 to 34 years, two participants did not indicate their age; 66 indicated that German was their native language, one that German was not their native language and one did not indicate language). Due to outliers, three participants were excluded in the mouse tracking analysis, resulting in a total *N* = 65 participants (47 female, 17 male, one preferred not to indicate gender; M_{age} = 22.83, SD_{age} = 2.32, range 19 to 29 years, two participants did not indicate their age; 63 indicated that German was their native language, one that German was not their native language and one did not indicate language) for this analysis. Participants from the local university received partial course credit for their participation. A one-factor (Valence: univalent positive vs. univalent negative vs. ambivalent random vs. 2222N vs. 2222P vs. 242P vs. 242N vs. 44P vs. 44N) within-participant design was realized for the self-reported measures. For ambivalence measured via mouse tracking, allocation of response was added, resulting in a 9 (Valence: univalent positive vs. univalent negative vs. ambivalent random vs. 2222N vs. 2222P vs. 242P vs. 242N vs. 44P vs. 44N) x 2 (Allocation of Response: left positive vs. left negative) mixed design. Again, Bonferroni correction was implemented for pairwise comparisons, and Greenhouse-Geisser correction was implemented when the assumption of Sphericity was violated.

Procedure

The procedure was the same as in Study 2, except that nine pictures of females with neutral facial expressions were used, and the valence condition had nine levels. Besides the univalent positive, univalent negative, and ambivalent random, six additional valence levels that should elicit ambivalence were added. That is, one condition presenting first all positive and then all negative information (i.e., 44P), one condition presenting first all negative and then all positive information (i.e., 44N), one condition in which two statements with the same valence are always alternated starting with positive information (i.e., 2222P), one condition in which two statements with the same valence are always alternated starting with negative information (i.e., 2222N), one condition which started with two positive followed by all negative and ending with two positive (i.e., 242P) and lastly, one condition which started with two negative followed by all positive information and ending with two negative information (i.e., 242N). As in the previous studies, the face pictures were only presented with a single information per screen.

We again excluded mouse tracking trials in which feedback was presented and when the reaction times were faster than the Median minus 2.5 times the Median Absolute Deviation and slower than the Median plus 2.5 times the Median Absolute Deviation (Leys et al., 2013). Thus, we excluded less than 10% of the trials. Because the Trait Ambivalence (Schneider et al., 2020), the Need for Cognitive Closure (Schlink & Walther, 2007), and the 6 Facets Reactivated F (Heidemeyer et al., 2021) scale did not influence the results, we do not report them.

Results and Discussion

For mouse tracking, the 9 (Valence: univalent positive vs. univalent negative vs. ambivalent random vs. 2222N vs. 2222P vs. 242P vs. 242N vs. 44P vs. 44N) x 2 (Allocation of Response: left positive vs. left negative) ANOVA with repeated measurement on the first factor revealed no significant effects (*p*s > .111). Thus, replicating the results of Study 2, there was no difference between face pictures paired with only positive or only negative information and face pictures paired with the same amount of positive and negative information.

The one-factor (Valence: univalent positive vs. univalent negative vs. ambivalent random vs. 2222N vs. 2222P vs. 242P vs. 242N vs. 44P vs. 44N) repeated measure ANOVA with potential ambivalence as dependent variable was significant, $F(6.65, 445.79) = 10.99$, $p < .001$, $\eta^2_p = .14$. Consistent with our hypothesis that face pictures paired with positive and negative statements lead to higher potential ambivalence than face pictures paired with only positive or only negative statements, we found significant differences between univalent positive and all ambivalent conditions (*p*s < .001; see Table 1 for Means and Standard Errors). Partly confirming our hypothesis, we found that univalent negative elicited significantly lower potential ambivalence compared to all ambivalent conditions (*p*s $< .05$) except when the statements were presented randomly ($p = .14$). The univalent conditions did not significantly differ in their potential ambivalence ($p > .05$).

Table 1

Means and Standard Errors for Potential and Felt Ambivalence by Valence

	Potential Ambivlance		Felt Ambivalence	
Valence	*M*	*SE*	*M*	*SE*
Negative	2.90	9.02	-47.94	5.84
Positive	-18.68	8.57	-58.67	6.38
Ambivalent Random	38.04	7.40	-13.55	6.11
2222N	37.41	7.79	-11.25	7.42
2222P	40.54	8.44	-10.19	7.37
242P	46.83	7.30	-15.57	6.63
242N	44.99	7.24	-12.48	6.33
44P	47.09	8.61	1.82	6.92
44N	47.06	7.57	-12.63	6.85

For felt ambivalence, the one-factor (Valence: univalent positive vs. univalent negative vs. ambivalent random vs. 2222N vs. 2222P vs. 242P vs. 242N vs. 44P vs. 44N) repeated measure ANOVA was significant, $F(7.24, 485.04) = 9.59$, $p < .001$, $\eta^2_p = .13$. Consistent with our hypothesis, univalent positive elicited significantly lower felt ambivalence than all ambivalent conditions (*p*s $< .001$; see Table 1 for Means and Standard Errors). Additionally, univalent negative also significantly differed from all ambivalent conditions (*p*s $< .037$) but 242P ($p = .059$). The two univalent conditions did not differ significantly from each other ($p > .05$).

In sum, the results replicate the results of Study 2. That is, there were no significant differences between the univalent and the ambivalent conditions in mouse tracking. Furthermore, all ambivalent conditions had higher potential and felt ambivalence than the univalent positive condition. Additionally, most ambivalent conditions had higher potential and felt ambivalence compared to univalent negative. It seems that block-size does not significantly influence ambivalence. However, we should interpret the results carefully, as we did not reach the planned sample size.

General Discussion

Ambivalence is omnipresent in our daily lives. However, little is known about the formation of ambivalent attitudes. Even though many attitude theories predict that ambivalent attitudes should be formed if an attitude object is connected to positive and negative aspects (e.g., Dalege et al., 2018; Petty et al., 2007), this has not been systematically investigated previously. In three studies, we found evidence that randomly presenting positive and negative statements about a person leads to higher self-reported potential and felt ambivalence compared to a person presented with only positive statements. In an online study, we found evidence that presenting a person with positive and negative information leads to higher ambivalence measured via mouse tracking than presenting only negative statements. However, we could not replicate this effect in two laboratory studies. Because the laboratory studies were in a more controlled environment than the online study and used the indicator that was validated for capturing ambivalence via mouse tracking, we propose that at least randomly presenting the same amount of positive and negative information might not lead to ambivalence measured via mouse tracking. However, to exclude that block-size influences ambivalence measured via mouse tracking, the sample size of Study 3 is too small. In sum, even though we found potential and felt ambivalence, evidence for indirectly measured ambivalence is weak.

This inconsistency between self-reported and indirect measures of ambivalence has been found in previous research (Petty et al., 2006; Zayas et al., 2022; Zoppolat et al., 2023). Even in the studies validating mouse tracking as an ambivalence measure, MAD did not consistently correlate with felt or potential ambivalence (Schneider et al., 2015). Interestingly, though, Petty et al. (2006) did not find ambivalence in direct measures but in indirect measures when they tested the predictions of the past attitudes are still there case of the MCM. They argue that when attitudes are explicitly reported, people are able to take the validity information into account. However, when people report their attitudes indirectly, they do not have time to consider the validity information. Even though this explains their results, as they tagged one evaluative association as false, this does not apply to the results of the current study. In the current study, participants did not get any validity information. Therefore, all information should have the same validity tag, and we would have expected ambivalence in self-reported and indirect attitude measures. Even so, implicit attitudes can be predictive of behavior (e.g., Cameron et al., 2012) ambivalence research shows that especially felt ambivalence leads to discomfort (Nordgren et al., 2006). For example, felt ambivalence influences information processing (Clark et al., 2008), can lead to procrastination (van Harreveld et al., 2009), or compensatory perception of order (van Harreveld et al., 2014).

Previous research demonstrated that felt ambivalence is higher when expectancies are violated (Durso et al., 2021). Specifically, Durso et al. (2021) compared random statement presentation, alternating statement presentation, and blocked statement presentation. In their study, they did not find differences in potential ambivalence. However, the blocked condition led to higher felt ambivalence compared to the other two conditions. Inconsistent with this research, we did not find significant differences in the ambivalent conditions for potential or felt ambivalence. There are several explanations for these deviations in results. We implemented a within-participant design. Many impression formation studies implement between-participant designs to avoid comparisons (DeMarree et al., 2015). Thus, when participants indicated their attitude, they might do this in relation to the other impressions they have formed. However, if this was true, we would have expected higher differences between the ambivalent conditions. The within-participants design, however, led to a second limitation. That is, even though the order of the face–information pairing was controlled, the order of when a face was presented was randomized. Thus, participants might have expected mixed information for all target persons. If this was true and participants could not form impressions, then the univalent conditions should not have worked either. However, the results of Study 3 should be interpreted with caution as we did not reach the aimed sample size, and thus power is not high.

The results of the current studies not only shed light on the formation of ambivalent attitudes but are also relevant for other research. For example, impression formation studies often implement procedures in which target people are first paired with statements of one valence and then with counter-attitudinal statements (Fourakis & Cone, 2020; Rydell & McConnell, 2006). Even though attitude theories (e.g., Dalege et al., 2018; Petty et al., 2007) propose that in such procedures, ambivalence is likely, this is rarely investigated. Neglecting ambivalence is especially problematic for the unambiguous interpretation of research results, as the experience of ambivalence can lead to downstream affective, cognitive, and behavioral consequences (van Harreveld et al., 2009, 2015). Besides impression formation research and in light of the current results, ambivalence might also be likely in other procedures in which objects are paired with positive and negative stimuli. For example, in counter-conditioning procedures (e.g., Hu et al., 2017), the genesis of ambivalence might also be likely.

Conclusion

According to the MCM (Petty et al., 2007), direct and indirect attitude measures should indicate ambivalence when an attitude object is paired with opposing evaluative information with the same validity information. Consistent with this assumption, we found that pairing positive and negative information with an attitude object leads to higher potential and felt ambivalence. However, we only found weak evidence for ambivalence on an indirect measure (i.e., mouse tracking). Considering that participants only inactively viewed the stimuli pairings and the univalent and ambivalent conditions were intermixed indicates that ambivalent attitudes might form easier than previously expected. Hence, ambivalence might have previously been overlooked in procedures where a neutral object is paired with positive and negative stimuli.

References

Béna, J., Mauclet, A., & Corneille, O. (2023). Does co-occurrence information influence evaluations beyond relational meaning? An investigation using self-reported and mouse-tracking measures of attitudinal ambivalence. *Journal of Experimental Psychology: General, 152*(4), 968–992. https://doi.org/10.1037/xge0001308

Buttlar, B., Pauer, S., Ruby, M. B., Chambon, M., Jimenez-Klingberg, A.-K., Scherf, J., & Scherrer, V. (2023). The Meat Ambivalence Questionnaire: Assessing domain-specific meat-related conflict in omnivores and veg*ans. *Collabra: Psychology, 9*(1), 73236. https://doi.org/10.1525/collabra.73236

Cacioppo, J. T., Gardner, W. L., & Berntson, G. G. (1997). Beyond bipolar conceptualizations and measures: The case of attitudes and evaluative space. *Personality and Social Psychology Review, 1*(1), 3–25. https://doi.org/10.1207/s15327957pspr0101_2

Cameron, C. D., Brown-Iannuzzi, J. L., & Payne, B. K. (2012). Sequential priming measures of implicit social cognition: A Meta-Analysis of associations with behavior and explicit attitudes. *Personality and Social Psychology Review, 16*(4), 330–350. https://doi.org/10.1177/1088868312440047

Clark, J. K., Wegener, D. T., & Fabrigar, L. R. (2008). Attitudinal ambivalence and message-based persuasion: Motivated processing of proattitudinal information and avoidance of counter-attitudinal information. *Personality and Social Psychology Bulletin, 34*(4), 565–577. https://doi.org/10.1177/0146167207312527

Contiero, P. P., & Wilson, D. M. (2019). Understanding ambivalence toward organ donation and transplantation: An exploratory study of nursing students. *Nurse Education Today, 76*, 191–195. https://doi.org/10.1016/j.nedt.2019.02.008

Dalege, J., Borsboom, D., Van Harreveld, F., & Van Der Maas, H. L. J. (2018). The Attitudinal Entropy (AE) Framework as a general theory of individual attitudes.

Psychological Inquiry, 29(4), 175–193. https://doi.org/10.1080/1047840X.2018.1537246

De Houwer, J. (2007). A conceptual and theoretical analysis of Evaluative Conditioning. *The Spanish Journal of Psychology, 10*(2), Article 2. https://doi.org/10.1017/S1138741600006491

DeMarree, K. G., Briñol, P., & Petty, R. E. (2015). Reducing subjective ambivalence by creating doubt: A metacognitive approach. *Social Psychological and Personality Science, 6*(7), Article 7. https://doi.org/10.1177/1948550615581497

Durso, G. R. O., Petty, R. E., Briñol, P., Siev, J. J., Hinsenkamp, L. D., & Sawicki, V. (2021). Dampening affect via expectations: The case of ambivalence. *Journal of Personality and Social Psychology, 121*(6), 1172-1194. https://doi.org/10.1037/pspa0000248

Fourakis, E., & Cone, J. (2020). Matters Order: The role of information order on implicit impression formation. *Social Psychological and Personality Science, 11*(1), Article 1. https://doi.org/10.1177/1948550619843930

Freeman, J. B., & Ambady, N. (2010). MouseTracker: Software for studying real-time mental processing using a computer mouse-tracking method. *Behavior Research Methods, 42*(1), 226–241. https://doi.org/10.3758/BRM.42.1.226

Glaser, T., Woud, M. L., Labib Iskander, M., Schmalenstroth, V., & Vo, T. M. (2018). Positive, negative, or all relative? Evaluative conditioning of ambivalence. *Acta Psychologica, 185*, 155–165. https://doi.org/10.1016/j.actpsy.2018.02.006

Hahn, L., Buttlar, B., & Walther, E. (2021). Unpacking plastic: Investigating plastic related ambivalence. *Sustainability, 13*(4), Article 4. https://doi.org/10.3390/su13042186

Heidemeyer, P., Wesser-Saalfrank, A., & Banse, R. (2021). The 6 Facets Reactivated F (6FRF) Scale.

Hu, X., Gawronski, B., & Balas, R. (2017). Propositional versus dual-process accounts of Evaluative Conditioning: II. The effectiveness of counter-conditioning and counterinstructions in changing implicit and explicit evaluations. *Social Psychological and Personality Science, 8*(8), 858–866. https://doi.org/10.1177/1948550617691094

Kaplan, K. J. (1972). On the ambivalence-indifference problem in attitude theory and measurement: A suggested modification of the semantic differential technique. *Psychological Bulletin, 77*, 361–372. https://doi.org/10.1037/h0032590

Kieslich, P. J., & Henninger, F. (2017). Mousetrap: An integrated, open-source mouse-tracking package. *Behavior Research Methods, 49*(5), Article 5. https://doi.org/10.3758/s13428-017-0900-z

Leys, C., Ley, C., Klein, O., Bernard, P., & Licata, L. (2013). Detecting outliers: Do not use standard deviation around the mean, use absolute deviation around the median. *Journal of Experimental Social Psychology, 49*(4), Article 4. https://doi.org/10.1016/j.jesp.2013.03.013

Ma, D. S., Correll, J., & Wittenbrink, B. (2015). The Chicago face database: A free stimulus set of faces and norming data. *Behavior Research Methods, 47*(4), Article 4. https://doi.org/10.3758/s13428-014-0532-5

Mathôt, S., Schreij, D., & Theeuwes, J. (2012). OpenSesame: An open-source, graphical experiment builder for the social sciences. *Behavior Research Methods, 44*(2), 314–324. https://doi.org/10.3758/s13428-011-0168-7

Mathur, M. B., & Reichling, D. B. (2019). Open-source software for mouse-tracking in Qualtrics to measure category competition. *Behavior Research Methods, 51*(5), Article 5. https://doi.org/10.3758/s13428-019-01258-6

Nordgren, L. F., van Harreveld, F., & van der Pligt, J. (2006). Ambivalence, discomfort, and motivated information processing. *Journal of Experimental Social Psychology, 42*(2), 252–258. https://doi.org/10.1016/j.jesp.2005.04.004

Norris, C. J., Do, E., Close, E., & Deswert, S. (2019). Ambivalence toward healthy and unhealthy food and moderation by individual differences in restrained eating. *Appetite, 140,* 309–317. https://doi.org/10.1016/j.appet.2019.05.033

Petty, R. E., Briñol, P., & DeMarree, K. G. (2007). The Meta–Cognitive Model (MCM) of attitudes: Implications for attitude measurement, change, and strength. *Social Cognition, 25*(5), Article 5. https://doi.org/10.1521/soco.2007.25.5.657

Petty, R. E., Tormala, Z. L., Briñol, P., & Jarvis, W. B. G. (2006). Implicit ambivalence from attitude change: An exploration of the PAST model. *Journal of Personality and Social Psychology, 90*(1), Article 1. https://doi.org/10.1037/0022-3514.90.1.21

Possidónio, C., Graça, J., Piazza, J., & Prada, M. (2019). Animal Images Database: Validation of 120 images for human-animal studies. *Animals, 9*(8), Article 8. https://doi.org/10.3390/ani9080475

Priester, J. R., & Petty, R. E. (1996). The gradual threshold model of ambivalence: Relating the positive and negative bases of attitudes to subjective ambivalence. *Journal of Personality and Social Psychology, 71*(3), Article 3. https://doi.org/10.1037/0022-3514.71.3.431

Puteri, B., Buttlar, B., & Jahnke, B. (2022). Take it or leave it? Investigating the ambivalence and willingness to pay for suboptimal fruits and vegetables among organic consumers in Germany. *Frontiers in Sustainable Food Systems, 6.* https://www.frontiersin.org/articles/10.3389/fsufs.2022.934954

Rydell, R. J., & McConnell, A. R. (2006). Understanding implicit and explicit attitude change: A systems of reasoning analysis. *Journal of Personality and Social Psychology, 91*(6), 995–1008. https://doi.org/10.1037/0022-3514.91.6.995

Schlink, S., & Walther, E. (2007). Kurz und gut: Eine deutsche Kurzskala zur Erfassung des Bedürfnisses nach kognitiver Geschlossenheit. *Zeitschrift Für Sozialpsychologie, 38*(3), Article 3. https://doi.org/10.1024/0044-3514.38.3.153

Schneider, I. K., & Mattes, A. (2021). Mix is different from nix: Mouse tracking differentiates ambivalence from neutrality. *Journal of Experimental Social Psychology, 95*, 104106. https://doi.org/10.1016/j.jesp.2021.104106

Schneider, I. K., Novin, S., van Harreveld, F., & Genschow, O. (2020). Benefits of being ambivalent: The relationship between trait ambivalence and attribution biases. *The British Journal of Social Psychology, 60*(2), 570-586. https://doi.org/10.1111/bjso.12417

Schneider, I. K., van Harreveld, F., Rotteveel, M., Topolinski, S., van der Pligt, J., Schwarz, N., & Koole, S. L. (2015). The path of ambivalence: Tracing the pull of opposing evaluations using mouse trajectories. *Frontiers in Psychology, 6.* https://doi.org/10.3389/fpsyg.2015.00996

Thompson, M. M., Zanna, M., & Griffin, D. (1995). Let's not be indifferent about (attitudinal) ambivalence. *Attitude Strength: Antecedents and Consequences.*

van Harreveld, F., Nohlen, H. U., & Schneider, I. K. (2015). Chapter Five - The ABC of ambivalence: Affective, behavioral, and cognitive consequences of attitudinal conflict. In J. M. Olson & M. P. Zanna (Eds.), *Advances in Experimental Social Psychology* (Vol. 52, pp. 285–324). Academic Press. https://doi.org/10.1016/bs.aesp.2015.01.002

van Harreveld, F., Rutjens, B. T., Schneider, I. K., Nohlen, H. U., & Keskinis, K. (2014). In doubt and disorderly: Ambivalence promotes compensatory perceptions of order. *Journal of Experimental Psychology: General*, *143*(4), 1666–1676. https://doi.org/10.1037/a0036099

van Harreveld, F., van der Pligt, J., & de Liver, Y. N. (2009). The agony of ambivalence and ways to resolve it: Introducing the MAID Model. *Personality and Social Psychology Review, 13*(1), 45–61. https://doi.org/10.1177/1088868308324518

Walther, E., Gawronski, B., Blank, H., & Langer, T. (2009). Changing likes and dislikes through the back door: The US-revaluation effect. Cognition and Emotion, 23(5), 889–917. https://doi.org/10.1080/02699930802212423

Zayas, V., Wang, A. M., & McCalla, J. D. (2022). Me as good and me as bad: Priming the self triggers positive and negative implicit evaluations. Jo*urnal of Personality and Social Psychology, 122*(1), 106–134. https://doi.org/10.1037/pspp0000332

Zoppolat, G., Righetti, F., Faure, R., & Schneider, I. K. (2023). A systematic study of ambivalence and well-being in romantic relationships*. Social Psychological and Personality Science,* 19485506231165584. https://doi.org/10.1177/19485506231165585

Funding: This research did not receive any funding.

Declaration of conflicting interests: The authors declare no conflict of interest.

Institutional Review Board Statement: The study protocol of Study 1 was approved by the local ethics committee in an application for ethical clearance of Study 2 and Study 3 (EK Nr. 62/2022).

Informed Consent Statement: Participants gave informed consent to the study procedure and data processing prior to participation.

Data Sharing Statement: Upon publication preregistration, data, material, and syntax will be shared on the Open Science Framework.

Acknowledgments: We thank Laura Täubert and Anne Schmidt-Freydag for their help in with the pilot study validating the statements, Lara Stiebel and Gil Konz for their help conducting Study 1, Yannic Schramm for his help conducting Study 2 and Micha Sasse for his help in conducting Study 3.

Author Contribution: Lena Hahn: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Project administration, Software, Validation, Visualization, and Writing - original draft.

Eva Walther: Conceptualization, Methodology, Project administration, Resources, Supervision, and Validation.

General Discussion

The centrality of the attitude concept for (social) psychology has been repeatedly highlighted (e.g., Allport, 1935; Ferguson & Fukukura, 2012; Murphy et al., 1937; Walther et al., 2005). However, before 2005, research on attitude formation was scarce (Walther et al., 2005). Whereas there has been an increase in research on univalent attitude formation over the last years, research on ambivalent attitude formation is still scarce. The dissertation at hand helps to bridge this research gap by presenting empirical research on ambivalent attitude formation. The first set of studies investigates ambivalent attitude formation from already existing univalent attitudes. In four studies, the hypothesis that adding attitude-incongruent behavior to a mostly univalent attitude will lead to ambivalence as the attitude object should be associated with opposing evaluative elements were tested. The results indicate that attitude-incongruent behavior might lead to ambivalence on an indirect attitude measure (i.e., mouse tracking) but not on a direct attitude measure (i.e., self-report).

In contrast, an impression formation paradigm was used to investigate ambivalent attitude formation in the second and third manuscripts enclosed. The results consistently show that face pictures which were paired with the same number of positive and negative statements elicit higher potential and felt ambivalence compared to face pictures which were paired with statements of one valence. However, evidence for ambivalence on an indirect attitude measure (i.e., mouse tracking) is strongest when statements of one valence is presented in a blocked manner. This is consistent with previous research indicating lower ambivalence when mixed information is expected (i.e., interspersed information presentation) than when mixed information is surprising (i.e., blocked information presentation; Durso et al., 2021). However, a future study with a sufficiently large sample size and comparing block-size of statements of one valence is needed to confirm this prediction.

One might argue that the results of the first manuscript are inconsistent with those of the second manuscript, as these results indicated that blocked presentation results in ambivalence on direct and indirect attitude measures. However, I would argue that the univalent attitudes towards the stimulus material used in the first set of studies were stronger than those induced in the first block in the impression formation studies. That is, in the first set of studies, the univalent stimulus material was selected on extreme ratings, whereas the univalence induced in the second set of studies was based on the pairing of a neutral face picture with maximally four univalent statements. Hence, I feel justified to argue that merely adding one counter-attitudinal element to a mostly univalent attitude is insufficient to elicit depictable ambivalence on a direct attitude measure.

Implications for Theoretical Perspectives on Attitudes

The empirical results presented are most consistent with the MCM (Petty et al., 2007). Consistent with the predictions of the MCM, the data in the second manuscript indicate that when an attitude object is associated with positive and negative evaluative elements with the same validity information, then direct and indirect attitude measures indicate ambivalence. At first glance, the results presented in the third manuscript seem inconsistent with the MCM, as the same amount of positive and negative information with the same validity tag is associated with an attitude object. However, according to the MCM, an attitude object can have a global evaluative association in memory. Therefore, the data might indicate that when the information of one valence was presented blocked, people started forming global evaluative associations (e.g., positive). When, in the second block, the information was opposing, then there might also be a global evaluative association to this valence (e.g., negative). Hence, these more global evaluative associations might result in the conflict measured in mouse tracking. However, if the opposing evaluation was presented interspersed, such global evaluations might not have formed. Hence, in mouse tracking, only the most diagnostic or salient information was retrieved, which might not result in conflict. When attitude is directly measured, all evaluative associations might be retrieved and used for evaluation, explaining the ambivalence on direct measures. The MCM also explains the dissociation of explicit and implicit measures in the first set of studies. Repeatedly reacting incongruent to a univalent attitude object results in associating the attitude object with opposing evaluations. However, the incongruent response is probably tagged as invalid or without any validity tag, whereas the initial univalent attitude is still tagged as valid. Because validity tags are only retrieved when the attitude is directly measured but not in implicit measures, direct attitude measures should not indicate ambivalence, whereas indirect measures should indicate ambivalence. These predictions are in line with the results of the first set of studies.

Whereas other attitude models can also explain the results of the first and second study sets, these models struggle to explain the dissociation between direct and indirect attitude measures in the third study set. For example, the Associative-Propositional Evaluation Model (Gawronski & Bodenhausen, 2006, 2007) proposes that an attitude object is associated with attitude elements in memory. The Associative-Propositional Evaluation Model differentiates between associative and propositional processes. Associative processes are automatic affective reactions that reflect indirectly measured attitudes. Because they reflect pattern activation, they are independent of truth values. In contrast to associative processes, propositional processes lead to directly measured attitudes, which depend on truth values. That is, activated associations in memory undergo syllogistic logic. Hence, the Associative-Propositional Evaluation Model can explain the results of the first and second sets of studies. For the first set of studies, similar to the explanation of the MCM, the propositional processes would discount the incongruent association as participants were asked to respond inconsistently to their attitude. For the second set of studies, the activated pattern in memory has the same truth value. Therefore, associative and propositional processes lead to the same attitude. However, this should also be the case for the third set of studies. Because the statements used as stimuli in the second and third sets of studies were the same and the assignment to the conditions was randomized, it is unlikely that the statements in the third set of studies led to additional propositions that explain the dissociation between direct and indirect attitude measures.

Implication for Other Research Areas

The most apparent research area affected by the research I conducted during my PhD is impression formation and impression updating. Research in this area often uses experimental procedures similar to the procedure in the second and third study sets (e.g., Fourakis & Cone, 2020; Rydell & McConnell, 2006). However, attitude in this research is often conceptualized as unidimensional and bipolar. The results from the studies consistently indicate that potential and felt ambivalence rise, even when the opposing statements are presented interspersed. Because felt ambivalence has been associated with downstream consequences (e.g., Nordgren et al., 2006; van Harreveld et al., 2009, 2014), neglecting ambivalence might result in inconclusive study interpretations.

Another area of research that might be affected is EC research when a CS is paired with positive and negative US. Such procedures include counter-conditioning (Baeyens et al., 1989) or US-revaluation procedures (Walther et al., 2009). In counter-conditioning, a CS is paired with a US of one valence in the first block and with a US of the opposing valence in the second block. A common finding is that CS changes in positivity from block one to block two (Baeyens et al., 1989). However, when this change is measured on a bipolar valence scale, ambivalence can not be differentiated from neutrality. Similarly, in US-revaluation, the valence of the US is changed, which also affects the evaluation of the CS. For example, Walther et al. (2009) paired a univalent US with a neutral CS, and afterward, the US was paired with a stimulus with opposing valence. They found that not only the evaluation of the US changed but also the evaluation of the CS, even though the CS was not paired with the US after it changed in valence. Based on the studies presented in this dissertation, it seems likely that such procedures might elicit ambivalence.

Ambivalent attitudes have a different underlying structure than univalent attitudes. That is, ambivalent attitude objects are associated with positive and negative evaluative elements, whereas univalent attitudes are associated with either only positive or only negative evaluative elements (Dalege et al., 2016; Petty et al., 2007). The previously mentioned research areas often use bipolar valence scales to measure attitude. Therefore, it is not clear if a change from a rather positive rating to a less positive rating is due to an increase of negative associations (i.e., ambivalence) or a decrease of positive associations (i.e., still positive attitude, however less intense). Whereas a decrease in positive associations might lead to the same decisions as the previous attitude, an increase in negative associations might lead to decision delay (van Harreveld, van der Pligt, et al., 2009) or biased processing (Nordgren et al., 2006). Additionally, people sometimes strive to hold ambivalent attitudes (Pillaud et al., 2013, 2018). For example, people strive to hold and express ambivalent attitudes towards controversial attitude objects (e.g., Genetically Modified Organisms) to present themselves more positively (Pillaud et al., 2013). Hence, besides the conceptual differences, ambivalence and univalence can lead to different affective, cognitive, and behavioral consequences (van Harreveld et al., 2015), and ambivalence can be used strategically to present oneself in a better light (Pillaud et al., 2013).

Directions for Future Research

Besides the investigation of impression formation and EC resulting from the presented studies' implications, one avenue for future research might be the role of context. For example, a vast amount of attitude models propose that the context of judgment influences which attitude elements are activated (Fazio, 2007; Gawronski & Bodenhausen, 2006; Petty et al., 2007). Think back to Alex, who is both disorganized and funny. If Alex is evaluated in a social context, then being funny should have more influence, whereas being disorganized should have less influence. However, if Alex is evaluated in a work context, then being disorganized should have more influence than being funny. Hence, ambivalence might only rise when the opposing associations are relevant to the decision. Some studies paired target individuals with trait information (Nohlen et al., 2016, 2019). They only found ambivalence if the positive (e.g., intelligent) and negative (e.g., dominant) trait information was relevant in the decision context (e.g., assessment if the target individual is a good collaborator) but not when only one aspect was relevant in the decisional context (e.g., assessment if the target individual can write a good research article; Nohlen et al., 2016). Hence, future research might investigate if this also applies when participants learn behavioral information about the target individual.

For behavioral information, not only the context of the decision might play a role but also the context in which the target individual exhibited the behavior (Gawronski et al., 2010, 2015, 2018). The Representational Theory of Contextualized Attitude Change (Gawronski et al., 2010, 2018) is a theoretical framework that predicts when an initially learned attitude or a later learned inconsistent attitude is observed. The theory centers around the violation of attitude-related expectancies. Those violations of attitude-related expectancies are, for example, when a positive person shows negative behavior. The theory proposes that the initially learned information about the attitude object is stored in memory context-free, and that subsequent counter-attitudinal information towards the same attitude object is stored in memory with context. If initial information is learned in context A and the counter-attitudinal information in context B, the theory predicts that in the initial context A (ABA renewal) and a new context C (ABC renewal), the valence of the initially learned information should be activated. An evaluation of the attitude object in context B, however, should lead to the activation of the information that was learned in context B. Conversely, if attention to context cues is high in the initial learning block, then the ABC renewal effect should be reduced, as the information of context A and context B should be activated in the new context C. Indeed, research indicates a dampened ABC renewal effect if attention is focused on the context in the initial learning block (Gawronski et al., 2010). The ABA renewal effect was unaffected when the attention was focused on the context in the initial learning block (Gawronski et al., 2010). Even the authors of the theory suggest that when attention was on context cues in the initial learning, then attitudes in context C might be neutral or ambivalent (Gawronski et al., 2018). The research presented in the dissertation at hand indicates that such procedures might elicit ambivalence. Even though the context was not explicitly manipulated, the time context changed, at least in the second study of the second manuscript. After receiving univalent information about the target individuals, participants were informed that they knew the individuals for a while and would receive additional information. Afterward, ambivalence via mouse tracking and self-reported potential and felt ambivalence was measured. In this study, participants indicated higher directly and indirectly measured ambivalence than the univalent negative control condition. Even though it is unclear if participants perceived the measurement after receiving the additional information as new context (ABC renewal) or as the same context in which they received the additional information, they indicated higher ambivalence. Additionally, in the third study of the third manuscript, block-size of valenced information, as well as the valence of the initial statement, was systematically manipulated. Even though the context was not manipulated, the results don’t indicate an effect of initial information on ambivalence. Hence, future studies should investigate if the attitudes in ABC renewal actually are ambivalent and if this ambivalence is higher when the attention is focused on the context in the initial learning block compared to when the attention is not focused on the context in the initial learning block. Additionally, research showed that highly diagnostic counter-attitudinal information can lead to context-independent attitude change (Brannon & Gawronski, 2017). In such a case, the initial information, as well as the highly diagnostic counter-attitudinal information, should be stored context-independent. Hence, the rise of ambivalence is likely. In sum, an avenue for future research is to focus on the context of information learning as well as the context in which the judgment has to be made.

Besides the context of information encoding and the context of information retrieval, future research might also investigate other boundary conditions of ambivalent attitude formation. Even though investigating trait influences on ambivalent attitude formation was not the goal of the experimental research, we consistently found our effects independent of Trait Ambivalence (Schneider et al., 2020) and Need for Cognitive Closure (Schlink & Walther, 2007). However, other personality traits might influence the formation of ambivalent attitudes. For example, high Need for Cognition (Cacioppo & Petty, 1982) has been associated with lower ambivalence (Thompson & Zanna, 1995). Besides personality-based influences, the importance of the decision might also play a role. For example, the Model of Ambivalence Induced Discomfort (van Harreveld et al., 2009) proposes that ambivalence should be amplified if the decision has immediate consequences for the self. Therefore, it might be fruitful for future research to investigate boundary conditions like personality traits or involvement in ambivalent attitude formation.

Conclusion

The dissertation at hand is an attempt to systematically study ambivalent attitude formation. The results for forming ambivalence based on a pre-existing univalent attitude are unclear. On the one hand, mouse trajectories consistently show more pull to the non-chosen response when evaluating attitude objects that were previously responded incongruently to. On the other hand, data from two studies do not indicate an effect on self-reported ambivalence. Therefore, future research needs to investigate how inconsistent information is integrated into an already existing univalent attitude because the results presented in the dissertation at hand indicate that forced incongruent behavior is not enough. Whereas I do not feel justified in arguing that incongruent behavior to a univalent attitude object leads to ambivalence, I feel justified in arguing that ambivalent attitude formation occurs when a neutral attitude object is paired with the same number of positive and negative statements with the same validity information. This indicates, that ambivalence might have been overlooked in other research when a neutral attitude object is paired with positive and negative information (e.g., counter-conditioning, impression formation). However, the dissertation at hand is just a first step in understanding the formation of ambivalent attitudes. Future research should investigate boundary conditions of ambivalent attitude formation.

References

Allport, G. W. (1935). Attitudes. In C. Murchison (Ed.), *Handbook of social psychology* (pp. 798–844). Clark University Press.

Baeyens, F., Eelen, P., van den Bergh, O., & Crombez, G. (1989). Acquired affective-evaluative value: Conservative but not unchangeable. *Behaviour Research and Therapy, 27*(3), 279–287. https://doi.org/10.1016/0005-7967(89)90047-8

Béna, J., Mauclet, A., & Corneille, O. (2023). Does co-occurrence information influence evaluations beyond relational meaning? An investigation using self-reported and mouse-tracking measures of attitudinal ambivalence. *Journal of Experimental Psychology: General, 152*(4), 968–992. https://doi.org/10.1037/xge0001308

Berger, K. T. (2020). *Attitudinal Ambivalence – A New Look at Structure, Measurement, and Induction Approaches* [Dissertation, Universität Tübingen]. https://doi.org/10.15496/publikation-26824

Berger, K. T., Hütter, M., & Corneille, O. (2019). Investigating attitudinal ambivalence via sequential priming: Evidence for the simultaneous and unintentional activation of opposite evaluations. *Journal of Experimental Psychology: General, 148*(7), Article 7. https://doi.org/10.1037/xge0000572

Brannon, S. M., & Gawronski, B. (2017). A second chance for first impressions? Exploring the context-(in)dependent updating of implicit evaluations. *Social Psychological and Personality Science, 8*(3), Article 3. https://doi.org/10.1177/1948550616673875

Brownstein, M., Madva, A., & Gawronski, B. (2019). What do implicit measures measure? *WIREs Cognitive Science, 10*(5), e1501. https://doi.org/10.1002/wcs.1501

Budner, N. Y. (1962). Intolerance of ambiguity as a personality variable. *Journal of Personality, 30*(1), 29–50. https://doi.org/10.1111/j.1467-6494.1962.tb02303.x

Buttlar, B., Löwenstein, L., Geske, M.-S., Ahlmer, H., & Walther, E. (2021). Love food, hate waste? Ambivalence towards food fosters people's willingness to waste food. *Sustainability, 13*(7), Article 7. https://doi.org/10.3390/su13073971

Buttlar, B., Pauer, S., Ruby, M. B., Chambon, M., Jimenez-Klingberg, A.-K., Scherf, J., & Scherrer, V. (2023). The Meat Ambivalence Questionnaire: Assessing domain-specific meat-related conflict in omnivores and veg*ans. *Collabra: Psychology, 9*(1), 73236. https://doi.org/10.1525/collabra.73236

Buttlar, B., & Walther, E. (2018). Measuring the meat paradox: How ambivalence towards meat influences moral disengagement. *Appetite, 128*, 152–158. https://doi.org/10.1016/j.appet.2018.06.011

Cacioppo, J. T., Gardner, W. L., & Berntson, G. G. (1997). Beyond bipolar conceptualizations and measures: The case of attitudes and evaluative space. *Personality and Social Psychology Review, 1*(1), 3–25. https://doi.org/10.1207/s15327957pspr0101_2

Cacioppo, J. T., & Petty, R. E. (1982). The need for cognition. *Journal of Personality and Social Psychology, 42*(1), 116–131. https://doi.org/10.1037/0022-3514.42.1.116

Contiero, P. P., & Wilson, D. M. (2019). Understanding ambivalence toward organ donation and transplantation: An exploratory study of nursing students. *Nurse Education Today, 76*, 191–195. https://doi.org/10.1016/j.nedt.2019.02.008

Dalege, J., Borsboom, D., van Harreveld, F., van den Berg, H., Conner, M., & van der Maas, H. L. J. (2016). Toward a formalized account of attitudes: The Causal Attitude Network (CAN) model. *Psychological Review, 123*(1), Article 1. https://doi.org/10.1037/a0039802

Dalege, J., Borsboom, D., Van Harreveld, F., & Van Der Maas, H. L. J. (2018). The Attitudinal Entropy (AE) Framework as a general theory of individual attitudes. *Psychological Inquiry, 29*(4), 175–193. https://doi.org/10.1080/1047840X.2018.1537246

De Houwer, J. (2007). A conceptual and theoretical analysis of Evaluative Conditioning. *The Spanish Journal of Psychology, 10*(2), 230–241. https://doi.org/10.1017/S1138741600006491

De Houwer, J., Thomas, S., & Baeyens, F. (2001). Association learning of likes and dislikes: A review of 25 years of research on human evaluative conditioning. *Psychological Bulletin, 127*(6), 853–869. https://doi.org/10.1037/0033-2909.127.6.853

DeMarree, K. G., Briñol, P., & Petty, R. E. (2015). Reducing subjective ambivalence by creating doubt: A metacognitive approach. *Social Psychological and Personality Science, 6*(7), Article 7. https://doi.org/10.1177/1948550615581497

Durso, G. R. O., Petty, R. E., Briñol, P., Siev, J. J., Hinsenkamp, L. D., & Sawicki, V. (2021). Dampening affect via expectations: The case of ambivalence. *Journal of Personality and Social Psychology, 121*(6), 1172-1194. https://doi.org/10.1037/pspa0000248

Eagly, A. H., & Chaiken, S. (1993). *The psychology of attitudes.* Harcourt Brace Jovanovich College Publishers.

Fazio, R. H. (1986). How do attitudes guide behavior? In *Handbook of motivation and cognition: Foundations of social behavior* (pp. 204–243). Guilford Press.

Fazio, R. H. (1990). Multiple processes by which attitudes guide behavior: The Mode Model as an integrative framework. In M. P. Zanna (Ed.), *Advances in Experimental Social Psychology* (Vol. 23, pp. 75–109). Academic Press. https://doi.org/10.1016/S0065-2601(08)60318-4

Fazio, R. H. (2007). Attitudes as object–evaluation associations of varying strength. *Social Cognition, 25*(5), Article 5. https://doi.org/10.1521/soco.2007.25.5.603

Fazio, R. H., Sanbonmatsu, D. M., Powell, M. C., & Kardes, F. R. (1986). On the automatic activation of attitudes. *Journal of Personality and Social Psychology, 50*(2), 229–238. https://doi.org/10.1037/0022-3514.50.2.229

Ferguson, M. J., & Fukukura, J. (2012). Likes and dislikes: A social cognitive perspective on attitudes. In S. Fiske & C. Macrae, *The SAGE Handbook of Social Cognition* (pp. 165–190). SAGE Publications Ltd. https://doi.org/10.4135/9781446247631.n9

Festinger, L. (1957). *A theory of cognitive dissonance*. Stanford university press.

Fourakis, E., & Cone, J. (2020). Matters order: The role of information order on implicit impression formation. *Social Psychological and Personality Science, 11*(1), Article 1. https://doi.org/10.1177/1948550619843930

Gardner, P. L. (1987). Measuring ambivalence to science. *Journal of Research in Science Teaching, 24*(3), 241–247. https://doi.org/10.1002/tea.3660240305

Gawronski, B. (2012). Back to the future of Dissonance Theory: Cognitive consistency as a core motive. *Social Cognition, 30*(6), 652–668. https://doi.org/10.1521/soco.2012.30.6.652

Gawronski, B., & Bodenhausen, G. V. (2006). Associative and propositional processes in evaluation: An integrative review of implicit and explicit attitude change. *Psychological Bulletin, 132*(5), 692–731. https://doi.org/10.1037/0033-2909.132.5.692

Gawronski, B., & Bodenhausen, G. V. (2007). Unraveling the processes underlying evaluation: Attitudes from the perspective of the Ape Model. *Social Cognition, 25*(5), Article 5. https://doi.org/10.1521/soco.2007.25.5.687

Gawronski, B., Hu, X., Rydell, R. J., Vervliet, B., & De Houwer, J. (2015). Generalization versus contextualization in automatic evaluation revisited: A meta-analysis of successful and failed replications. *Journal of Experimental Psychology: General, 144*(4), e50–e64. https://doi.org/10.1037/xge0000079

Gawronski, B., Rydell, R. J., De Houwer, J., Brannon, S. M., Ye, Y., Vervliet, B., & Hu, X. (2018). Chapter One—Contextualized attitude change. In J. M. Olson (Ed.), *Advances in Experimental Social Psychology* (Vol. 57, pp. 1–52). Academic Press. https://doi.org/10.1016/bs.aesp.2017.06.001

Gawronski, B., Rydell, R. J., Vervliet, B., & De Houwer, J. (2010). Generalization versus contextualization in automatic evaluation. *Journal of Experimental Psychology: General, 139*(4), Article 4. https://doi.org/10.1037/a0020315

Ghirardato, P., Maccheroni, F., & Marinacci, M. (2004). Differentiating ambiguity and ambiguity attitude. *Journal of Economic Theory, 118*(2), 133–173. https://doi.org/10.1016/j.jet.2003.12.004

Glaser, T., Woud, M. L., Labib Iskander, M., Schmalenstroth, V., & Vo, T. M. (2018). Positive, negative, or all relative? Evaluative conditioning of ambivalence. *Acta Psychologica, 185*, 155–165. https://doi.org/10.1016/j.actpsy.2018.02.006

Hahn, L., Buttlar, B., & Walther, E. (2021). Unpacking plastic: Investigating plastic related ambivalence. *Sustainability, 13*(4), Article 4. https://doi.org/10.3390/su13042186

Hofmann, W., De Houwer, J., Perugini, M., Baeyens, F., & Crombez, G. (2010). Evaluative conditioning in humans: A meta-analysis. *Psychological Bulletin, 136*(3), Article 3. https://doi.org/10.1037/a0018916

Hohman, Z. P., Crano, W. D., Siegel, J. T., & Alvaro, E. M. (2014). Attitude ambivalence, friend norms, and adolescent drug use. *Prevention Science, 15*(1), Article 1. https://doi.org/10.1007/s11121-013-0368-8

Kaplan, K. J. (1972). On the ambivalence-indifference problem in attitude theory and measurement: A suggested modification of the semantic differential technique. *Psychological Bulletin, 77*, 361–372. https://doi.org/10.1037/h0032590

Mays, D., Johnson, A. C., Phan, L., Tercyak, K. P., Rehberg, K., & Lipkus, I. (2020). Effect of risk messages on risk appraisals, attitudes, ambivalence, and willingness to smoke hookah in young adults. *Health Psychology and Behavioral Medicine, 8*(1), 96–109. https://doi.org/10.1080/21642850.2020.1730844

McConnell, A. R., & Rydell, R. J. (2014). The systems of evaluation model: A Dual-systems approach to attitudes. In *Dual-process theories of the social mind* (pp. 204–218). The Guilford Press.

Murphy, G., Murphy, L. B., & Newcomb, T. M. (1937). *Experimental social psychology: An interpretation of research upon the socialisazion of the individual.* Harper & Brothers.

Newby-Clark, I. R., McGregor, I., & Zanna, M. P. (2002). Thinking and caring about cognitive inconsistency: When and for whom does attitudinal ambivalence feel uncomfortable? *Journal of Personality and Social Psychology, 82*, 157–166. https://doi.org/10.1037/0022-3514.82.2.157

Nohlen, H. U., van Harreveld, F., & Cunningham, W. A. (2019). Social evaluations under conflict: Negative judgments of conflicting information are easier than positive judgments. *Social Cognitive and Affective Neuroscience, 14*(7), Article 7. https://doi.org/10.1093/scan/nsz045

Nohlen, H. U., van Harreveld, F., Rotteveel, M., Barends, A. J., & Larsen, J. T. (2016). Affective responses to ambivalence are context-dependent: A facial EMG study on the role of inconsistency and evaluative context in shaping affective responses to ambivalence. *Journal of Experimental Social Psychology, 65*, 42–51. https://doi.org/10.1016/j.jesp.2016.02.001

Nordgren, L. F., van Harreveld, F., & van der Pligt, J. (2006). Ambivalence, discomfort, and motivated information processing. *Journal of Experimental Social Psychology, 42*(2), 252–258. https://doi.org/10.1016/j.jesp.2005.04.004

Norris, C. J., Do, E., Close, E., & Deswert, S. (2019). Ambivalence toward healthy and unhealthy food and moderation by individual differences in restrained eating. *Appetite, 140,* 309–317. https://doi.org/10.1016/j.appet.2019.05.033

Ostrom, T. M. (1969). The relationship between the affective, behavioral, and cognitive components of attitude. *Journal of Experimental Social Psychology, 5*(1), 12–30. https://doi.org/10.1016/0022-1031(69)90003-1

Petty, R. E., & Briñol, P. (2006). A metacognitive approach to "implicit" and "explicit" evaluations: Comment on Gawronski and Bodenhausen (2006). *Psychological Bulletin, 132*(5), 740–744. https://doi.org/10.1037/0033-2909.132.5.740

Petty, R. E., Briñol, P., & DeMarree, K. G. (2007). The Meta–Cognitive Model (MCM) of attitudes: Implications for attitude measurement, change, and strength. *Social Cognition, 25*(5), Article 5. https://doi.org/10.1521/soco.2007.25.5.657

Petty, R. E., Briñol, P., & Johnson, I. (2012). Implicit Ambivalence. In B. Gawronski & F. Strack (Eds.), *Cognitive consistency: A fundamental principle in social cognition* (pp. 178–201). Guilford Press.

Petty, R. E., Tormala, Z. L., Briñol, P., & Jarvis, W. B. G. (2006). Implicit ambivalence from attitude change: An exploration of the PAST model. *Journal of Personality and Social Psychology, 90*(1), 21–41. https://doi.org/10.1037/0022-3514.90.1.21

Pillaud, V., Cavazza, N., & Butera, F. (2013). The social value of being ambivalent: Self-presentational concerns in the expression of attitudinal ambivalence. *Personality and Social Psychology Bulletin, 39*(9), 1139–1151. https://doi.org/10.1177/0146167213490806

Pillaud, V., Cavazza, N., & Butera, F. (2018). The social utility of ambivalence: Being ambivalent on controversial issues is recognized as competence. *Frontiers in Psychology, 9*. https://www.frontiersin.org/articles/10.3389/fpsyg.2018.00961

Priester, J. R., & Petty, R. E. (1996). The gradual threshold model of ambivalence: Relating the positive and negative bases of attitudes to subjective ambivalence. *Journal of Personality and Social Psychology, 71*(3), Article 3. https://doi.org/10.1037/0022-3514.71.3.431

Priester, J. R., & Petty, R. E. (2001). Extending the bases of subjective attitudinal ambivalence: Interpersonal and intrapersonal antecedents of evaluative tension. *Journal of Personality and Social Psychology, 80*(1), 19–34. https://doi.org/10.1037/0022-3514.80.1.19

Rydell, R. J., & McConnell, A. R. (2006). Understanding implicit and explicit attitude change: A systems of reasoning analysis. *Journal of Personality and Social Psychology, 91*(6), 995–1008. https://doi.org/10.1037/0022-3514.91.6.995

Schlink, S., & Walther, E. (2007). Kurz und gut: Eine deutsche Kurzskala zur Erfassung des Bedürfnisses nach kognitiver Geschlossenheit. *Zeitschrift Für Sozialpsychologie, 38*(3), 153–161. https://doi.org/10.1024/0044-3514.38.3.153

Schneider, I. K., & Mattes, A. (2021). Mix is different from nix: Mouse tracking differentiates ambivalence from neutrality. *Journal of Experimental Social Psychology, 95*, 104106. https://doi.org/10.1016/j.jesp.2021.104106

Schneider, I. K., Novin, S., van Harreveld, F., & Genschow, O. (2020). Benefits of being ambivalent: The relationship between trait ambivalence and attribution biases. *The British Journal of Social Psychology, 60*(2), 570-586. https://doi.org/10.1111/bjso.12417

Schneider, I. K., van Harreveld, F., Rotteveel, M., Topolinski, S., van der Pligt, J., Schwarz, N., & Koole, S. L. (2015). The path of ambivalence: Tracing the pull of opposing evaluations using mouse trajectories. *Frontiers in Psychology, 6*. https://doi.org/10.3389/fpsyg.2015.00996

Schneider, I. K., Veenstra, L., van Harreveld, F., Schwarz, N., & Koole, S. L. (2016). Let's not be indifferent about neutrality: Neutral ratings in the International Affective Picture System (IAPS) mask mixed affective responses. *Emotion, 16*(4), Article 4. https://doi.org/10.1037/emo0000164

Sipilä, J., Tarkiainen, A., & Sundqvist, S. (2018). Toward an improved conceptual understanding of consumer ambivalence. *AMS Review, 8*(3), 147–162. https://doi.org/10.1007/s13162-017-0098-3

Sparks, P., Harris, P. R., & Lockwood, N. (2004). Predictors and predictive effects of ambivalence. *British Journal of Social Psychology, 43*(3), 371–383. https://doi.org/10.1348/0144666042037980

Thompson, M. M., & Zanna, M. P. (1995). The conflicted individual: Personality-based and domain specific antecedents of ambivalent social attitudes. *Journal of Personality, 63*(2), Article 2. https://doi.org/10.1111/j.1467-6494.1995.tb00810.x

Thompson, M. M., Zanna, M. P., & Griffin, D. (1995). Let's not be indifferent about (attitudinal) ambivalence. *Attitude Strength: Antecedents and Consequences.*

Van Dessel, P., Cummins, J., Hughes, S., Kasran, S., Cathelyn, F., & Moran, T. (2020). Reflecting on 25 years of research using implicit measures: Recommendations for their future use. *Social Cognition, 38*(Supplement), s223–s242. https://doi.org/10.1521/soco.2020.38.supp.s223

van Harreveld, F., Nohlen, H. U., & Schneider, I. K. (2015). Chapter Five - The ABC of ambivalence: Affective, behavioral, and cognitive consequences of attitudinal conflict. In J. M. Olson & M. P. Zanna (Eds.), *Advances in Experimental Social Psychology* (Vol. 52, pp. 285–324). Academic Press. https://doi.org/10.1016/bs.aesp.2015.01.002

van Harreveld, F., Rutjens, B. T., Rotteveel, M., Nordgren, L. F., & van der Pligt, J. (2009). Ambivalence and decisional conflict as a cause of psychological discomfort: Feeling tense before jumping off the fence. *Journal of Experimental Social Psychology, 45*(1), 167–173. https://doi.org/10.1016/j.jesp.2008.08.015

van Harreveld, F., Rutjens, B. T., Schneider, I. K., Nohlen, H. U., & Keskinis, K. (2014). In doubt and disorderly: Ambivalence promotes compensatory perceptions of order.

Journal of Experimental Psychology: General, 143(4), 1666–1676. https://doi.org/10.1037/a0036099

van Harreveld, F., van der Pligt, J., & de Liver, Y. N. (2009). The agony of ambivalence and ways to resolve it: Introducing the MAID Model. *Personality and Social Psychology Review, 13*(1), 45–61. https://doi.org/10.1177/1088868308324518

Walther, E., Gawronski, B., Blank, H., & Langer, T. (2009). Changing likes and dislikes through the back door: The US-revaluation effect. *Cognition and Emotion, 23*(5), Article 5. https://doi.org/10.1080/02699930802212423

Walther, E., Nagengast, B., & Trasselli, C. (2005). Evaluative conditioning in social psychology: Facts and speculations. *Cognition and Emotion, 19*(2), 175–196. https://doi.org/10.1080/02699930441000274

Wegener, D. T., Downing, J., Krosnick, J. A., & Petty, R. E. (1995). Measures and manipulations of strength-related properties of attitudes: Current practice and future directions. In R. E. Petty & J. A. Krosnick (Eds.), *Attitude strength: Antecedents and Consequences* (pp. 455–487). Lawrence Erlbaum Associates, Inc.

Zoppolat, G., Righetti, F., Faure, R., & Schneider, I. K. (2023). A systematic study of ambivalence and well-being in romantic relationships. *Social Psychological and Personality Science,* 19485506231165584. https://doi.org/10.1177/19485506231165585

Authorship, Publication Status and Contribution

Manuscripts 1 to 3 are research articles that will soon be submitted for publication to international, peer-reviewed scientific journals. The authors, publication status and authors contribution are listed below.

Hahn, L., & Walther, E. (2023). The genesis of ambivalent attitudes: Does forced incongruent behavior lead to ambivalence. Manuscript in Preparation.

Lena Hahn: Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Software, Validation, Visualization, and Writing - original draft.

Eva Walther: Conceptualization, Funding acquisition, Methodology, Project administration, Resources, Supervision, and Validation.

Hahn, L., & Walther, E. (2023). Hidden in plain sight: Ambivalence in impression formation tasks. Manuscript in Preparation.

Lena Hahn: Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Software, Validation, Visualization, and Writing - original draft.

Eva Walther: Conceptualization, Funding acquisition, Methodology, Project administration, Resources, Supervision, and Validation.

Hahn, L., & Walther, E. (2023). Always assumed never tested: A systematic investigation of the formation of ambivalent attitudes. Manuscript in Preparation.

Lena Hahn: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Project administration, Software, Validation, Visualization, and Writing - original draft.

Eva Walther: Conceptualization, Methodology, Project administration, Resources, Supervision, and Validation.

Declaration of Authorship

I hereby certify that this thesis has been composed by me and is based on my own work, unless stated otherwise. No other person's work has been used without acknowledgement in this thesis. All references have been quoted and all sources of information have been specifically mentioned.

Eigenständigkeitserklärung

Hiermit erkläre ich, dass die vorliegende Arbeit von mir und basierend auf meiner Arbeit entstanden ist. Keine andere Person war an der Erstellung beteiligt, die nicht in der Danksagung zu dieser Arbeit erwähnt wird. Alle Referenzen werden entsprechend zitiert und Daten aus anderen Quellen werden unter Angabe der Quelle als solche gekennzeichnet.

Trier, ____________________________ ____________________________

Date/Datum Signature/Unterschrift