JUSTUS-LIEBIG-UNIVERSITÄT GIESSEN

Interindividuelle Unterschiede in Emotionsverarbeitung und -regulation: Familiäre emotionale Expressivität, habituelle Emotionsregulation und elektrokortikale Korrelate

Kumulative Dissertation

zur Erlangung des akademischen Grades

Doctor rerum naturalium (Dr. rer. nat.)

vorgelegt von

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Gießen, Oktober 2023

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1. Überblick

„Ich will nicht meinen Gefühlen ausgeliefert sein. Ich möchte sie benutzen, sie genießen und sie beherrschen“ (übersetzt aus Wilde, 2012, p. 138). – Wie wir unsere Gefühle ausdrücken, ob wir sie als hilfreich erleben und wie wir diese regulieren, erlernen wir während der Zeit des Aufwachsens. Dies stellt einen Lernprozess dar, der sich über die gesamte Lebensspanne erstreckt (Holodynski et al., 2013; Morris et al., 2007; Thomsen et al., 2017). Damit wird der Familie sowie nahen Bezugspersonen eine wichtige Rolle zuteil, indem sie das Familienklima z. B. über den Ausdruck von Emotionen und durch ihr Verhalten das Repertoire an Emotionsregulationsstrategien beeinflussen. Der Ausdruck von Gefühlen im familiären Kontext und die Emotionsregulationsfähigkeit sind dabei mit psychischer Gesundheit im Erwachsenalter assoziiert und spielen transdiagnostisch eine wichtige Rolle: So konnte beispielsweise gezeigt werden, dass höhere mütterliche negative Expressivität und Kontrolle, höhere Angst- und Depressionswerte bei Jugendlichen vorhersagen (z. B. Luebbe & Bell, 2014). Auch Diagnosesysteme zur Klassifikation psychischer Störungen weisen auf die Wichtigkeit von Emotionen und Emotionsregulation (ER) hin: So werden psychische Störungen nach DSM-5 definiert als klinisch bedeutsame Störungen in Kognitionen, ER und Verhalten (American Psychiatric Association, 2018). Für die ER konnte gezeigt werden, dass ein flexibler und adaptiver Einsatz von Emotionsregulationsstrategien mit Wohlbefinden und psychischer Gesundheit assoziiert ist (Brockman et al., 2017; Gross & John, 2003). Insbesondere die kognitive ER in Form der kognitiven Neubewertung stellt dabei ein Vorgehen dar, das gerade in der Kognitiven Verhaltenstherapie (KVT) als zentraler transdiagnostischer Bestandteil zur Modifikation dysfunktionaler Gedanken und Bewältigung belastender Emotionen (A. T. Beck, 1976; Clark & Beck, 2010) angesehen wird. Dabei wurde die differentielle Wirksamkeit verschiedener Taktiken der kognitiven ER bisher nur wenig erforscht. Auch weitere Einflussfaktoren wie die habituelle ER oder die familiäre emotionale Expressivität (FEE) sind in Zusammenhang mit ER im Erwachsenenalter kaum untersucht.

Im Rahmen dieser Dissertation wurden die Voraussetzungen geschaffen, die beiden Konstrukte FEE und kognitive ER zu verbinden. Dazu wurde zunächst der deutsche Fragebogen zur Erfassung der familiären emotionalen Expressivität entwickelt und psychometrisch überprüft (Fragestellung 1). Des Weiteren wurde das Paradigma zur Erfassung der unmittelbaren und überdauernden (differentiellen) Effekte der kognitiven Neubewertungstaktiken Reinterpretation und Distanzieren sowie der Einfluss der habituellen ER auf elektrokortikaler und subjektiver Ebene untersucht (Fragestellung 2).

2. Theoretischer Hintergrund

2.1. Familiäre emotionale Expressivität

Nach dem dreigliedrigen Modell des familiären Einflusses auf die kindliche Emotionsregulierung und Anpassung (*Tripartite Model of the Impact of the Family on Children's Emotion Regulation and Adjustment*; TMIF; Morris et al., 2007) wird die ER über drei Wege beeinflusst (siehe Abb. A1): nämlich über Beobachtungslernen, elterliche Erziehungspraktiken sowie das emotionale Klima. Das Mediationsmodell geht von einer wechselseitigen Beeinflussung zwischen elterlichen, kindlichen sowie familiären Kontextfaktoren aus, wobei postuliert wird, dass frühe Sozialisationspraktiken das Fundament für die spätere Sozialisation und Anpassunsleitstung des Kindes legen (Morris et al., 2007).

Das Modell (Morris et al., 2007) sowie existierende Literatur weisen dabei der Familie beim Erlernen und Ausdrücken von Emotionen sowie deren Regulation eine zentrale Rolle zu (z. B. Are & Shaffer, 2016; Gao & Han, 2016; Liew et al., 2011; Petermann & Wiedebusch, 2016). Innerhalb des Familienklimas scheint die FEE von großer Bedeutung (Morris et al., 2007), welche definiert wird als ein beständiges Muster, wie verbal und nonverbal positive sowie negative Gefühle innerhalb der Familie während der Zeit des Aufwachsens ausgedrückt werden (Halberstadt et al., 1995). Diese hängt wiederum eng mit dem elterlichen Erziehungsverhalten zusammen: Eltern, die vermehrt positive Gefühle zum Ausdruck bringen, weisen mit höherer Wahrscheinlichkeit Erziehungsverhaltensweisen wie Wärme, Akzeptanz oder Unterstützung auf und demonstrieren erfolgreicher, wie sie auf positive Weise ihre Gefühle bewältigen, was sich u. a. durch Beobachtungslernen positiv auf die Emotionsregulationsfähigkeit des Kindes auswirkt (Morris et al., 2007). Ein vermehrtes Zeigen negativer Gefühle hingegen erhöht feindliche und weniger reaktive Verhaltensweisen gegenüber dem Kind und vermittelt ein negatives Modell, mit Gefühlen umzugehen (Cummings et al., 2002; Halberstadt et al., 1999; Morris et al., 2007).

Eine Vielzahl an Studien demonstriert, dass eine höhere positive FEE mit positiven Outcomes wie stärker ausgeprägter sozialer Kompetenz (Cumberland-Li et al., 2003), emotionalem Verständnis und emotionaler Kompetenz (Denham et al., 1997) oder erhöhtem Selbstwertgefühl (Halberstadt et al., 1999) assoziiert ist. Weniger konsistent erscheinen die Ergebnisse bezüglich negativer Expressivität (Morris et al., 2007): Einige Studien deuten auf eine negative Beeinflussung hin, indem höhere negative FEE mit einer geringeren Verwendung adaptiver Emotionsregulationsstrategien (Thomsen et al., 2017), verminderter Selbstregulation (Haskett et al., 2012; Milojevich & Haskett, 2018) oder internalisierenden Problemen (Chen et al., 2022)

einhergeht. Die inkonsistenten Befunde könnten auf einen kurvilinearen Zusammenhang zwischen negativer FEE und der sozio-emotionalen Entwicklung des Kindes hinweisen (Morris et al., 2007). Während ein niedrigeres bis mittleres Ausmaß Kinder eher darin fördert, die Bandbreite aller Emotionen zu erleben und ihre Emotionen zu regulieren, ist ein hohes Ausmaß mit erhöhtem Distress und weniger erfolgreicher ER assoziiert (Halberstadt, 1986; Halberstadt et al., 1999). Auch wird in Bezug auf die FEE keine Unterscheidung in die Art der Emotion vorgenommen (z. B. Trauer vs. Wut) und meist nicht erhoben gegenüber wem die Emotion, wie intensiv oder wie häufig ausgedrückt wird. Damit ist die Art und Weise, wie das Konstrukt der FEE gemessen wird, von zentraler Bedeutung.

Auf Fragebogenebene wird die FEE meist mit dem „Familiy Expressiveness Questionnaire“ (FEQ; Halberstadt, 1983, 1986) erfasst, ein Fragebogen, für welchen bislang keine deutsche psychometrisch überprüfte Übersetzung vorlag. In diesem Fragebogen werden Ausfüllende gebeten, die Häufigkeit von vorgegebenen Szenarien während der Zeit des Aufwachsens auf einer 9-stufigen Likert-Skala von *gar nicht häufig* (*not at all frequently*) bis *sehr häufig* (*very frequently*) einzuschätzen. Während für das englischsprachige Original vier theoretisch abgeleitete Dimensionen postuliert wurden (Halberstadt, 1986), welche sich aus der Kreuzung von Valenz (positiv, negativ) und Dominanz (submissiv, dominant) ergeben, finden im Forschungskontext häufig nur die Valenzfaktoren des Fragebogens Verwendung (z. B. Halberstadt et al., 2011; Suveg et al., 2014). Des Weiteren wird zusätzlich eine 3-faktorielle Lösung eingesetzt, nämlich positive, negativ-submissive und negativ-dominante FEE (z. B. Baker & Crnic, 2005; Jones et al., 1998). Auch ein unterschiedliches Ausmaß an Expressivität über verschiedene Kulturkreise (Are & Shaffer, 2016; Consedine & Magai, 2002) hinweg sowie über die Zeit (Keller & Lamm, 2005; Rogoff, 2003) macht eine psychometrische Überprüfung notwendig: Während Individuen aus kollektivistischer geprägten Kulturen eher dazu tendieren, ihren emotionalen Ausdruck zu unterdrücken (Morelen et al., 2013; Wu & Chao, 2016), wird in individualistischer geprägten Kulturen eine stärkere emotionale Expressivität gefördert (Gao & Han, 2016; Halberstadt & Lozada, 2011; Ramzan & Amjad, 2017; Rychlowska et al., 2015). Nach Hofstede (2009) stellen Individualismus (I) und Kollektivismus (K) die beiden Enden eines Kontinuums dar, wodurch sich ein Ausprägungsgrad mittels des I-C-Wertes (Range 100 – 0; Hofstede, 2009) angeben lässt. Dabei liegt Deutschland in der oberen Hälfte (Hofstede’s I-C: 67), die Vereinigten Staaten am oberen Ende des Kontinuums (Hofstede’s I-C: 91) Richtung Individualismus. Dies weist folglich auch auf kulturelle Unterschiede in der FEE hin und unterstreicht die Wichtigkeit der psychometrischen Überprüfung des Konstruktes in einer deutschen Stichprobe. Zudem ist in der deutschen Geschichte eine Zunahme an Individualisierung

ab der Mitte der 1980er beobachtbar (U. Beck, 1986) und damit einhergehend auch ein verändertes Wertesystem, welches z. B. emotionalen Ausdruck von Unterstützung, Lob oder Wärme stärker fokussierte (Keller & Lamm, 2005). Verhaltensweisen, die insbesondere über die Skala positive FEE abgedeckt werden. Eine Bedeutungsveränderung der Iteminhalte über die Zeit lässt sich daher nicht ausschließen und deutet einmal mehr auf die Wichtigkeit der psychometrischen Überprüfung einer deutschen Übersetzung des FEQ hin.

2.2. Kognitive Emotionsregulation

Wie durch das TMIF-Modell (Morris et al., 2007) dargelegt, hat die FEE einen großen Einfluss auf die Entwicklung der (kindlichen) ER. Im Generellen bezieht sich ER darauf, eine emotionale Antwort durch regulatorische Prozesse bewusst oder unbewusst zu initiieren oder zu verändern (Gross, 1998; Gross & Thompson, 2007; Ochsner et al., 2012). Dabei ist ein flexibler Gebrauch verschiedener Regulationsstrategien wichtig, um auf (Umwelt-)Anforderungen zu reagieren (Webb et al., 2012) und es ist mitentscheidend, in welchem Kontext Emotionsregulationsstrategien als adaptiv oder maladaptiv gelten (Aldao & Nolen-Hoeksema, 2012). Eine Emotionsregulationsstrategie, die im Allgemeinen zu den adaptiven Strategien zählt, stellt die kognitive Neubewertung dar, welche eine gedankliche Umbewertung eines Stimulus oder einer Situation umfasst, sodass diese als weniger emotional beeinflussend wahrgenommen wird (Ochsner et al., 2012). Die kognitive Neubewertung schließt dabei unterschiedliche Taktiken ein, wie Reinterpretation oder Distanzieren (Ochsner et al., 2012). Während Reinterpretation impliziert, die Bedeutung eines Stimulus oder einer Situation zu verändern, z. B. durch die Vorstellung, dass eine Situation ein gutes Ende nimmt, wird bei der Taktik Distanzieren die persönliche Beziehung zu oder Distanz von einem Stimulus oder einer Situation verändert, z. B. durch die Vorstellung ein unbeteiligter, objektiver Beobachter einer Situation zu sein (Ochsner et al., 2012; Shiota & Levenson, 2012).

Insbesondere in der KVT werden Patient*innen unter Rückgriff auf die kognitive Neubewertung dazu ermutigt, mehr adaptive und positivere Bewertungen bezüglich belastender Situationen zu finden und diese in ihren Alltag zu integrieren (A. T. Beck, 1976; Clark & Beck, 2010), wodurch die Wichtigkeit ein besseres Verständnis dieser Emotionsregulationstaktiken zu erlangen sowie deren überdauernde Wirksamkeit zu untersuchen betont wird. Dabei sind vor allem differentielle Effekte zwischen Reinterpretation und Distanzieren sowie deren überdauernde Wirksamkeit in gesunden als auch klinischen Stichproben in Bezug auf biologische Korrelate wie ereigniskorrelierte Potentialen (EKPs) in der Elektroenzephalografie (EEG) kaum untersucht.

2.2.1. Kurzfristige Effekte kognitiver Neubewertung

Durch das Anwenden der kognitiven Neubewertung in Bezug auf negative Bilder zeigte sich auf subjektiver Ebene eine Reduzierung negativer Emotionen (z. B. Hermann et al., 2017; Hermann et al., 2021) und des Erregungsniveaus sowie eine Zunahme der Valenz (Qi et al., 2017; Thiruchselvam et al., 2011; für eine Metaanalyse siehe Webb et al., 2012).

Auf elektrokortikaler Ebene zeigte sich eine Reduktion der Amplitude des Late Positive Potentials (LPP), das als ein Maß des Erregungsniveaus sensitiv auf kognitive Regulation reagiert (Krompinger et al., 2008; Moran et al., 2013; für Reviews siehe: Hajcak & Foti, 2020; Hajcak et al., 2010). Auch getrennt betrachtet, führte sowohl die Anwendung von Reinterpretation (Qi et al., 2017; Willroth & Hilimire, 2016) als auch von Distanzieren (Qi et al., 2017) zu einer Amplitudenreduktion im LPP (beides verglichen mit dem Betrachten aversiver Bilder) und deutet so auf eine erfolgreiche ER durch beide Taktiken hin. Distanzieren reduzierte die Amplitude im Vergleich zu Reinterpretation früher im Zeitverlauf (Qi et al., 2017).

2.2.2. Überdauernde Effekte kognitiver Neubewertung

Bei erneuter Betrachtung von aversiven Bildern, die zuvor neubewertet wurden, zeigte sich ein überdauernder Effekt auf das Erleben negativer Gefühle, welcher über eine halbe Stunde (z. B. Qi et al., 2017; Thiruchselvam et al., 2011) bis zu einer Woche messbar war (Hermann et al., 2021). Differentiell zeigte sich, dass vorherige Reinterpretation beim erneuten Betrachten überdauernd die Valenz erhöhte, vorheriges Distanzieren hingegen das Erregungsniveau reduzierte (Qi et al., 2017).

Auf elektrokortikaler Ebene sind die überdauernden Effekte kognitiver Neubewertung weniger gut untersucht. Ohne die beiden Taktiken zu unterscheiden, zeigte sich bei erneuter Bildbetrachtung nach einer halben Stunde eine stärkere Reduktion der Amplitude im LPP bei Bildern, die zuvor neubewertet wurden im Vergleich zu Bildern, die zuvor nur betrachtet wurden (Thiruchselvam et al., 2011). In einer weiteren Studie wurde ein überdauernder Effekt von Distanzieren berichtet, nicht jedoch für zuvor reinterpretierte Bilder (beides verglichen mit vorherigem Betrachten aversiver Bilder; Qi et al., 2017).

2.2.3. Zusammenhang kognitiver Neubewertung mit habitueller Emotionsregulation

Wie bereits erwähnt, ist ein verstärkter Einsatz adaptiver Emotionsregulationsstrategien (wie z. B. Neubewertung) mit höherem Wohlbefinden und psychischer Gesundheit assoziiert (z. B. Brockman et al., 2017; Gross & John, 2003), die häufigere Anwendung maladaptiver

Strategien (wie z. B. Grübeln) hingegen mit stärker ausgeprägter Psychopathologie (z. B. Gross & Muñoz, 1995; Sloan et al., 2017). Daher ist es von großer Wichtigkeit zu untersuchen, wie Individuen habituell ihre Gefühle regulieren. Inwieweit die habituelle Anwendung insbesondere von Neubewertung auch mit Veränderungen in EKPs während der Implementierung dieser Strategie zusammenhängt, ist in gesunden Stichproben kaum untersucht.

Im Selbstbericht war eine stärkere habituelle Neubewertung mit einem stärkeren Rückgang negativer Gefühle durch Neubewertung verbunden (McRae et al., 2012). Auf elektrokortikaler Ebene demonstrierten erste Studien, dass Individuen, die habituell häufiger Neubewertung anwandten, eine verringerte Amplitude beim Betrachten aversiver Bilder (im Vergleich zu neutralen) aufwiesen (Harrison & Chassy, 2019). Ebenso war eine höhere habituelle Neubewertung mit einer stärkeren Reduktion der Amplitude im LPP durch Reinterpretation negativer Bilder assoziiert (Moser et al., 2014). Diese Studien schließen damit eine Lücke zwischen habitueller Anwendung spezifischer Emotionsregulationsstrategien im Alltag und der unmittelbaren im Labor. Es bleiben jedoch die Fragen unbeantwortet, wie die differentielle Betrachtung von Distanzieren und Reinterpretation sowie deren überdauernde Effekte im Zusammenhang mit der habituellen Emotionsregulation stehen. Auch weitere Zusammenhänge etwa zwischen der kognitiven Neubewertung und der familiären emotionalen Expressivität sind bisher kaum untersucht.

2.3. Zusammenspiel von familiärer emotionaler Expressivität und Emotionsregulation

Für das Kindesalter konnte gezeigt werden, dass sich mütterliche positive FEE positiv auf die Emotionsregulationsfähigkeit des Kindes auswirkt, ein höheres Ausmaß an negativer FEE hing dagegen mit geringerer kindlicher Emotionsregulationsfähigkeit zusammen (Are & Shaffer, 2016; Eisenberg et al., 2001). In einer longitudinalen Studie zeigte sich beispielsweise, dass ein negatives familiäres Klima, welches negative FEE einschließt, Depressionssymptome bei Jugendlichen vorhersagte (Ogbaselase et al., 2022). Dieser Zusammenhang war zusätzlich durch die habituelle kognitive Neubewertung und Unterdrückung von Emotionen der Jugendlichen selbst mediiert (Ogbaselase et al., 2022). Für ein positives familiäres Klima in der Jugend konnte eine Assoziation mit einer größeren Bindungssicherheit mit dem Partner über 60 Jahre später aufgezeigt werden (Waldinger & Schulz, 2016). Dabei war die Korrelation durch die ER im Erwachsenenalter beeinflusst, indem sie mitentscheidend war, ob eine Bindung gestärkt wurde oder nicht (Waldinger & Schulz, 2016). Auch eine transgenerationale Weitergabe des Familienklimas (Brenning et al., 2020) erfordert diesem Konstrukt besondere Beachtung zu schenken: Brenning et al. (2020) zeigten, dass das rückwirkend eingeschätzte Kontrollverhalten

der eigenen Eltern, welches mit negativer FEE assoziiert ist, mit dem Ausmaß des eigenen Kontrollverhaltens im Umgang mit dem Kind positiv assoziiert war und diese Beziehung durch die mütterliche ER mediiert war.

Bisherige Studien konzentrieren sich dabei auf die Untersuchung der FEE im Kindes- und Jugendalter (z. B. Eisenberg et al., 2001; Morris et al., 2007; Ramsden & Hubbard, 2002), obwohl einige wenige Studien eine Beeinflussung bis ins (hohe) Erwachsenenalter zeigen (Denham et al., 1997; Eisenberg et al., 2001; Halberstadt et al., 1995; Waldinger & Schulz, 2016). Der Zusammenhang zwischen den beiden Konstrukten FEE und adulter ER ist jedoch nicht erforscht. Ebenso ausstehend ist die Erforschung biologischer Korrelate von unmittelbarer sowie überdauernder kognitiver Neubewertung, wie dem LPP, und der FEE sowie dem Einwirken weitere individueller Einflussfaktoren, beispielsweise durch die eigene habituelle Emotionsregulation. Um diesen Fragen nachgehen zu können, wurden im Rahmen dieser Dissertation die Voraussetzungen geschaffen.

3. Fragestellungen

Im Rahmen dieser Dissertation wurden zwei Fragestellungen untersucht:

Fragestellung 1:

Die FEE während der Zeit des Aufwachsens ist Teil des Fundamentes für den späteren Ausdruck und die Regulation von Gefühlen (Morris et al., 2007) und beeinflusst viele wichtige Faktoren, die zur Salutogene oder Pathogenese von Individuen beitragen (z. B. Kyeong et al., 2021; Luebbe & Bell, 2014). Der in der Forschung am häufigsten eingesetzte Fragebogen, um die FEE zu erfassen, der FEQ (Halberstadt, 1983, 1986), liegt jedoch nicht in einer deutschen psychometrisch überprüften Fassung vor. Auch die Einflüsse von Zeit (z. B. Keller & Lamm, 2005) und Kultur (z. B. Gao & Han, 2016) sowie ein inkonsistenter Einsatz verschiedener Faktorlösungen des FEQ im Forschungskontext unterstreichen die Wichtigkeit einer aktuellen psychometrischen Überprüfung.

Daher wurde zunächst untersucht, welche bisher existierende Faktorenstruktur die deutsche Übersetzung des FEQ, den FEQ-GR, wiederspiegelt. Auch die Frage nach der Überprüfung weiterer psychometrischer Kennwerte wie der Reliabilität und der Validität sollte nachgegangen werden. Dies sollte in Fragestellung 1 (Zehtner et al., 2021) untersucht werden.

Fragestellung 2:

Auch die Anwendung von Emotionsregulationsstrategien hängt mit Psychopathologie und Wohlbefinden zusammen (z. B. Brockman et al., 2017). Im Kontext von Therapieeffekten und

deren langfristiger Wirkung sind dabei insbesondere überdauernde Effekte der Anwendung von Emotionsregulationsstrategien von Interesse. Obwohl die Forschung auf eine unterschiedliche Wirkweise und Wirksamkeit verschiedener Neubewertungstaktiken auf subjektiver wie auf elektrokortikaler Ebene hinweist, sind insbesondere differentielle Effekte der Taktiken Reinterpretation und Distanzieren kaum untersucht (z. B. Qi et al., 2017; Willroth & Hilimire, 2016). Auch überdauernde Effekte sowie weitere Einflussfaktoren (z. B. habituelle Neubewertung), die eine Lücke zwischen Laborforschung und Alltagsanwendung schließen könnten, sind bisher nahezu unbeantwortet. In Fragestellung 2 (Zehtner et al., 2023) wurden daher folgende Punkte adressiert: Welche kurzfristigen und überdauernden (differentiellen) Effekte finden sich auf elektrokortikaler sowie subjektiver Ebene für die beiden Taktiken Reinterpretation und Distanzieren? Wie hängen diese Effekte mit der habituellen Anwendung von kognitiver Neubewertung zusammen?

4. Erfassung des Konstruktes familiäre emotionale Expressivität (Studie 1)

4.1. Methode

Um eine deutsche Version des FEQ (Halberstadt, 1983, 1986) zu entwickeln, den FEQ-GR, wurde das Instrument zunächst von zwei bilingualen Muttersprachlern übersetzt und rückübersetzt sowie anschließend Abweichungen der Übersetzung zusätzlich mit Psycholog*innen diskutiert und angepasst. Anders als im Original wurde ein absoluter Nullpunkt eingeführt (*überhaupt nicht* anstelle von *not at all frequently*). Zusätzlich wurden zwei Items ausgeschlossen: Item 19 (*Expressing sorrow when a pet dies*. / *Trauer zeigen, wenn ein Haustier stirbt*.), da es nicht auf alle Ausfüllenden zutrifft sowie Item 28 (*Expressing concern for the success of family members.* / *Sorge über den Erfolg anderer Familienmitglieder ausdrücken*.) aufgrund von Übersetzungsschwierigkeiten. Während das Wort *concern* im Englischen in diesem Zusammenhang eine positive Konnotation aufweist und der positiven Skala zugeschrieben wurde, besitzt die gewählte deutsche Übersetzung *Sorge* eine eindeutig negative Konnotation.

Zunächst wurde die Faktorstruktur der deutschen Übersetzung aufgrund eines inkonsistenten Gebrauchs einer im Original postulierten 4-Faktorlösung sowie einer 2- und 3-Faktorlösung in der Anwendung im englischen Sprachraum mittels einer Stichprobe von 650 Personen überprüft. Die Itemzuordnung zu den Faktoren erfolgte entsprechend Halberstadt (1986). In der 2-Faktorlösung finden die beiden Valenz-Skalen Verwendung, i. e. positive und negative FEE, in der 3-Faktorlösung wird die negative FEE in submissiv (NS) und dominant (ND) aufgeteilt, während die positive FEE (P) eine eigenständige Skala bildet. Die Stichprobe wurde zufällig in zwei Hälften geteilt, wobei mit der ersten Hälfte konfirmatorische Faktorenanalysen für die

existierenden Lösungen durchgeführt wurden. Dabei wurden Items mit zu geringer Ladung entfernt (Worthington & Whittaker, 2006). Anschließend wurden die Lösungen miteinander verglichen und die Lösung mit der besten Modellpassung anhand der zweiten Hälfte der Stichprobe erneut überprüft. In einer zweiten unabhängigen Stichprobe (N = 225) wurde die Konstruktvalidität mittels Korrelationen von konstruktnahen und -fernen Instrumenten untersucht. Konvergente Validität sollte insbesondere unterstützt werden durch hohe Korrelationen zwischen den Skalen des FEQ-GR und dem erinnerten elterlichen Erziehungsverhalten (gemessen durch den Fragebogen zum erinnerten elterlichen Erziehungsverhalten, FEEV; Schumacher et al., 1999) sowie der adaptiven emotionalen Expressivität (gemessen durch den Emotionale-Kompetenz-Fragebogen, EKF; Rindermann, 2009). In den Instrumenten FEEV und EKF wurden die Ratings getrennt für Mütter und Väter erhoben. Dabei sollten die Skala P des FEQ-GR und emotionale Wärme (FEEV) hoch positiv korreliert sein, da diese Konstrukte eine inhaltliche Übereinstimmung zeigen. Entsprechend sollte vor allem die Skala ND, welche Verhaltensweisen wie Anschuldigungen, Missachtung oder Streit beinhaltet, hoch positiv mit der Skala Zurückweisung und Strafe und in einem geringeren Ausmaß mit Kontrolle und Überbehütung (FEEV) assoziiert sein. Eigene Schüchternheit (gemessen durch die Skala zur Schüchternheit; Czeschlik & Nuerk, 1995) sowie eigene nonverbale Expressivität (gemessen durch den Fragebogen zum expressiven Verhalten, FEX; Traue, 1998) sollte nur gering mit FEE zusammenhängen und so die diskriminante Validität unterstreichen. Deskriptive Statistiken wurden mittels SPSS 26 (IBM Corporation, Armonk, NY, USA), die weiteren Analysen mittels R (Version 4.0.4, R Core Team, 2019 R) durchgeführt.

4.2. Ergebnisse

Da die 4-Faktorlösung keine sinnvolle Lösung ergab, wurden nur die 2- und 3-Faktorlösungen mittels des Vuong-Tests (Vuong, 1989) miteinander verglichen. Dabei wies die 3-Faktorlösung eine signifikant bessere Passung auf. Zudem besaßen nur zwei Items in der 3-Faktorlösung eine zu geringe Ladung, in der 2-Faktorlösung hingegen sechs Items. Die konfirmatorische Faktorenanalyse wurde anschließend erneut mit der zweiten Hälfte der ersten Stichprobe wiederholt. Die Passungsindizes waren nahe den vorab postulierten Schwellen. Die Reliabilitäten der Subskalen waren in einem akzeptablen bis exzellenten Bereich (Cronbach's α = .73 – .95).

In Stichprobe 2 zeigte sich, wie angenommen, für die Skala P des FEQ-GR eine negative Assoziation mit Zurückweisung und Strafe sowie Kontrolle und Überbehütung (FEEV). Gleichzeitig wies sie erwartungsgemäß eine mittlere bis hohe Korrelation mit den Konstrukten

Emotionale Expressivität (EKF) sowie mit der Skala Emotionale Wärme (FEEV) auf. Die Skala P war gering positiv mit eigener nonverbaler Expressivität korreliert (FEX) und hing gering negativ mit Schüchternheit zusammen. Die Skala ND wies einen gering negativen Zusammenhang mit Emotionaler Expressivität (EKF) auf sowie einen mittleren negativen mit Emotionaler Wärme (FEEV). Positive Assoziationen zwischen der Skala ND des FEQ-GR zeigten sich erneut erwartungskonform mit den Skalen Zurückweisung und Strafe sowie mit Kontrolle und Überbehütung im FEEV. Eine gering positive Korrelation ergab sich mit Schüchternheit und es zeigte sich kein Zusammenhang mit der eigenen nonverbalen Expressivität (FEX). Die Skala NS des FEQ-GR war nur für Mütter mit der Skala Emotionaler Expressivität (EKF) sowie Zurückweisung und Strafe (FEEV) gering positiv assoziiert, für Väter mit Kontrolle und Überbehütung (FEEV).

4.3. Diskussion

Als erste Studie im deutschen Sprachraum wurden die Faktorstruktur, die Konstruktvalidität sowie die internale Konsistenz für den FEQ-GR überprüft. Die 3-Faktorlösung mit den Skalen P, ND und NS zeigte sich im FEQ-GR, gegenüber der 4- sowie 2-Faktorlösung überlegen. Aufgrund zu geringer Ladungen wurden zwei Items nach der Faktorenanalyse entfernt. Beide Items zeigten in einer modifizierten Version des FEQ (Self-Expressiveness in Family Questionnaire, SEFQ; Halberstadt et al., 1995), in dem das Ausmaß der eigenen Expressivität innerhalb der Familie eingeschätzt werden soll, ebenfalls eine unzureichende Ladung bzw. wiesen Mehrfachladungen auf dem positiven und negativen Valenzfaktor auf (Halberstadt et al., 1995). Die Passungsindizes waren nahe der gesetzten Schwellen, ein Befund der nach Expertenmeinung nicht zu streng interpretiert werden sollte und selbst in etablierten Fragebogen in ähnlicher Weise zu finden ist (Hopwood & Donnellan, 2010; Kelley & Pornprasertmanit, 2016; Ribbat et al., 2021; Swami & Barron, 2019). Reliabilitässchätzungen waren in Stichprobe 1 und 2 in einem akzeptablen bis sehr guten Bereich. Zudem lagen diese für alle drei Subskalen in einem ähnlichen Bereich verglichenen mit einer englischen 3-Faktorlösung (Baker & Crnic, 2005; Jones et al., 1998).

Trotz kultureller Unterschiede und einer möglichen Bedeutungsänderung der Items über die Zeit, behielten die ursprünglich konzipierten Skalen ihre inhaltliche Übereinstimmung mit dem FEQ, was für eine inhaltliche Vergleichbarkeit der deutschen und englischen Version spricht. Aufgrund unterschiedlicher Itemzahlen in beiden Versionen wird jedoch empfohlen die Skalenmittelwerte anstelle der Summenwerte heranzuziehen. Dabei ist darauf zu achten, dass

die deutsche Version entgegen der englischen einen absoluten Nullpunkt besitzt, wodurch das Ausmaß an FEE nicht direkt miteinander verglichen werden kann.

Bezüglich der Konstruktvalidierung zeigte sich der erwartete Zusammenhang, d. h. eine hohe Korrelation zwischen den Subskalen des FEQ-GR und den konstruktnahen Skalen zum erinnerten elterlichen Erziehungsverhalten sowie zur adaptiven emotionalen Expressivität. Entsprechend korrelierten die konstruktfernen Skalen zur eigenen nonverbalen Expressivität und zur Schüchternheit gering mit den Subskalen des FEQ-GR.

Eine Limitation der Studie stellt ein hoher Frauenanteil in beiden Stichproben dar. Dabei wurde in der Literatur gezeigt, dass Mütter (verglichen mit Vätern) im Selbstbericht angaben, mehr emotionale Wärme zu zeigen, während Väter (verglichen mit Müttern) berichteten, häufiger negative Expressivität zu zeigen (Halberstadt et al., 1995). Auch in anderen Studien gaben Frauen an mehr positive sowie internalisierende Gefühle auszudrücken, wie Sympathie oder Traurigkeit, Männer häufiger externalisierende Emotionen, wie Ärger (Chaplin & Aldao, 2013; Simon & Nath, 2004). Auch das durchschnittlich relative junge Alter sowie ein hohes Bildungsniveau limitiert die Generalisierung der Ergebnisse auf die Gesamtpopulation. Dabei zeigte sich in Studien, dass ein höheres Ausbildungsniveau mit einem höheren sozioökonomische Status assoziiert ist, welcher wiederum Erziehungsverhalten und somit auch die FEE beeinflusst (E. Chen & Berdan, 2006; Hoff et al., 2002; Hosokawa & Katsura, 2017).

Zusammenfassend kann der FEQ-GR zur Erfassung der FEE als ein reliables und valides Instrument betrachtet werden. Im Einklang mit einigen bisherigen Studien wurde eine 3-faktorielle Struktur bestätigt, nämlich positive, negativ-dominante sowie negativ-submissive FEE.

5. Untersuchung der kurzfristigen und überdauernden kognitiven Neubewertung sowie des Zusammenhanges mit habitueller Neubewertung (Studie 2)

5.1. Methode

Um kurzfristige sowie überdauernde Effekte kognitiver Neubewertung auf elektrokortikaler und subjektiver Ebene zu untersuchen, wurden 57 Personen in der aktiven Emotionsregulationsphase gebeten, wiederholt Bilder für 6 s entweder zu betrachten oder Neubewertung (Reinterpretation, Distanzieren) anzuwenden. Etwa eine halbe Stunde später wurden diese Bilder ohne Instruktion erneut 3 s präsentiert, wobei die Proband*innen gebeten wurden, diese nur zu betrachten (Abrufphase). Während beider Phasen wurde das EEG gemessen und Proband*innen gaben nach der Bildpräsentation an, wie stark sie gerade negative Gefühle empfanden. Um den Zusammenhang mit der habituellen Anwendung von kognitiver Neubewertung zu

untersuchen, füllten die Proband*innen den Emotion Regulation Questionnaire (ERQ; Abler & Kessler, 2009) aus.

An einem ersten Termin wurde ein strukturiertes klinisches Interview durchgeführt (Diagnostisches Interview bei psychischen Störungen; Margraf, Cwik, Pflug, & Scheider, 2017; Margraf, Cwik, Suppiger, & Schneider, 2017), um Proband*innen mit einer aktuellen oder früheren psychischen Erkrankung auszuschließen. Weitere Ausschlusskriterien waren eine frühere oder aktuelle psychotherapeutische Behandlung, die Einnahme von Psychopharmaka, ein Alter von < 18 Jahren oder > 65 Jahren, Linkshändigkeit, chronische oder schwere körperliche oder neurologische Erkrankungen, Schwangerschaft, Verletzungen an der Kopfhaut und Schwierigkeiten im Verständnis der deutschen Sprache. Nach dem ersten Termin erhielten die Teilnehmenden einige Fragebogen, die sie zum zweiten Termin ausgefüllt mitbringen sollten.

Am zweiten Termin erfolgte das Emotionsregulationsparadigma. Die aktive Emotionsregulationsphase bestand aus 96 Trials mit 24 Durchgängen pro Bedingung (4 Bedingungen: Reinterpretation, Distanzieren, Betrachten aversiv, Betrachten neutral). Jedes Bild wurde sechs Mal mit derselben Instruktion gepaart präsentiert, um, ähnlich zu Trainings- oder Therapieeffekten, eine tiefere Einspeicherung ins Gedächtnis zu ermöglichen. Bei den Bedingungen der kognitiven Neubewertung wurden die Proband*innen explizit instruiert, ihre negativen Gefühle zu reduzieren, indem sie sich ein konkretes gutes oder besseres Ende vorstellen (Instruktion: *Umdeuten*; Reinterpretation) oder die Perspektive eines neutralen und sachlichen, außenstehenden Beobachters einnehmen sollten (Instruktion: *Distanzieren*). Für die Kontrollbedingungen, nämlich dem Betrachten aversiver und neutraler Bilder (Instruktion: *Betrachten*), wurden die Teilnehmenden angeleitet, den Bildinhalt einfach zu betrachten und alle aufkommenden Gedanken und Gefühle zuzulassen, ohne diese zu verändern.

Nach einer etwa halbstündigen Pause, in der die Proband*innen gebeten wurden, einige Fragebogen auszufüllen, erfolgte die Abrufphase. In dieser wurden dieselben sowie acht neue Bilder präsentiert (4 neue neutrale, 4 neue aversive), wodurch sich 6 Bedingungen ergaben (zuvor betrachten aversiv, zuvor betrachten neutral, zuvor reinterpretieren, zuvor distanzieren, betrachten neu aversiv, betrachten neu neutral; die beiden zusätzlichen Bedingungen waren nicht Teil der Publikation). Die Abrufphase bestand aus 144 Trials mit 24 Durchgängen pro Bedingung. In beiden Phasen waren die Bedingungen pseudo-randomisiert, wobei dieselbe Bedingung nicht mehr als zweimal hintereinander präsentiert wurde.

Die Zeitfenster wurden entsprechend anderer Studien (DeCicco et al., 2012; Krompinger et al., 2008; Liu et al., 2019) in Abschnitte eingeteilt: P300 (300 – 500 ms), frühes LPP (500 – 800 ms), mittleres LPP (800 – 1400 ms) und spätes LPP (1400 – 3000 ms). Aufgrund bisheriger

Studien (Hua et al., 2015; Moser et al., 2014; Parvaz et al., 2012; Paul et al., 2013) und der visuellen Inspektion der Daten wurde das LPP über die 5 Elektroden CPz, Pz, POz, O1, O2 gemittelt betrachtet. Die EEG-Daten wurden zunächst mittels BrainVision Analyser (BrainProducts, Gilching, Germany, Version 2.2.0.7383) vorverarbeitet sowie die gemittelte Amplitude exportiert. Anschließend wurden alle statistischen Analysen mit IBM SPSS Statistics (Version 28) ausgewertet. Es wurden Varianzanalysen (ANOVA) mit Messwiederholung durchgeführt, wobei die Bedingung als Innersubjektfaktor aufgenommen wurde und der Mittelwert der Skala Neubewertung des ERQ als Kovariate (mittelwertszentriert). Analysen wurden getrennt für (überdauernde) emotionale Reaktivität ((zuvor) betrachten aversiv vs. (zuvor) betrachten neutral) sowie (überdauernde) ER durchgeführt. Die Ergebnisse der ANOVAs wurden Greenhouse-Geisser korrigiert, wenn die Spherizitätsannahme verletzt war. Anschließend wurden vorab geplante *t*-Tests für abhängige Stichproben Bonferroni-Holm korrigiert berechnet. Außerdem wurde bei einer signifikanten Interaktion zwischen Bedingung und ERQ-Wert eine Korrelationsanalyse für folgende Differenzwerte durchgeführt: (zuvor) betrachten aversiv minus (zuvor) betrachten neutral (für Effekte der (überdauernden) emotionalen Reaktivität) sowie (zuvor) betrachten aversiv minus (zuvor) reinterpretieren bzw. (zuvor) distanzieren (für die Effekte der (überdauernden) ER). Alle Ergebnisse wurden zweiseitig auf einem Signifikanzniveau von $\alpha = .05$, auf Trendlevel für $\alpha = .10$ berichtet.

5.2. Ergebnisse

Durch die Anwendung kognitiver Neubewertung wurden unmittelbar negative Gefühle verringert, wobei Reinterpretation (verglichen mit Distanzieren) zu einer stärkeren Reduktion führte. Dieser Effekt wurde nicht durch habituelle Neubewertung moderiert.

Auf elektrokortikaler Ebene führte das Betrachten aversiver Bilder in allen Zeitfenstern zu einem höheren LPP als das Betrachten neutraler Bilder. Dabei war in der aktiven Emotionsregulationsphase eine höhere habituelle Neubewertung mit einer erhöhten P300 und einem stärkeren frühen LPP beim Betrachten aversiver im Vergleich zu neutralen Bildern assoziiert, nicht jedoch das mittlere und späte LPP. Reinterpretation (verglichen mit dem Betrachten aversiver Bilder) führte im frühen (Trend), mittleren (Trend) und späten Zeitfenster zu einer Reduktion der LPP-Amplitude (Bonferroni-Holm korrigiert), Distanzieren im mittleren (Trend) und späten (Trend). Beide Taktiken unterschieden sich nicht signifikant voneinander. Die Effekte wurden nicht durch habituelle Neubewertung moderiert.

In der Abrufphase zeigte sich, dass das Betrachten von zuvor betrachteten aversiven Bildern (verglichen zu neutralen Bildern) zu einem stärkeren Erleben negativer Gefühle führte und

nicht durch habituelle Neubewertung moderiert war. Die Anwendung beider Taktiken in der aktiven Regulationsphase resultierte in einer überdauernden Reduktion negativer Gefühle beim erneuten Betrachten dieser Bilder in der Abrufphase (im Vergleich aversiven Bildern, die zuvor betrachtet wurden), wobei es keinen differentiellen Effekt gab. Auch lag kein Hinweis auf das Vorliegen einer Moderation durch habituelle kognitive Neubewertung vor.

Auf elektrokortikaler Ebene wiesen die Amplituden der ERPs über alle Zeitfenster eine höhere P300 und ein höheres LPP beim erneuten Betrachten von aversiven im Vergleich zu neutralen Bildern auf. Es zeigten sich keine überdauernden Regulations- und Moderationseffekte für die ERPs.

5.3. Diskussion

Im Einklang mit einer Vielzahl an Studien führte aversives Stimulusmaterial verglichen mit neutralem sowohl zu einem erhöhten Erleben negativer Gefühle (Hermann et al., 2021) als auch erhöhten Amplituden in der P300 und dem LPP (Hajcak et al., 2010; Hajcak & Nieuwenhuis, 2006; Paul et al., 2013; Qi et al., 2017; Thiruchselvam et al., 2011). Ein Effekt, der sich auf elektrokortikaler Ebene sowohl bei der Wiederholung der Bildpräsentation auf bis zu 60 Mal (Codispoti et al., 2006) und auch über die Zeit (Ferrari et al., 2020) als stabil erwies. Ebenfalls konnte repliziert werden, dass die unmittelbare Anwendung beider Taktiken (im Vergleich zum Betrachten aversiver Bilder) negative Gefühle reduzierte (Hermann et al., 2021; Shiota & Levenson, 2012; Webb et al., 2012), wobei Reinterpretation dem Distanzieren überlegen war. Dieser differentielle Effekt auf das Erleben negativer Gefühle könnte darauf beruhen, dass Reinterpretation zu einer Erhöhung an positiven Gefühlen führt, während Distanzieren zu einer neutraleren Reaktion beiträgt (Hermann et al., 2021; Qi et al., 2017; Shiota & Levenson, 2012). Dazu passend scheint Distanzieren stärker das Rating des Erregungsniveaus zu reduzieren, Reinterpretation hingegen einen Anstieg der Valenz zu bewirken (Qi et al., 2017). Auf elektrokortikaler Ebene führten beide Taktiken zu einer Abschwächung des frühen (nur Reinterpretation), mittleren und späten LPP (verglichen mit dem Betrachten aversiver Bilder). Im Gegensatz zu einer anderen Studie, in der Distanzieren zu einer früheren und stärkeren Reduktion der LPP-Amplitude führte (Qi et al., 2017), zeigten sich in unserer Studie keine differentiellen Effekte. Dies könnte in unserer Studie durch eine wiederholte Bildpräsentation erklärt werden, wodurch es zu einer stärkeren Einspeicherung und zu einem schnelleren Abruf der alternativen Gedächtnisrepräsentation kommen könnte.

Auch überdauernd führte die erneute Bildpräsentation zu einem verminderten Erleben negativer Gefühle. Dies ist im Einklang mit einer Studie, die dasselbe Bildmaterial nutzte und

diesen Effekt über den Zeitraum von einer Woche berichtete (Hermann et al., 2021). Auf elektrokortikaler Ebene ergab sich kein Unterschied für zuvor neubewertete verglichen mit erneut betrachteten aversiven Bildern. Auch Qi et al. (2017) berichteten keinen überdauernden Effekt für Reinterpretation, jedoch für Distanzieren. Ein fehlender überdauernder Regulationseffekt in unserer Studie könnte darauf hinweisen, dass die wiederholte Bildpräsentation auch zu einer Abschwächung der LPP-Amplitude in der zuvor Betrachten aversiv Bedingung führte. In Einklang mit dieser Möglichkeit konnte gezeigt werden, dass dreimaliges verglichen mit einmaligem Betrachten negativer Bilder eine reduzierte LPP-Amplitude evozierte (Paul et al., 2013). Eine andere Erklärung könnte von der Wirkung von Reinterpretation auf positive Gefühle stammen, wodurch das Erregungsniveau steigen könnte und somit auch die LPP-Amplitude beim erneuten Betrachten.

Anders als hypothetisiert (Harrison & Chassy, 2019) war ein häufigerer habitueller Einsatz von kognitiver Neubewertung in unserer Studie mit einer erhöhten emotionalen Reaktivität verbunden, gemessen an erhöhten Amplituden für die P300 und das frühe LPP beim Betrachten aversiver im Vergleich zu neutralen Bildern. Eine erhöhte P300 ist mit furcht- und selbstbezogener Verarbeitung assoziiert (Wang et al., 2021), wobei Aufmerksamkeit automatisch auf saliente Stimuli gezogen wird (Hajcak & Foti, 2020). Vor allem spätere Abschnitte der P300 werden in der Literatur mit Prozessen der Gedächtnisaktualisierung verknüpft (Polich, 2007). Eine gesteigerte Reaktivität könnte folglich auf eine erhöhte Bereitschaft zur Regulation auf saliente Stimuli hinweisen. Die Regulationseffekte wurden anders als in einer bisherigen Studie (Moser et al., 2014) nicht durch die habituelle Anwendung von Neubewertung moderiert. Dies könnte darauf hindeuten, dass sich Individuen nur in ihrer spontanen Reaktion auf emotionale Stimuli unterscheiden, aber in der Lage sind zu regulieren, wenn dies erforderlich ist. Auch für überdauernde Effekte konnte kein Moderationseffekt aufgezeigt werden, wobei die wiederholte Bildpräsentation zu einer generellen Abschwächung des Erregungsniveaus über alle Bedingungen geführt haben könnte.

Aufgrund nicht erfasster Valenz- und Erregungsniveau-Ratings kann die angenommene unterschiedliche Wirksamkeit der beiden Taktiken auf diesen Dimensionen nicht aufgeklärt werden. Unterschiede in der Effektivität der Anwendung beider Taktiken könnten auch darauf zurückgeführt werden, wie aversiv das Stimulusmaterial wahrgenommen wurde: Entsprechend scheinen Individuen kognitiv anstrengendere Strategien eher einzusetzen, wenn das Material als weniger aversiv erlebt wird (Sheppes & Levin, 2013). Da in der vorliegenden Studie nur vier Bildkategorien und die Bilder mehrmalig gezeigt wurden, könnte dies auch auf unser Stimulusmaterial zutreffen.

Ein direkter Vergleich von EEG-Studien zu kognitiver Neubewertung ist oftmals aus mehreren Gründen erschwert: Zum einen unterscheiden sich Studien in ihrer Art der Instruktion der Taktiken, zum anderen in der Auswahl der untersuchten Elektroden sowie Zeitfenster (Hajcak et al., 2010; Hajcak & Nieuwenhuis, 2006; Moser et al., 2010).

Insgesamt tragen die Ergebnisse dieser Studie zu einem verbesserten Verständnis von unmittelbaren sowie überdauernden Effekten der beiden Neubewertungstaktiken Reinterpretation und Distanzieren bei. Die Assoziation zwischen erhöhter emotionaler Reaktivität bei Individuen, die Neubewertung habituell häufiger nutzen, könnte auf eine erhöhte Bereitschaft zu regulieren hindeuten. Neubewertung zu trainieren, könnte folglich die spontane Reaktion auf Stimuli verbessern.

6. Abschließende Diskussion und Zusammenfassung

Interindividuelle Unterschiede in der Emotionsverarbeitung und der ER ergeben sich bereits früh durch Erfahrungen in der Kindheit, wie etwa durch ein unterschiedliches Ausmaß sowie die Art der FEE (Bariola et al., 2011; Morris et al., 2007) oder durch die elterliche ER (Calkins & Johnson, 1998; Diener & Mangelsdorf, 1999; Röll et al., 2012). Beide Konstrukte sind eng miteinander verknüpft (Morris et al., 2007) und beeinflussen bis ins hohe Erwachsenenalter (Denham et al., 1997; Eisenberg et al., 2001; Halberstadt et al., 1995; Waldinger & Schulz, 2016). Trotz dieser Beeinflussung wurde der Zusammenhang zwischen der FEE mit den Effekten der unmittelbaren und überdauernden ER sowie deren neuronalen Korrelaten bei Erwachsenen nicht untersucht. Im Rahmen dieser Dissertation sollten die Voraussetzungen geschaffen werden, diese Lücke zu schließen, indem zunächst der Fragebogen zur Erhebung der FEE für den deutschen Sprachraum evaluiert wurde (Fragestellung 1) sowie das Paradigma zur Erfassung der (elektrokortikalen) Effekte der unmittelbaren und überdauernden ER (Fragstellung 2) untersucht wurde. Beide Fragestellungen sollen nun getrennt voneinander evaluiert werden:

Im Rahmen der Überprüfung der psychometrischen Eigenschaften des FEQ-GR (Fragestellung 1) ist das Hinzuziehen zweier bilingualer Muttersprachler sowie die Untersuchung der Faktorenstruktur in zwei voneinander unabhängigen Stichproben besonders hervorzuheben. Eine qualitativ sorgfältige Überprüfung von Fragebogenübersetzungen ist für den Vergleich von internationalen Forschungsergebnissen zentral (Ziegler & Bensch, 2013). Auch sorgt eine adäquate Überprüfung für eine bessere Definition des zu messenden Konstruktes und somit zu einer Abgrenzung zu anderen verwandten Konstrukten. Im Kontext der FEE sind hier beispielsweise elterliches Erziehungsverhalten oder das Konzept der „Expressed Emotions“ zu nennen.

Unter „Expressed Emotions“ wird das Ausmaß an durch die Bezugspersonen ausgedrückter Kritik und übermäßiger emotionaler Beteiligung (Morris et al., 2007) verstanden, wobei sich eine inhaltlich hohe Überschneidung zu negativ-dominanter FEE zeigt, die in zukünftigen Studien für eine weitergehende Überprüfung der Konstruktvalidität exploriert werden sollte. Positiv hervorzuheben ist des Weiteren die Erhebung eines Fragebogens zur sozialen Erwünschtheit, um zu untersuchen, ob Testausfüllende versuchen, ihre Familien in besserer oder schlechterer Weise darzustellen (Halberstadt, 1983). Die Durchführung eines solchen Instrumentes kommt der GESIS-Empfehlung (Bogner & Landrock) zur Kontrolle von Antworttendenzen in standardisierten Umfragen nach. In der vorliegenden Arbeit (Zehtner et al., 2021) wurde hierzu die Kurzskala Soziale Erwünschtheit-Gamma (KSE-G; Kemper et al., 2012) durchgeführt; die Subskalen wiesen nur eine geringe Korrelation mit den Subskalen des FEQ-GR auf, was darauf schließen lässt, dass Versuchspersonen eher nicht dazu tendierten sozial erwünscht zu antworten. Gleichwohl zeigten die Subskalen des KSE-G in der vorliegenden Stichprobe nur eine geringe internale Konsistenz und vor dem Hintergrund von hohen Korrelationen zwischen Persönlichkeitsfaktoren und sozialer Erwünschtheit (Bensch et al., 2019) sind diese Ergebnisse mit Vorsicht zu interpretieren. Um weitere Verzerrungseffekte in der vorliegenden Studie zu untersuchen, wurden sowohl Kontrollitems in die Umfrage eingestreut sowie Ausfüllende gebeten, anzugeben, auf wen sie ihre Antworten bezogen. Personen, die diese Items nicht hinreichend beantworten konnten, wurden von weiteren Analysen ausgeschlossen.

Kritisch anzumerken ist eine fehlende Untersuchung der Messinvarianz zwischen interkulturellen Stichproben (F. F. Chen, 2008), um eine optimale internationale Vergleichbarkeit der FEE zu gewährleisten. Aufgrund der bereits beschriebenen Anpassungen des FEQ-GR ist dies aber mit den vorliegenden Daten nicht möglich.

Auch fehlen Untersuchungen zur Zeitstabilität des Konstruktes im deutschen Sprachraum. Für die 4-Faktorlösung wurde für den FEQ eine exzellente Retest-Reliabilität für einen Zeitraum von 10 Tagen berichtet (Halberstadt, 1986). In longitudinalen Untersuchungen könnte künftig eine länger überdauernde Stabilität der erinnerten FEE untersucht werden sowie die FEE im Erwachsenenalter. Dabei konzentrierte sich die bisherige Forschung zur FEE auf das Kindesalter (z. B. Are & Shaffer, 2016; Ramsden & Hubbard, 2002). Insbesondere wurden die Mütter stellvertretend gebeten eine Einschätzung über ihre FEE in der aktuellen Familie zu treffen (z. B. Are & Shaffer, 2016; Eisenberg et al., 2001; Ramsden & Hubbard, 2002), wodurch eine einseitige Berichterstattung gegeben ist, welche zudem nicht zwingend dem Empfinden des Kindes entspricht. Auch das bereits erwähnte unterschiedliche Ausmaß der Elternteile im

Ausdrücken von Emotionen (z. B. Cassidy et al., 1992) könnte diesen Selbstbericht verzerren. Zukünftige Forschung könnte daher eine getrennte Untersuchung naher Bezugspersonen sowie eine Einschätzung der Gewichtung durch ein älteres bzw. erwachsenes Kind berücksichtigen. Dies wird weiterhin von dem Befund gestützt, dass die eigene emotionale Expressivität von Vätern nicht mit dem Copingverhalten des Kindes assoziiert war, jedoch eine höhere negative mütterliche emotionale Expressivität mit weniger konstruktivem Coping des Kindes zusammenhing (Valiente et al., 2004).

Auch in klinischen Populationen wurde die FEE bisher kaum untersucht, obgleich Studien auf einen Zusammenhang zwischen FEE und Depressivität- sowie Angstsymptome im Jugendalter (z. B. Luebbe & Bell, 2014) hinweisen.

In der zweiten Fragestellung dieser Dissertation wurde die differentielle kurzfristige und überdauernde Wirksamkeit von Reinterpretation und Distanzieren sowie deren Zusammenhang mit habitueller Neubewertung auf elektrokortikaler und subjektiver Ebene untersucht. Die Studie zeichnet sich insbesondere durch eine große Stichprobe (N = 57) aus; vergleichbare EEG-Studien zu überdauernden Effekten liegen deutlich darunter (z. B. Thiruchselvam et al., 2011: N = 19; Qi et al., 2017: N = 25), obwohl eine Poweranalyse mit G*Power (Faul et al., 2009; Faul et al., 2007) eine Stichprobengröße von mindestens 52 Personen nahelegte.

Hervorzuheben ist außerdem die wiederholte Bilddarbietung in der vorliegenden Studie, um eine stärkere Gedächtniskonsolidierung zu bewirken und dadurch Trainings- bzw. Therapieeffekte zu simulieren und zu untersuchen. In einer fMRT-Studie konnten Denny et al. (2015) zeigen, dass wiederholte Neubewertung von Bildern (verglichen mit einmaliger Neubewertung, gleichhäufiger Betrachtung alter Bilder) zu einer überdauernden Verringerung der Amygdalaaktivität führte, als die Bilder nach einer Woche erneut präsentiert wurden. Die Autoren führten diesen Befund auf eine anhaltende Veränderung der neuronalen Repräsentation der emotionalen Stimulusbedeutung zurück (Denny et al., 2015). Zukünftige Studien könnten den Dosis-Wirkungszusammenhang in Abhängigkeit der Zeit genauer explorieren.

Auch positiv anzumerken sind die Zusatzanalysen (Zehtner et al., 2023) zur expliziten Erinnerung der Kopplung zwischen Bild und Bedingung (Reinterpretation, Distanzieren, Betrachten) sowie zum unaufgeforderten Einsetzen der Taktiken in der Abrufphase, um differentielle Effekte von Reinterpretation und Distanzieren tiefergehend zu explorieren. In Einklang zu Studien über Gedächtniseffekte von Reinterpretation und Distanzieren (z. B. Willroth & Hilimire, 2016) zeigte sich, dass sich Proband*innen häufiger richtig an die Instruktion Umdeuten als

Distanzieren und Betrachten erinnerten sowie die Taktik Reinterpretation häufiger unaufgefordert in der Abrufphase erneut einsetzten. Dies könnte für eine tiefere Elaboration des Bildinhaltes während Reinterpretation sprechen (Willroth & Hilimire, 2016), aber auch durch die Art der Instruktion beeinflusst sein: Reinterpretation wurde in der vorliegenden Studie spezifisch instruiert, d. h. Proband*innen wurden gebeten, sich ein konkretes gutes bzw. besseres Ende vorzustellen. Distanzieren wurde hingegen global angeleitet, d. h. Proband*innen sollten die Position eines unbeteiligten Beobachters einnehmen, wodurch eine Bedeutungsänderung über verschiedene Bildinhalte hinweg möglich ist und eine genauere Auseinandersetzung mit dem spezifischen Bildinhalt minimiert sein könnte. Zukünftige Studien könnten den Effekt der spezifischen bzw. globalen Instruktion systematisch untersuchen. Ob in diesem Zusammenhang unterschiedliche Aufmerksamkeitsprozesse beteiligt sind, könnte unter Hinzunahme anderer Parameter wie Eyetracking objektiv geprüft werden.

Als Limitation der Studie ist die Zusammensetzung der Stichprobe als relativ jung und gebildet zu nennen, welche eine Generalisierung auf ein breites Altersspektrum sowie Bildungsniveau einschränkt. Neben den bereits genannten Limitationen (siehe 5.3 Diskussion; z. B. bzgl. Valenz- und Erregungsniveau-Ratings) ist auch das Laborsetting zu nennen, welches zwar zu einer hohen Standardisierung beiträgt, jedoch die Übertragbarkeit auf die alltägliche Emotionsregulation mit individuellen emotionalen Auslösern unterschiedlicher Natur einschränkt. Zukünftige Studien könnten daher individualisierte Stimuli nutzen, um die individuelle Emotionsregulationsfähigkeit besser zu erfassen. Forschungsergebnisse geben Hinweise darauf, dass Personen auf elektrokortikaler Ebene (gemessen durch das LPP) stärker auf persönlich saliente Stimuli reagieren (Hajcak & Foti, 2020; Hajcak et al., 2010). Beispielsweise zeigten Personen mit der Diagnose einer Zwangsstörung eine erhöhte LPP-Amplitude auf mit ihrem Zwang assoziiertes verglichen mit aversivem Bildmaterial (Paul et al., 2016). Auch denkbar wäre das Nutzen von mobilen Apps, die Personen z. B. nach Ansteigen physiologischer Parameter in Stresssituationen zur Situation und eingesetzter Emotionsregulationsstrategie befragen. Mobile EEG-Systeme würden außerdem die Untersuchung komplexerer Umweltinteraktionen zulassen.

Zusammenfassend zeigte sich der FEQ-GR als psychometrisch valides und reliables Instrument, um die FEE zu erfassen. Auch erwies sich das Emotionsregulationsparadigma als ein geeignetes Verfahren, Effekte der Neubewertung auf elektrokortikaler und subjektiver Ebene zu erfassen, wobei sich eine Beeinflussung durch habituelle ER auf die unmittelbare emotionale

Reaktivität zeigte. Die vorliegende Studie versucht unter Einbezug der habituellen Emotionsregulationsfähigkeit erste persönliche Einflussfaktoren von ER zu erfassen, die Untersuchung andere Einflussfaktoren wie z. B. die der FEE ist jedoch ausstehend. So liegt bisher weder in einer gesunden noch einer klinischen Stichprobe eine Studie zu unmittelbaren und überdauernden Effekten der ER sowie deren elektrokortikalen Korrelaten in Zusammenhang mit der FEE im Erwachsenenalter vor. Aufgrund des Zusammenhanges beider Konstrukte mit psychischer Gesundheit stellen sie einen Ansatzpunkt für Präventionsprogramme dar (Ogbaselase et al., 2022; Speidel et al., 2020), welcher in zukünftigen Fragestellungen weiter erforscht werden könnte. Durch die vorliegende Dissertation wurden die Voraussetzungen geschaffen, diese anschließenden Fragen tiefergehend zu beleuchten.

Zusammenfassung

Zur Überprüfung der psychometrischen Eigenschaften des FEQ-GR wurde zunächst in Fragestellung 1 die Faktorstruktur überprüft, wobei sich in Einklang mit einigen Befunden (Baker & Crnic, 2005; Jones et al., 1998) eine 3-faktorielle Lösung bestätigte, nämlich positive, negativ-dominante sowie negativ-submissive FEE. Zusätzlich wurde die Konstruktvalidität anhand von Fragebogen zu assoziierten und divergenten Komponenten überprüft, wie beispielsweise des erinnerten elterlichen Erziehungsverhaltens oder der Schüchternheit. Auch die Reliabilitätswerte gemessen anhand der internalen Konsistenz zeigten sich als zufriedenstellend bis sehr gut. Insgesamt ist der FEQ-GR als ein psychometrisch solides Instrument zur Erfassung der FEE während der Zeit des Aufwachsens zu beurteilen.

Bei der Untersuchung der unmittelbaren Wirkung der Neubewertungstaktiken Reinterpretation und Distanzieren zeigte sich in Fragestellung 2, dass Versuchspersonen darin erfolgreich waren, ihre negativen Gefühle durch beide Taktiken zu verringern. Reinterpretation führte dabei zu einer stärkeren Reduktion. Auch resultierte der Einsatz der beiden Taktiken in eine Verringerung des LPP (verglichen mit dem Betrachten aversiver Bilder). Bei erneutem Betrachten der Bilder nach einer halben Stunde zeigte sich ein überdauernder Effekt auf subjektiver Ebene, nicht jedoch auf elektrokortikaler. Während der aktiven Emotionsregulationsphase war eine höhere habituelle Neubewertung mit höherer emotionaler Reaktivität in der P300 und dem frühen LPP verbunden. Dieser Befund wurde vor dem Hintergrund diskutiert, dass Individuen, die habituell häufiger Neubewertung anwenden, möglicherweise eine höhere Regulationsbereitschaft aufweisen.

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8. Anhang

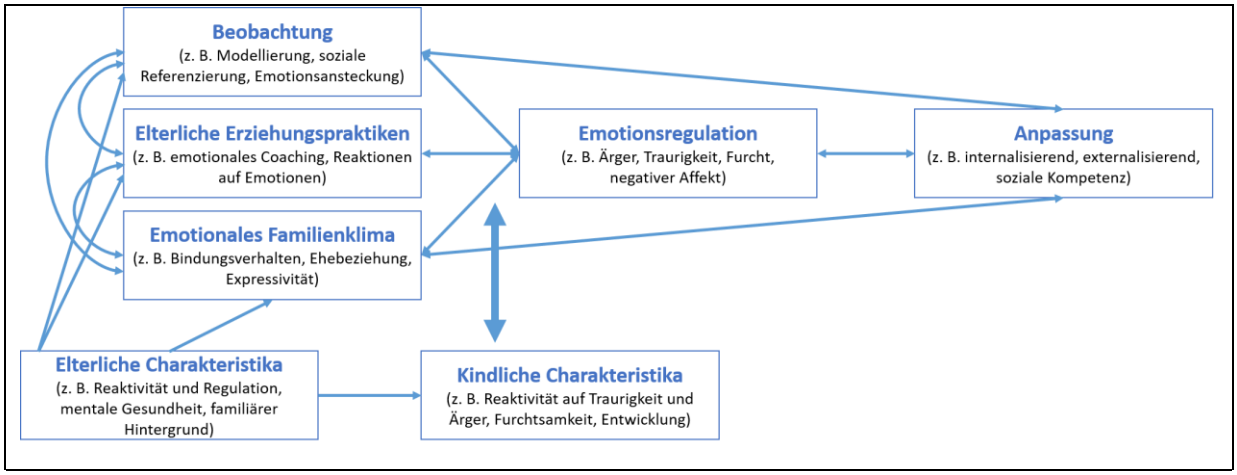

Abbildung A1. Dreigliedriges Modell des familiären Einflusses auf die kindliche Emotionsregulierung und Anpassung (übersetzt nach Morris et al., 2007)

9. Liste aller Publikationen

Artikel, Erstautorenschaften

Zehtner, R. I., Baeurle, C. L., Walter, B., Stark, R., & Hermann, A. (2021). Factor structure and psychometric properties of the German version of the Family Expressiveness Questionnaire (FEQ-GR). *Psychological Test Adaptation and Development, 2*(1), 111–123. https://doi.org/10.1027/2698-1866/a000015

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Artikel, Co-Autorenschaften

Fricke, S., Seinsche, R. J., Neudert, M. K., Schäfer, A., **Zehtner, R. I.**, Stark, R., & Hermann, A. (2023). Neural correlates of context-dependent extinction recall in social anxiety disorder: Relevance of intrusions in response to aversive social experiences. Psychological Medicine, 1–10. https://doi.org/10.1017/S0033291723002179

Hermann, A., Neudert, M. K., Schäfer, A., **Zehtner, R. I.**, Fricke, S., Seinsche, R. J., & Stark, R. (2021). Lasting effects of cognitive emotion regulation: Neural correlates of reinterpretation and distancing. *Social cognitive and affective neuroscience*, *16*(3), 268–279. https://doi.org/10.1093/scan/nsaa159

Neudert, M. K., Schäfer, A., **Zehtner, R. I.**, Fricke, S., Seinsche, R. J., Kruse, O., ... & Hermann, A. (2023). Behavioral pattern separation is associated with neural and electrodermal correlates of context-dependent fear conditioning. *Scientific Reports*, *13*(1), 5577. https://doi.org/10.1038/s41598-023-31504-z

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Erklärung

„Hiermit erkläre ich, dass ich die vorliegende Arbeit selbständig und ohne unzulässige Hilfe oder Benutzung anderer als der angegebenen Hilfsmittel angefertigt habe. Alle Textstellen, die wörtlich oder sinngemäß aus veröffentlichten oder nichtveröffentlichten Schriften entnommen sind, und alle Angaben, die auf mündlichen Auskünften beruhen, sind als solche kenntlich gemacht. Bei den von mir durchgeführten und in der Dissertation erwähnten Untersuchungen habe ich die Grundsätze guter wissenschaftlicher Praxis, wie sie in der „Satzung der Justus-Liebig-Universität Gießen zur Sicherung guter wissenschaftlicher Praxis“ niedergelegt sind, eingehalten sowie ethische, datenschutzrechtliche und tierschutzrechtliche Grundsätze befolgt. Ich versichere, dass Dritte von mir weder unmittelbar noch mittelbar geldwerte Leistungen für Arbeiten erhalten haben, die im Zusammenhang mit dem Inhalt der vorgelegten Dissertation stehen, und dass die vorgelegte Arbeit weder im Inland noch im Ausland in gleicher oder ähnlicher Form einer anderen Prüfungsbehörde zum Zweck einer Promotion oder eines anderen Prüfungsverfahrens vorgelegt wurde. Alles aus anderen Quellen und von anderen Personen übernommene Material, das in der Arbeit verwendet wurde oder auf das direkt Bezug genommen wird, wurde als solches kenntlich gemacht. Insbesondere wurden alle Personen genannt, die direkt und indirekt an der Entstehung der vorliegenden Arbeit beteiligt waren. Mit der Überprüfung meiner Arbeit durch eine Plagiatserkennungssoftware bzw. ein internetbasiertes Softwareprogramm erkläre ich mich einverstanden.“

Gießen, den _____

Danksagung

Hiermit möchte ich mich herzlich bedanken bei …

… PD Dr. Andrea Hermann für die Betreuung meiner Promotion, ihre Ansprechbarkeit in wirklich jeder Lebenslage, die vielen konstruktiven und wertvollen Gespräche und Rückmeldungen zu Problemen rund um die Studien, ihre uneingeschränkte Unterstützung, die Freiheit eigene Ideen umsetzen zu dürfen und ihre wertschätzende Art.

… Prof. Dr. Rudolf Stark für die Möglichkeit in der Abteilung promovieren zu dürfen, für sein entgegengebrachtes Vertrauen in meine Arbeit und die anhaltende Unterstützung trotz der viele „Rückschläge“ im Labor sowie für sein hilfreiches Feedback sei es in Meetings oder beim Kommentieren der Artikel.

… meinen Kolleg*innen in der Abteilung sowie der Ambulanz für ihre Unterstützung und den hilfreichen Austausch z. B. bei Mensaessen oder Spaziergängen, für jede Menge Spaß bei Doktorand*innentreffen, Sommer-/Weihnachtsfeiern, Abteilungsessen, für das gemeinsame Überbrücken des Hackerangriffes und des Lockdowns durch Online-Meetings, -Kaffeepausen und -Spieleabende. Insbesondere möchte ich mich bei den Kollegen Dr. Axel Schäfer, Dr. Bertram Walter, Dr. Helge Gebhardt, Dr. Carlo Blecker und Dr. Ulrich Ott für die statistische Hilfe bei Auswertung und Fragen sowie Unterstützung rund um das Labor bedanken. Außerdem gilt ein großer Dank meinen Kolleg*innen der Arbeitsgruppe Marie Neudert, Susanne Fricke, Rosa Seinsche, Sebastian Palmer, Johanna Jengert-Stahl und Ann-Kathrin Noll für die vertrauensvolle und motivierende Zusammenarbeit, Spaß und Unterstützung bei Konferenzen sowie die hilfreichen Kommentare beim Korrekturlesen der Artikel. Auch herzlich danken möchte ich meinen „3L“-Bürokolleginnen in der Ambulanz Lena Krüger und Franziska Zinßer für ihre emotionale Unterstützung, ihr offenes Ohr und den sportlichen Ausgleich zur Arbeit.

… Prof. Dr. Daniela Mier für die Begutachtung meines Kumulus und allen Personen der Prüfungskommission für ihre aufgebrachte Mühe und Zeit.

… Malte, der mir nicht nur tatkräftig zur Seite stand, etwa beim Waschschrank bauen in der Ambulanz, durch das Übernehmen des Essenkochens in stressigen Zeiten oder Tips beim Layouten von Postern, sondern der mir vor allem auch eine wertvolle emotionale Stütze war.

… meiner Familie für ihre Unterstützung, ihren Glauben in mich und ihren Zuspruch, für das „Rundum-Sorglos-Paket“ bei Home-Office Tagen in Oberbayern.

… allen Proband*innen, studentischen Hilfskräften und Praktikant*innen, die die Durchführung der Studien ermöglicht haben.

Original Article

Factor Structure and Psychometric Properties of the German Version of the Family Expressiveness Questionnaire (FEQ-GR)

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Abstract. *Background:* This study aimed to develop a German version of the Family Expressiveness Questionnaire (FEQ; Halberstadt, 1983, 1986), which investigates emotional expressiveness within the family context while growing up. While a theoretically derived four-factor structure was postulated, 2- and 3-scale versions have been applied in research. *Methods:* In Study 1 (N = 650), these existing models were tested against each other. A confirmatory factor analysis was conducted for the solution that best fitted the data with half of the sample, and results were cross-validated in the other half. Construct validation was investigated in Study 2 (N = 225). *Results:* An acceptable model fit for a three-factor solution was attained in Study 1. In Study 2, correlation patterns indicated a good convergent and discriminant validity. Reliability estimates in both studies were in an acceptable to excellent range. *Conclusion:* Findings suggest that the FEQ German version is a psychometrically sound instrument for assessing expressiveness within the family.

Keywords: family expressiveness, assessment, factor structure, validation

The family provides an important source in which children learn about emotions such as understanding, expressing, experiencing, and regulating them (Halberstadt et al., 1995; Petermann & Wiedebusch, 2016). This process is often referred to as emotional socialization (Eisenberg et al., 1998). An important factor of it is family expressiveness. According to Halberstadt et al. (1995), family expressiveness refers to a persistent pattern in "exhibiting nonverbal and verbal expressions" (p. 93) within the family context. These expressions are mostly emotionally charged and assessed in terms of frequency of occurrence (Halberstadt et al., 1995). It is noteworthy that family expressiveness contributes to children's development in many ways as it is linked to the individuals' emotional experiences (Dunn & Brown, 1994; Nelson et al., 2012), self-expressiveness (Eisenberg et al., 2003; Halberstadt & Eaton, 2014; Halberstadt et al., 1999), emotion regulation (Are & Shaffer, 2016; Gao & Han, 2016; Liew et al., 2011; Morris et al., 2007; Ramsden & Hubbard, 2002), social functioning and competence (Cumberland-Li et al., 2003), and peer relations (Cassidy et al., 1992), as well as to self-esteem (Halberstadt et al., 1999). Even though children become more and more influenced by their peer social environment while growing up (Morris et al., 2007), effects of family expressiveness seem to persist from childhood throughout adulthood (Halberstadt et al., 1995, 1999). The extent to which emotions are expressed is highly cultural dependent (Are & Shaffer, 2016; Consedine & Magai, 2002) and so is family expressiveness. While individuals from collectivistic cultures tend to suppress their expressions, to avoid showing strong positive or negative emotions (Morelen et al., 2013; Wu & Chao, 2016), individuals from individualistic cultures emphasize the importance of individual emotional experiences as well as their expression (Gao & Han, 2016; Halberstadt & Lozada, 2011; Ramzan & Amjad, 2017; Rychlowska et al., 2015). When collectivism (C) and individualism (I) are considered as the ends of a continuum, as for example expressed by Hofstede's I-C (range 0–100; Hofstede, 2009), Germany (Hofstede's I-C: 67) would lie on the upper half, the United States (Hofstede's I-C: 91) close to the end of the continuum toward individualism, whereas countries on the

https://doi.org/10.1027/2698-1866/a000015

opposite side would be, for example, Indonesia (Hofstede's I-C: 12) or China (Hofstede's I-C: 20; Hofstede, 2009; Rychlowska et al., 2015). Furthermore, cultural norms are dynamic and change over time, which is also reflected in the family environment (Keller & Lamm, 2005; Rogoff, 2003). With respect to the German historical background, a strong increase in individualization began around the mid-1980s (Beck, 1986), the influence of which is addressed in the study of Keller and Lamm (2005). They compared two German cohorts in their parenting styles (Cohort 1: 1977/1978 vs. Cohort 2: 2000); compared to the first cohort, the second showed more independence-promoting strategies (e.g., object play fostering individual space). Moreover, the second but not the first demonstrated stronger emotional positivity (e.g., smiling at the child) and emphasized praise as educational goals which are core elements of positive expressiveness within the family. This highlights not only cultural differences in expressiveness but also changes over time, which could result in a drift of the intended meaning of items measuring such constructs.

The Family Expressiveness Questionnaire (FEQ; Halberstadt, 1983, 1986) is the most frequently used questionnaire to measure expressiveness within the family of origin (e.g., Are & Shaffer, 2016; Burrowes & Halberstadt, 1987; Gao & Han, 2016; Morelen et al., 2013; Ramsden & Hubbard, 2002), and so far, there exists no German version of the questionnaire.

The Family Expressiveness Questionnaire

Halberstadt (1986) emphasizes that the FEQ is constructed to measure nonverbal and verbal expressiveness and focuses especially on emotionally expressive behaviors such as admiring or apologizing. The FEQ comprises 40 items and asks the participant to estimate how often given expressive scenarios occurred within the family while growing up. The given scenarios are classified into the dimensions valence/affect (positive and negative) and dominance/power (dominant and submissive). This classification results in 4 subscales containing 10 items each: positive-submissive (PS; e.g., "Thanking family members for something they have done"), positive-dominant (PD; e.g., "Spontaneously hugging a family member"), negative-submissive (NS; e.g., "Crying after an unpleasant disagreement"), and negative-dominant (ND; e.g., "Threatening someone"). This quadripartite structure is theoretically derived from the Profile of Nonverbal Sensitivity Test (Rosenthal et al., 1979) but has not been tested by means of factor analysis so far (Halberstadt, 1983, 1986). In research literature, however, the FEQ is most commonly conducted in a 2-scale version, namely positive and negative family expressiveness (e.g., Baker et al., 2011; Clark & Phares, 2016; Gao & Han, 2016; Halberstadt et al., 1993, 2011; Heinhold et al., 1998; Liu et al., 2009; Morelen et al., 2013; Ramsden & Hubbard, 2002; Suveg et al., 2014). Some researchers also postulated a three-factor solution, using a combined positive scale (P) and retaining the division into ND and NS (Baker & Crnic, 2005; Eisenberg et al., 1991, 1992; Jones et al., 1998).

Reliabilities of the theoretically derived and postulated four FEQ subscales range from Cronbach's $\alpha = .75$ to $\alpha = .88$ (Halberstadt, 1986), which indicates an acceptable internal consistency (George & Mallery, 2016). Using the negative and positive subscales resulted in a similar range of values of internal consistencies (Clark & Phares, 2016; Gao & Han, 2016). Furthermore, test–retest reliability coefficients over 10 days were excellent, ranging from $r = .89$ to $r = .92$ for the four subscales (Halberstadt, 1986).

The construct validity of the overall FEQ score was supported by a small to moderate association with nonverbal emotional self-expressiveness and correlated negatively with shyness in men, but not women (Halberstadt, 1986). Halberstadt (1986) concluded that nonverbal self-expressiveness and shyness share some common variance while still being perceived as distinct constructs.

The FEQ also exists in a self-rating version, the Self-Expressiveness in Family Questionnaire (SEFQ; Halberstadt et al., 1995). In the SEFQ, not the expressiveness of the whole family as an entity while growing up is assessed but one's own individual contribution within the current family. As the original FEQ has neither been designed for measuring individual contributions nor for estimations within the current family, Halberstadt et al. (1995) claimed that psychometric properties of the FEQ do not account for the SEFQ, which is why we do not refer to these findings in more detail in the Introduction section.

Summarizing, despite being conceptualized as a four-dimensional construct, there seems to be no consistent solution in the adoption of the 2 or 3 scales and an appropriate statistical evaluation of the underlying structure is missing. Moreover, the existing literature indicates cultural differences in the adaptive expression of emotions as well as a drift of the meaning over time, highlighting once more the need for an examination of these three postulated scale solutions.

Study Aims

The aim of our study was to develop a reliable and valid German adaption of the FEQ. The FEQ has so far been

applied for research purposes, which is also the aim for the development of the German version of the FEQ (FEQ-GR) addressing a German-speaking sample. First, we translated and adapted the questionnaire. In Study 1, we tested the existing scale solutions against each other, that is, Halberstadt's (1986) postulated 4-scale version and the 2- and 3-scale solutions as applied in research, and determined the model fit by means of confirmatory factor analysis (CFA) with the first half of the sample (n = 325). After elimination of items with insufficient loadings, we conducted a CFA with the second half of the sample to assess the final model fit. In Study 2, the construct validity was considered in an independent sample of N = 225 participants. For this purpose, the FEQ-GR was correlated with questionnaires assessing nonverbal emotional expressiveness, parents' adaptive emotional expressiveness, and parental rearing behavior as constructs being somewhat related with family expressiveness. However, shyness was classified as construct being distinct to family expressiveness.

Study 1

Methods

Translation Process and Adaptions

First, the FEQ (Halberstadt, 1983, 1986) was translated into German by a bilingual person and back-translated by another bilingual person. Any discrepancies between the original and back-translated versions were discussed with a psychologist as well as with the two bilingual persons and if necessary revised. Unlike the English original, we established an absolute zero of the response scale to allow participants that a scenario did not occur in their families, resulting in the anchors *not at all* (German: *überhaupt nicht*) and *very frequently* (German: *sehr häufig*) for the 9-point Likert scale, in contrast to the anchors *not at all frequently* and *very frequently* of the original version.

Furthermore, two items were deleted previously to analyses: First, Item 19 ("Expressing sorrow when a pet dies") was dropped as this statement does not account to every individual. Second, Item 28 ("Expressing concern for the success of family members") was deleted due to difficulties in a consistent German translation of *concern* regarding a more positive or negative connotation.

Participants and Procedure

The online survey comprised sociodemographic information, such as age, gender, and highest level of education, and the German translation of the FEQ. Thereby, participants have to estimate how often given expressive scenarios occurred within their family while growing up. The FEQ is described in detail in the Introduction section (for the final German version, see ESM 1). Following the scenarios, we added one control item, asking the participants to click the answering option on the very right when reading this statement, to ensure attendance to the questions while filling out. Participants who did not follow this instruction were excluded from further analyses. In the end, participants were asked whom they were thinking of when answering the FEQ to control for a correct understanding of the instruction as well as to account for the many family constellations that exist during growing up. Answering options were mother, father, siblings, grandmother, grandfather, aunt, uncle, cousin, and others (i.e., persons not mentioned before). Participants were excluded from further analyses if they referred the statements of the questionnaire not to their family of origin but their current family only (e.g., my children or my partner). Underage participants (<18 years) were also excluded from analyses. Participants were recruited via social networks and a mailing list from the local university. The procedure was in accordance with the 1964 Declaration of Helsinki and its later amendments. Participants were informed about the study and anonymous data collection on the first page; by confirming this page, they agreed in participation and saving of their data. They were reimbursed with course credits and could participate on a raffle of one 50 € coupon.

The online survey was opened 1,166 times, of whom n = 687 completed the questionnaire and remained within further analyses. Of these, n = 37 cases had to be excluded due to being underage (n = 1), because they related the FEQ to their current family only (n = 1; "my own children"), did not specify any person (n = 2; "nobody in particular and general"), or did not answer the control item correctly (n = 33). So, the final sample consisted of n = 650 participants (n = 504 females [77.54%], n = 142 males [21.84%], n = 4 other like nonbinary [0.62%]) who were between 18 and 62 years (M = 26.28 years, SD = 7.74 years). Most of the participants (n = 381) had the German Abitur, a German school leaving examination qualifying for university entrance, or a similar qualification, followed by an university degree (n = 256), while only n = 12 participants had a lower graduation or no graduation so far (n = 1).

Data Analyses

With respect to the required sample size for the intended calculations, recommendations of the necessary size vary, whereby a minimum size of 200 participants is advisable for structural equation modeling (Kline, 2005; Worthington & Whittaker, 2006). This also fits with the Bentler and Chou's (1987) guideline of a ratio of at least 5:1 of participants to number of parameters, that is, 200 for our purposes.

Descriptive statistics were performed with SPSS 26 (IBM Corporation, Armonk, NY, USA). All remaining analyses were computed with R version 4.0.4 (R Core Team, 2019) using the R packages psych version 2.90.12 (Revelle, 2019) and MBESS version 4.8.0 (Kelley, 2007). Model comparisons and CFAs were performed with the R packages nonnest2 (version 0.5–5), lavaan (version 0.6–6), and semTools (version 0.5–3). The sample (N = 650) was randomly split into two halves, whereby both samples did not significantly differ according to their age, level of education, and relationship status. Using the Vuong test (Vuong, 1989), we planned to compare the CFAs of the 2- and 3-scale versions, as well as Halberstadt's postulated 4-scale version against each other within the first subsample (Subsample 1). Thereby, the item assignment to the respective scales followed the categorization of Halberstadt (1986). Then, a CFA was conducted for the model that best fitted the data to identify candidate items for exclusion within Subsample 1: As to our knowledge only rules of thumb criteria exist for item removal, we relied on the recommendations of Worthington and Whittaker (2006) and dropped items with a standardized loading $\lambda < .32$. CFAs were conducted with maximum likelihood estimation with robust (Huber–White) standard errors and a scaled test statistic equal to Yuan–Bentler test statistic (Raykov, 2012) because Li (2016) demonstrated this estimator to be superior to other estimators when using more than eight answer categories. Furthermore, the Steiger–Lind RMSEA and the Bentler Comparative Fit Index (CFI) were calculated with CIs in their robust version (Savalei, 2018). For interpretation of the fit indices, we followed Hooper et al. (2008) who suggested the following cutoff scores: The standardized root mean square residual (SRMR) should be < .08, RMSEA < .10, and CFI > .95 (note that it was recommended by some authors [e.g., Hopwood & Donnellan, 2010; Kelley & Pornprasertmanit, 2016; Swami & Barron, 2019] to acknowledge that these values should not be interpreted rigidly).

To cross-validate our retained results, we repeated the CFA with the second half of the sample (Subsample 2). Finally, item analyses and reliability estimators (hierarchical omegas Ω_H; Kelley & Pornprasertmanit, 2016) were calculated.

Results

For the 4-scale solution, the covariance matrix of the latent variables was not positive definite and the 2 positive scales showed a correlation of 1.02, which is why this version had to be rejected. Thus, only the three- and two-factor solutions were compared against each other. The variance test indicated that both models were distinguishable ($w2$ = 2.668, $p \leq .001$). The non-nested likelihood ratio test indicated that the three-factor model significantly outperformed the two-factor model according to its fit ($z = -3.758$, $p \leq .001$).

The fit indices of the 3-scale CFA from Subsample 1 did not meet our set threshold but were close to them, SRMR = .134, robust RMSEA = .088, and robust CFI = .739 (see Table 1). Due to insufficient loadings, two items had to be dropped (see Table 2), that is, Item 13 belonging to the P scale and Item 29 belonging to NS scale. For the ND scale, one item, that is, Item 37, showed a loading of $\lambda = .31$, which was very close to the threshold of $\lambda < .32$. As the content of the item was clearly negative and item deletion only based on cutoffs is not recommended (e.g., Ziegler, 2014), the item remained within the questionnaire. Then, the CFA was repeated within Subsample 2.

Fit indices retained from Subsample 2 did only marginally improve compared to Subsample 1 and were again close to the set thresholds, SRMR = .124, robust RMSEA = .083, and robust CFI = .786 (see Table 1). The Ω_H of Subsample 2 were acceptable to excellent (Ω_H(P) = .947, Ω_H(ND) = .852, Ω_H(NS) = .752). The results of the CFA resulting from the 2-scale solution are reported in Table 2. Thereby, six items showed a considerably smaller loading than $\lambda < .32$, and one item (Item 37) was close to this threshold.

All remaining items within the 3-scale solution revealed corrected item–score correlations greater than r_{it} = .29 (see Table in ESM 2). The resulting 3 scales were related as follows within Subsample 2: P was negatively correlated with ND ($r = -.41$) and weakly positively with NS (r = .29), and the negative factors showed a positive correlation of r = .40 (all $p \leq .001$).

Study 2

Methods

Participants and Procedure

The procedure of data acquisition and exclusion criteria of the second online survey followed Study 1. Participants received course credits and could participate on a raffle of one out of five 10€ coupons. The online survey was opened 518 times and completed from n = 228 participants. Three participants had to be excluded from further analyses because they did not correctly answer all of the four control items of the survey (see Study 1). This resulted in a final sample of n = 225 participants (n = 189 females [84.0%], n = 36 males [16.0%]) who were between 18 and 60 years (M = 24.28 years, SD = 7.74 years). Most of the participants (n = 191) had the German Abitur or a similar

Table 1. Model fit indices of the CFAs, hierarchical omegas (Ω_H) and alphas (α) for the scales positive and negative (two-factor solution) as well as negative-dominant and negative-submissive family expressiveness (three-factor solution)

	Two-scale solution (P, N)		Three-scale solution[a] (P, ND, NS)					
	Subsample 1[b]		Subsample 1[b]			Subsample 2		
SRMR	.138		.134			.124		
Robust RMSEA	.093		.088			.083		
Robust CFI	.706		.739			.786		
	P	N	P	ND	NS	P	ND	NS
Ω_H [95% CI][c]	.934 [.921, .948]	.696 [.659, .799]	.936 [.921, .948]	.855 [.837, .885]	.712 [.564, .728]	.947 [.938, .956]	.852 [.836, .886]	.752 [.564, .728]
α	.937	.832	.937	.858	.703	.947	.862	.728
No. of items to be deleted	1	5	1	—	1	—	—	—

Note. N = negative expressiveness; ND = negative-dominant family expressiveness; NS = negative-submissive family expressiveness; P = positive family expressiveness. [a]Three-scale solution was significantly better compared to 2-scale solution when all items were included. [b]Coefficients retrieved from Subsample 1 include items with poor loadings. [c]Confidence intervals (CI) were determined by bootstrapping via the R package MBESS version 4.8.0 (Kelley, 2007)

qualification, followed by university degree (n = 32); only n = 2 participants had a secondary education.

Measures and Hypotheses on Validity

Besides sociodemographic questions and the German translation of the FEQ, questionnaires were conducted that aimed to assess convergent and divergent aspects of family expressiveness. Questionnaires targeting more convergent aspects measured one's own nonverbal expressiveness, the adaptive expressiveness of one's parents that should be a part of family expressiveness as well as parental rearing behavior; in particular, the subscale emotional warmth should be moderately to highly associated with the positive subscale of the FEQ-GR, as both constructs show an overlap. However, shyness was assessed to target a divergent facet of family expressiveness. Cronbach's α values of all measures are reported in Table 3.

Affective Communication Test

The German version of the Affective Communication Test (ACT; Traue, 1998) comprises 13 items and is answered on a 9-point Likert scale ranging from −4 (*not at all true of me*) to +4 (*very true of me*). It is a valid and reliable instrument to measure one's own nonverbal emotional expressiveness, also called charisma (Friedman et al., 1980).

Subscale Emotional Expressivity of the Emotional Competence Questionnaire

The Emotional Competence Questionnaire (EKF; Rindermann, 2009) measures emotional competence by 6 subscales, of which only the scale concerning emotional expressiveness was used in the current study. This subscale of the EKF explicitly measures the adaptive expression of emotions and comprises 17 items. The word anchors were coded from 1 (not true at all) to 5 (completely true). In the version, in which external ratings were required, the person completing the questionnaire had to refer the statements to a specific person. In our study, participants related the items of this subscale to their mother and father separately.

Questionnaire of Recalled Parental Rearing Behavior

The Questionnaire of Recalled Parental Rearing Behavior (QRPRB; Schumacher et al., 1999) assesses remembered parental rearing behavior separately for fathers and mothers. It possesses 3 scales, namely (1) rejection and punishment (2) emotional warmth, and (3) control and overprotection. Each scale contains eight items ranging from 1 (*no, never*) to 4 (*yes, always*).

Shyness Scale

The German version of the Shyness Scale (Cheek & Buss, 1981; Czeschlik & Nuerk, 1995) consists of eight items to measure shyness. Items are answered on a 5-point Likert scale covering options from 1 (*applies almost never*) to 5 (*applies almost always*).

Short Scale Social Desirability-Gamma

The short scale Social Desirability-Gamma (KSE-G; Kemper et al., 2012) captures the gamma factor of social desirability, which describes a moral bias where unwanted behavior is denied and "saint-like attributes" are claimed (Paulhus, 2002, p. 64). It is divided into the exaggeration of positive qualities (PQ+) and the minimization of negative qualities (NQ−). The KSE-G meets the GESIS recommendation (Bogner & Landrock, 2015) to control for response biases in standardized surveys. Halberstadt (1983) emphasizes the importance of examining possible

Table 2. Standardized loadings of the two- and three-factor solutions resulting from CFA in subsample 1

	Two-factor solution	Three-factor solution
Item number and content	Positive family expressiveness	Positive family expressiveness
22. Showing sympathy	.859	.860
23. Showing deep affection or love	.795	.797
33. Comforting someone	.785	.787
38. Showing gratitude	.777	.775
40. Saying "Sorry"	.763	.761
35. Expressing happiness	.745	.744
18. Admiration	.731	.730
06. Praising for work	.728	.726
21. Paying compliments about their look	.712	.713
02. Thanking family members	.709	.705
30. Offering a favor	.684	.683
26. Hugging	.680	.682
03. Expressing joy over a nice day	.683	.680
39. Surprising someone with a gift	.674	.674
31. Cuddling up to someone	.659	.662
01. Forgiving someone	.602	.602
17. Expressing excitement	.547	.550
16. Expressing exhilaration	.386	.389
13. Seeking approval	**.098**	**.108**
	Negative family expressiveness	Negative-dominant family expressiveness
09. Accusing each other	.740	.737
11. Putting someone down	.719	.729
36. Threatening somebody	.710	.722
04. Showing contempt	.688	.700
12. Showing dislike	.663	.684
05. Expressing dissatisfaction	.600	.605
27. Expressing current anger	.600	.581
24. Arguing	.586	.568
07. Showing anger about carelessness	.506	.497
37. Criticizing for lateness	.302	.310
		Negative-submissive family expressiveness
10. Crying after disagreement	.412	.748
32. Crying for being punished	.421	.594
15. Breaking apart with increasing tension	.463	.552
08. Sulking over unfair treatment	.592	.486
20. Expressing disappointment	**.098**	.452
25. Crying goodbye	**.010**	.432
14. Expressing embarrassment	**.063**	.404
34. Telling when being hurt	−**.053**	.358
29. Apologizing for lateness	−**.199**	**.117**

Note. The content of the items is represented, not their literal statement. For the original formulation of the items and item assignment to scales, see Halberstadt (1986). For the three-factor solution, the negative scale of the two-factor solution was split into negative-dominant and negative-submissive, while the positive scale remained undivided. Dropped items due to insufficient loadings are presented in bold type.

Table 3. Descriptive statistics for the conducted questionnaires

Construct (instrument)	*N*	*M (SD)*	Cronbach's α
Family expressiveness (FEQ-GR)			
Positive expressiveness	225	6.12 (1.45)	.95
Negative-dominant expressiveness	225	4.42 (1.41)	.86
Negative-submissive expressiveness	225	4.63 (1.17)	.70
Own nonverbal expressivity (ACT)	225	65.72 (15.27)	.78
Emotional expressiveness (EKF)			
Mother	220	3.33 (0.85)	.95
Father	205	2.57 (0.84)	.95
Remembered parental rearing behavior (QRPRB)			
Rejection and punishment			
Mother	223	9.92 (2.90)	.86
Father	215	10.13 (3.15)	.86
Emotional warmth			
Mother	223	25.58 (5.07)	.91
Father	215	22.58 (6.14)	.92
Control and overprotection			
Mother	223	14.15 (4.08)	.75
Father	215	12.75 (3.41)	.75
Shyness scale	225	2.45 (0.79)	.85
Social desirability (KSE-G)			
Exaggeration of positive qualities (PQ+)	225	3.49 (0.58)	.44
Minimization of negative qualities (NQ−)	225	2.15 (0.71)	.50

Note. ACT = German version of the Affective Communication Test; EKF = Emotional Competence Questionnaire; FEQ-GR = German version of the Family Expressiveness Questionnaire; KSE-G = short scale of social desirability; NQ− = subscale minimization of negative qualities of the KSE-G; PQ+ = subscale exaggeration of positive qualities of the KSE-G; QRPRB = German version of the Questionnaire of Recalled Parental Rearing Behavior.

influences of social desirability as participants "might try to portray their families in whatever manner they predicted the experimenter preferred" (Halberstadt, 1983, p. 22).

Data Analyses

Statistical analyses were implemented using SPSS 26 (IBM Corporation, Armonk, NY, USA). We calculated Pearson's *r* to investigate the validation of the FEQ-GR; all correlations are reported two-tailed. Participants were allowed to skip the EKF and the QRPRB if it did not apply for them (e.g., if a parent does not live anymore). Therefore, the sample sizes varied slightly for these instruments (see Table 3).

Results

Scale Statistics

Descriptive statistics for all scales are reported in Table 3. Cronbach's α for the positive expressiveness scale (P) was α = .95, α = .86 for ND expressiveness, and α = .70 for the NS scale, which fits with the results of Study 1. Except from the KSE-G scales, the internal consistencies of the other scales were acceptable to excellent.

Construct Validity

The P and ND subscales of the FEQ-GR showed a medium negative correlation of $r = -.44$ ($p < .001$), the P and the NS subscales showed a weak positive association ($r = .223$, $p < .001$), and the two negative scales showed a medium positive correlation ($r = .40$, $p < .001$). Table 4 shows the correlations among the FEQ-GR subscales and the other questionnaires. As expected, the subscale P of the FEQ-GR showed a medium-sized positive association with the ACT, which measures one's own nonverbal expressiveness. The negative subscales of the FEQ-GR showed, unlike expected, no substantial correlation. The subscale emotional expressiveness of the EKF was positively related to the P scale of the FEQ-GR for mothers and fathers, as hypothesized. Unlike expected, the ND scale of the FEQ-GR was only weakly related for mothers and fathers and the negative-submissive (NS) scale showed a weak association

Table 4. Pearson's correlations of the questionnaires with the scores of the subscales of the FEQ-GR

	Subscales		
Construct (instrument)	Positive expressiveness	Negative-dominant expressiveness	Negative-submissive expressiveness
Family expressiveness (FEQ-GR)			
Negative-dominant expressiveness	−.439**		
Negative-submissive expressiveness	.223**	.395**	
Own nonverbal expressivity (ACT)	.317**	−.051	.118
Emotional expressiveness (EKF)			
Mother	.435**	−.183**	.180**
Father	.328**	−.137*	.097
Remembered parental rearing behavior (QRPRB)			
Rejection and punishment			
Mother	−.339**	.469**	.208**
Father	−.456**	.475**	.127
Emotional warmth			
Mother	.689**	−.506**	.044
Father	.677**	−.420**	.099
Control and overprotection			
Mother	−.237**	.309**	.118
Father	−.142*	.324**	.149*
Shyness scale	−.273**	.184**	.093
Social desirability (KSE-G)			
Exaggeration of positive qualities (PQ+)	.105	−.142*	−.118
Minimization of negative qualities (NQ−)	−.135*	.139*	−.092

Note. ACT = German version of the Affective Communication Test; EKF = Emotional Competence Questionnaire; FEQ-GR = German version of the Family Expressiveness Questionnaire; KSE-G = short scale of social desirability, NQ− = subscale of the KSE-G minimization of negative qualities; PQ+ = subscale of the KSE-G exaggeration of positive qualities; QRPRB = German version of the Questionnaire of Recalled Parental Rearing Behavior.
*$p < .05$, two-tailed.
**$p < .01$, two-tailed.

with the EKF for mothers. The correlation pattern for the P scale of the FEQ-GR was as expected, that is, we found a high positive association with parental emotional warmth and a moderate negative association with rejection and punishment as well as a small correlation with control and overprotection. The ND subscale revealed, as expected, the reverse pattern, that is, ND showed a medium-sized positive association with rejection and punishment as well as with control and overprotection, while ND was negatively related with emotional warmth. The NS scale was only weakly related with the subscales rejection and punishment for mothers and control and overprotection for fathers. It was not related with emotional warmth neither for mothers nor for fathers. The Shyness scale was weakly negatively correlated with P and positively with ND, but not with NS. For the KSE-G, that assesses social desirability, the ND scale of the KSE-G was weakly related with both the PQ+ and NQ− scales. The P scale of the FEQ-GR was weakly and negatively related with NQ− with the KSE-G, while the NS scale was not related with the KSE-G.

Discussion

The purpose of this study was to develop a German version of the FEQ (Halberstadt, 1983, 1986), the FEQ-GR. While Halberstadt (1986) originally hypothesized 4 scales, which arose from the valence dimension (positive and negative) crossed by the power dimension (dominant and submissive), it is common practice to assess only 2 scales, namely the valence subscales positive and negative family expressiveness (Clark & Phares, 2016; Gao & Han, 2016; Halberstadt et al., 1993, 2011). Some researchers also administered the FEQ in a 3-scale solution, whereby the negative subscale was split into dominant and submissive expressiveness while the positive subscale remained undivided (e.g., Baker & Crnic, 2005; Eisenberg et al., 1992; Jones et al., 1998). Therefore, we decided to compare these three solutions and to examine the best solution by means of CFAs (Study 1) and addressed the question of validity in a second independent sample (Study 2).

Two items were deleted previously to analyses: first, Item 19 (["Expressing sorrow when a pet dies."] originally

belonging to the NS scale) because the item content does not apply to everyone filling out the questionnaire, and second, Item 28 (["Expressing concern for the success of other family members."] originally belonging to the PD scale) due to a negative connotation of the German translation, which seems not be given in the English original version.

The results of our study suggested that the 4-scale solution as theoretically postulated by Halberstadt (1986) did not show a sufficient solution and had therefore been rejected. Thereby, the covariance matrix of the latent variables was not positive definite, and the two positive scales were highly positively related. This is in line with Eisenberg et al. (1992) who found a positive correlation of .82 ($p \leq .001$) between PS and PD. The model comparison indicated the three-factor model to be superior to the two-factor model. Following CFA for the 3-scale solution within Subsample 1, two items with an insufficient loading were removed and model fit indices were again calculated within Subsample 2 to cross-validate our findings. For the P scale, Item 13 ("Seeking approval for an action") had to be removed, resulting in a final number of 18 items for the P scale. Considering the SEFQ, in which one's own contribution to the expressivity within the family is assessed, Item 13 loaded onto the negative factor (Halberstadt et al., 1995). So, despite representing positive affect, it seems to possess a negative connotation explaining the poor loading in our sample. For the ND scale, the loading of Item 37 ("Criticizing someone for being late") was only slightly below the set threshold. We decided to keep the item within the questionnaire, as the content clearly belongs to the negative scale and it is not recommended to delete items purely based on the cutoff criteria (e.g., Ziegler, 2014). This close insufficient result might further be an effect only found in our sample. Moreover, by keeping the item we intended to maximize the comparability between the German and the English versions. So, the final ND scale remained unchanged and comprises 10 items. The final NS scale consists of eight items whereby only Item 29 ("Apologizing for being late") was deleted following the CFA within Subsample 1. This item also loaded onto the positive factor in the study examining the SEFQ (Halberstadt et al., 1995) suggesting once more a different connotation. Additionally, the original assignment of items expressing ways of apologizing might not have been stringent: While Item 29 belongs to the NS scale, Item 40 ("Saying 'I'm sorry' when one realizes one was wrong") to the positive-submissive scale. In both scenarios, admitting and apologizing for (small) mistakes leads more likely to positive emotions at the receiver, for example, feeling less negative emotions such as anger (e.g., Ebesu Hubbard et al., 2013). Furthermore, this behavior, when meant sincerely, might even contribute to a deeper feeling of understanding each other (e.g., Ebesu Hubbard et al., 2013; Maio et al., 2008). This change in feelings and closeness might affect the judgment of the given scenario in a less negative way and might explain why the item does not show a strong loading on the NS scale. In all, not only the model comparison but also the number of items that had to be dropped due to insufficient loadings, that is, two for the 3-scale version versus six for the 2-scale version, supported that the three-factor solution best represented the structure of the data. The values of the fit indices retained from the CFA of Subsample 2 were close to the set thresholds. These subthreshold results should not be interpreted too rigidly and are also a common finding even in well-established (personality) questionnaires (e.g., Hopwood & Donnellan, 2010; Kelley & Pornprasertmanit, 2016; Ribbat et al., 2021; Swami & Barron, 2019).

Despite cultural differences and a drift of meaning over time, the resulting subscales of the FEQ-GR revealed a contentual coherence with the FEQ, which is why the authors assume that a sufficiently high comparability to the English version is given. Furthermore, the reliability estimates for all 3 scales were in an acceptable to excellent range (George & Mallery, 2016) in Study 1 and Study 2 and were in a similar range than those reported in the literature when conducting the FEQ in a 3-scale solution (e.g., Baker & Crnic, 2005).

Due to different item numbers of the subscales, we advise to report the scores calculated as means of the item responses rather than the sum scores. It is noteworthy that we established an absolute zero (*not at all* instead of *not at all frequently*) to allow participants to indicate that a given scenario did not occur in their family while growing up; this modification might result in slightly different levels of expressiveness when comparing mean values of the English and the German questionnaire.

The added question of whom participants were thinking of when answering the questionnaire showed that participants thought of many different persons. In Study 1, unlike expected, one participant mentioned their current family only and another two participants could not specify any person indicating that they did not follow the given instruction. To ensure quality standards, we recommend implementing this question as a standard control question.

For investigating convergent and discriminant validity of the FEQ-GR scales, the association of the FEQ-GR with several questionnaires assessing different components of expressiveness, such as one's own nonverbal expressiveness or adaptive positive expressiveness of one's parents as well as with shyness, remembered parental rearing behavior, and social desirability were investigated in Study 2. Convergent validity should be supported by a medium to high positive relation between P of the FEQ-GR and emotional warmth, as these constructs show a contentual

overlap. In line with that, especially the ND scale, dominated by behaviors such as accusations, contempt or disputes, should be positively associated with rejection and punishment and to a smaller degree with control and overprotection. Own shyness, on the other hand, should be related to a lesser extent to family expressiveness, which would support discriminant validity. Our result revealed the assumed pattern with regard to the remembered parental rearing behavior, measured by the QRPRB. The P scale of the FEQ-GR and parental warmth showed a high positive correlation. This also fits with the literature examining actual influences of parental family expressiveness and emotional warmth (e.g., Smith et al., 2007; Speidel et al., 2020; Zhou et al., 2002). Zhou et al. (2002), for example, reported that parental positive expressivity mediated the association between parental warmth and children's empathy. Thereby, parental positive expressivity was positively related to parental warmth (Zhou et al., 2002). Similarly, we found a medium-sized correlation of parental adaptive expression and the P scale of the FEQ-GR. This underlines that in a family environment in which a higher level of positive expressiveness is shown, parents foster a healthier way in dealing with their feelings. Suveg et al. (2005), for example, showed that in an emotion interaction task, mothers of children with no actual mental disorder (compared to children suffering from an anxiety disorder) used more positive emotion words, encouraged their child more often, and fostered more emotional expressiveness in their families. In line with this, we found a negative medium-sized relation of P with rejection and punishment. As assumed, the ND scale of the FEQ-GR was positively related with punishment and rejection and to a lesser extent with control and overprotection. This fits well with the literature on child maltreatment, showing that maltreating parents (compared to nonmaltreating parents) demonstrated higher levels of negative affect, which was associated with an increase of conflict and stress, but also with lower levels of positivity (Cicchetti & Valentino, 2016; Wilson et al., 2008). Moreover, in their study, Baker and Crnic (2005) showed that the mothers' experienced level of ND expressiveness in their family of origin even influenced their today's son–child interaction; thereby, higher levels of ND were related with a poorer emotional support during son–mother interactions (Baker & Crnic, 2005). Participants who reported that maternal rejection and punishment as well as fatherly control and overprotection occurred more frequently also experienced more often the expressions of emotions such as disappointment and sadness while growing up, as measured with the NS scale, indicated by a weak positive relation between the respective scales of the QRPRB.

We also found a medium-sized association between one's own nonverbal expressivity, measured by the ACT, and P. The items of the ACT to a high extent represent positive emotions, which is why there might only be a relation to the P scale, but not the NS and ND scales. Furthermore, this is in line with Halberstadt (1986) who reported a moderate correlation of nonverbal self-expressiveness and the FEQ. One's own reported shyness was only very weakly positively associated with ND, not with NS and negatively with P, indicating family expressiveness to be perceived as a distinct construct from shyness. This fits with the finding that parents from nonsocially anxious and socially anxious children, whereby social anxiety could be considered a heightened form of shyness (Renneberg & Ströhle, 2006), did not differ in their perception of child-rearing styles and family environment (Caster et al., 1999).

Social desirability, assessed by the KSE-G, was only very weakly associated with some of the FEQ-GR subscales. This might indicate that our participants did not try to present themselves in a more socially desirable way when responding the questions. But these results should be treated with caution as NQ– and PQ+ showed only very low consistencies within our sample and research has demonstrated an overlap between social desirability and personality test scores (Bensch et al., 2019).

Some limitations of the current studies need to be mentioned: Samples of both studies comprised a high proportion of women (78% and 84%, respectively), which might have biased the results. When the individual contribution of actual parental family expressiveness was assessed, mothers (compared to fathers) reported to show positive expressiveness more often and fathers (compared to mothers) to show negative expressiveness more often (Halberstadt et al., 1995). This effect could possibly be traced back to valence, as females compared to males report to be more expressive, showing more positive and internalizing emotions (e.g., sadness or sympathy) while males report to show more externalizing emotions (e.g., anger; Chaplin & Aldao, 2013; Simon & Nath, 2004).

Despite a high age range (18–60 years), the mean age of 26 and 24 years, respectively, was rather low, which might limit the scope of application of the observed results. A further limitation of our study was the high educational status within both samples that is related to a higher socioeconomic status, which in turn might influence parental rearing behavior and thus family expressiveness (e.g., Chen & Berdan, 2006; Hoff et al., 2002; Hosokawa & Katsura, 2017).

In addition to these issues, future studies should investigate the test–retest reliability of the FEQ-GR to further demonstrate the stability of the construct.

In conclusion, the FEQ-GR can be considered as a valid and reliable instrument for measuring family expressiveness. In accordance with some studies, three facets,

namely positive, negative-dominant, and negative-submissive expressiveness, have been identified, which showed acceptable to excellent internal consistencies and sufficient convergent and divergent validity.

Electronic Supplementary Material

The electronic supplementary material is available with the online version of the article at https://doi.org/10.1027/2698-1866/a000015

ESM 1. FEQ-GR final version

ESM 2. Table with item parameters of the FEQ-GR from Subsample 2

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History
Received January 4, 2021
Revision received August 10, 2021
Accepted August 11, 2021
Published online November 23, 2021

Acknowledgments
We would like to thank Prof. Dr. A. Halberstadt for her permission to translate the FEQ into German as well as for her friendly and quick answers to any questions. We also would like to thank Dr. S. Kagerer, J. Hill, and R. Hill for support in the translation process.

Conflict of Interest
The authors declare that they have no conflict of interest to disclose.

Open Data
Data, codes, and outputs can be found at https://doi.org/10.22029/jlupub-11 (Zehtner et al., 2021).

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Cognitive, Affective, & Behavioral Neuroscience
https://doi.org/10.3758/s13415-023-01105-4

RESEARCH ARTICLE

Weathering the storm of emotions: immediate and lasting effects of reinterpretation and distancing on event-related potentials and their association with habitual use of cognitive reappraisal

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Accepted: 19 April 2023

Abstract

Reinterpretation and distancing, two cognitive reappraisal tactics, are known to effectively reduce negative feelings and event-related potentials (ERPs), such as the P300 and the late positive potential (LPP), in the short-term. Less is known about differential and lasting effects on ERPs as well as their association with habitual reappraisal. Fifty-seven participants were instructed to passively view or reappraise (reinterpretation, distancing) pictures that were repeatedly presented with the same instruction (active regulation phase). Thirty minutes later, these pictures were shown again without instruction for the assessment of lasting effects (re-exposure phase). ERPs were recorded and participants rated the intensity of negative feelings following picture presentation. Reappraisal led to an attenuation of the LPP, and both tactics decreased negative feelings during active regulation, whereby reinterpretation had a stronger impact on the subjective level. Passive re-exposure resulted in reduced negative feelings for previously reappraised pictures but had no lasting effects on ERPs. Higher habitual reappraisal was associated with higher P300 and early LPP amplitudes for emotional reactivity during the active regulation phase. During the re-exposure phase, higher habitual reappraisal was not related to ERPs. The current findings emphasize the effectiveness of both tactics in the short-term and lasting effects on the subjective experience of negative feelings. Enhanced emotional reactivity on the electrocortical level in individuals with a more frequent habitual use of reappraisal might indicate a higher preparedness to regulate.

Keywords Emotion regulation · Cognitive control · EEG · LPP · P300 · Negative feelings · Neural

Introduction

An adaptive and flexible use of emotion regulation strategies is crucial to well-being and social functioning in healthy (Brockman et al., 2017; Gross and John, 2003) as well as clinical populations (Berking et al., 2008; Kraiss et al., 2020; Sloan et al., 2017). Thereby, emotion regulation is a core element of transdiagnostic treatments of mental disorders (Sloan et al., 2017). Fears and cognitive distortions often are addressed by cognitive restructuring via cognitive reappraisal (Beck, 1976; Klumpp et al., 2014), which refers to cognitively construing a potentially emotion-eliciting situation in a way that alters its emotional impact (Gross and John, 2003). In this context, trainability and enduring effects of cognitive reappraisal as well as the association with habitual use of this strategy are of great importance.

For the immediate effect of emotion regulation during active regulation, a large body of research has shown cognitive reappraisal to be effective in reducing the experience of negative feelings (Webb et al., 2012) and in the modulation of neural response patterns to emotional stimuli as shown via electroencephalography (EEG) (for reviews see, Dennis and Hajcak, 2009; Hajcak and Foti, 2020; Hajcak et al., 2010; Olofsson et al., 2008). In the EEG, the P300 and late positive potential (LPP) have been demonstrated

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Published online: 25 May 2023

to be sensitive to arousal-related changes by cognitive reappraisal, leading to reduced amplitudes compared with passively watching aversive pictures (Hajcak and Foti, 2020; Hajcak et al., 2010; Hajcak and Nieuwenhuis, 2006; Krompinger et al., 2008; Qi et al., 2017; Thiruchselvam et al., 2011; Willroth and Hilimire, 2016). The P300 (being maximal approximately 300–600 ms after stimulus onset) indexes stimulus significance for motivationally salient stimuli (Hajcak and Foti, 2020; MacNamara et al., 2022), both being nonemotional (e.g., detecting targets; Gonsalvez et al., 2007) and emotional in nature (e.g., aversive compared with neutral pictures, often referred to as emotional reactivity; Hajcak et al., 2010; Weinberg et al., 2012). The LPP might resemble a sustained version of the P300, beginning approximately 400 ms after stimulus onset and lasting for several seconds, whereby it is associated with emotional meaning (Hajcak et al., 2010; MacNamara et al., 2022). Different reappraisal tactics, such as distancing and reinterpretation, have not always been examined distinctly (Cao et al., 2020; Moser et al., 2009; Moser et al., 2010; Thiruchselvam et al., 2011), although there seems to be a different pattern in timing and effectiveness (Qi et al., 2017; Willroth and Hilimire, 2016). While reinterpretation implies altering the meaning of a stimulus or situation (e.g., imagining a better ending of the depicted situation), distancing is defined as changing one's personal connection to or psychological distance from a stimulus or situation (e.g., taking the perspective of a detached observer) (Ochsner et al., 2012). Previous studies on event-related potentials (ERPs) show inconsistent results, with only reinterpretation (also compared with distancing) (Willroth and Hilimire, 2016) or both tactics (Qi et al., 2017) to reduce the LPP during active regulation.

Lasting effects of cognitive reappraisal on ERPs during passive re-exposure to previously reappraised pictures have only been investigated in a few studies. On a self-report level, reappraisal-related modulations are reported to last for shorter periods (such as 30 minutes; Qi et al., 2017; Thiruchselvam et al., 2011), over 1 day (Hermann et al., 2017) up to 1 week (Ahn et al., 2015 for men only; Denny and Ochsner, 2014; Hermann et al., 2021). For the EEG, Thiruchselvam et al. (2011) showed a lasting effect on LPP reduction of previously reappraised pictures (compared with previously passive watching) during re-exposure 30 minutes later. So far, only one ERP study differentiated between lasting effects of reinterpretation and distancing (Qi et al., 2017), indicating a reduced centroparietal LPP amplitude during passive re-exposure 30 minutes later, specifically for pictures previously distanced from (but not for reinterpretation). They further demonstrated a lasting effect of reinterpretation on the reported valence of the pictures and of distancing on arousal ratings (Qi et al., 2017).

In this context, individual differences in the habitual use of reappraisal have not been accounted for, which might impact the effectiveness of both tactics. Previous research has demonstrated habitual use of reappraisal to be associated with stronger reductions of the LPP amplitudes during both, passively watching aversive stimuli (Harrison and Chassy, 2019), as well as the implementation of reinterpretation (Moser et al., 2014). However, no studies to date examined the association of habitual use of cognitive reappraisal with emotional reactivity and immediate or lasting effects of the different reappraisal tactics reinterpretation and distancing.

Therefore, the goals of our study were to examine the association of habitual reappraisal with spontaneous responding to aversive compared to neutral pictures, i.e., emotional reactivity, as well as with immediate (active emotion regulation phase) and lasting effects (30 minutes later, re-exposure phase) of reinterpretation and distancing. We hypothesized that looking at aversive pictures (compared with neutral ones) should lead to a stronger experience of negative feelings and higher LPP amplitudes, whereby a greater habitual use of reappraisal should be related to less emotional reactivity during active regulation and re-exposure. Furthermore, we assumed that the implementation of both tactics should result in a decrease of negative feelings and LPP amplitudes (compared with passively looking at aversive pictures) during active regulation as well as during re-exposure, which also should be associated with a greater use of habitual cognitive reappraisal.

Methods and materials

Participants

This study is part of a larger project investigating emotion regulation in healthy participants as well as patients with emotional disorders. Seventy-six healthy participants volunteered in the current study, recruited via mailing lists and a participant database at the local university, as well as via public notice boards. A short telephone interview was conducted to screen for inclusion and exclusion criteria of the study and to set two appointments. On the first appointment, participants were screened with the Diagnostic Interview for mental disorders for DSM-5 (DIPS; Margraf, Cwik, Pflug, and Scheider, 2017a; Margraf, Cwik, Suppiger, and Schneider, 2017b) to ensure that participants did not meet the full criteria of any mental disorder currently as well as in the past. They further received questionnaires to complete until the next appointment on which the emotion regulation paradigm was conducted. The following criteria led to exclusion from the study: mental disorders (current or past), chronic or severe medical diseases or neurological disorders,

psychotropic drug intake, psychological treatment (current or past), scalp injuries, pregnancy, and left-handedness as assessed by the Edinburgh Inventory of Handedness (Oldfield, 1971). Participants had to be aged between 18 and 65 years, had normal or corrected-to-normal vision, and spoke German fluently. All participants were reimbursed with course credits or 8€/h and provided written, informed consent according to the guidelines of the ethical standards of the Declaration of Helsinki. The study was approved by the local ethical review board of the Faculty of Psychology and Sports Science at the Justus Liebig University Giessen, Germany.

In all, 19 screened participants had to be excluded. The reasons were as following: not appearing to the second appointment due to the pandemic condition or due to private reasons ($n = 5$), meeting criteria for a mental disorder ($n = 6$) or having received psychotherapy in the past ($n = 2$), technical problems during EEG recordings ($n = 2$), and excessive artifacts in the EEG ($n = 2$). Inspection of the reappraisal score of the ERQ indicated either the presence of outliers or data skewness. Therefore, further investigation based on the method described in Hubert and Vandervieren (2008) and implemented in the R (version 4.0.4, R Core Team, 2022) package univOutl (version 0.4; D'Orazio, 2022) were conducted. In short, the interval [Q1 – 1.5*IRQ, Q3 + 1.5*IRQ] (Q1 and Q3: first and third quartile, IRQ = interquartile range) commonly used for outlier detection is adapted according to the medcouple measure for skewness. This analysis revealed two outliers at the lower tail of the distribution. In addition, these two cases revealed a mean of the reappraisal score <1.5 (range: 1–7). Given that the sample should be mentally healthy and thus, more likely to apply reappraisal, their score seems not plausible and might point to inaccuracies in filling in the ERQ. Thus, we decided to exclude these two cases from analyses. Therefore, the final sample consisted of 57 participants ($n = 37$ (64.9%) women, $n = 20$ (35.1%) men, age: $M = 30.77$ years, $SD = 12.98$ years, range = 18–59 years, $Md = 25$ years; years of education: $M = 17.21$ years, SD = 4.28 years, range = 11.50–32.00 years, $Md = 16.00$ years, further sample characteristics are shown in Table 1).

Stimuli

The picture set for the emotion regulation paradigm comprised 16 aversive and eight neutral pictures. Aversive pictures depicted one or more people suffering and could be divided into four subcategories: homeless person, domestic violence, ill person in the hospital, and accident scene. Neutral pictures showed everyday scenes (e.g., a conversation). Pictures were taken from the International Affective Picture System (IAPS) (Lang et al., 1997) or from the Internet. The picture set was rated by an independent sample and used in previous studies (for details, see Hermann et al., 2017; Hermann et al., 2021). Pictures were rated regarding their valence and arousal on a 9-point Likert scale in an independent sample ($N = 36$; age: $M = 26.19$ years, $SD = 4.01$ years, range: 20–37 years; 41.7% women, 58.3% men). Aversive pictures were perceived as less pleasant ($M = 2.50$; $SD = 0.84$) and more arousing ($M = 5.13$; $SD = 1.58$) than neutral pictures (valence: $M = 5.58$, $SD = 0.77$; arousal: $M = 2.00$, $SD = 0.99$). Stimuli were presented on a full screen of a 27-inch monitor, which was distanced 45 inches from the participants.

Procedure

In the experimental session, the emotion regulation paradigm was conducted. First, the procedure of the session was described, and a 5-minute baseline measurement was conducted assessing EEG, electrodermal activity, heart rate, and respiration (data will be reported elsewhere). The regulation task followed, during which participants were instructed to look at the pictures (German: 'Betrachten') or were explicitly told to reduce their negative feelings via distancing (German: 'Distanzieren') or reinterpretation (German: 'Umdeuten'). For the 'look' condition, participants were told to simply watch the scene while permitting all upcoming feelings and thoughts without altering them. During distancing, participants should imagine that they were an objective/detached observer of the scene or that they do not know the person depicted on the picture. During reinterpretation, participants should imagine a concrete happy ending of the scene or that it is better than expected in order to reduce their negative feelings. Participants received a written instruction of the task and following, all strategies were trained face-to-face using a picture set independent from the one used in the regulation task. While implementing the strategy, participants should think aloud and the experimenter corrected them if the strategies were misapplied (e.g., imagining that the scene was a film clip as this imagination would not reduce negative feelings in their everyday personal live). Following this, a computer-based training of the experimental task was conducted to allow the participants to familiarize with the task. During this training session, 26 example trials were conducted with different pictures from the regulation task (8 trials/condition for aversive pictures so that each picture subcategory was presented two times; 2 trials for the look neutral condition). Afterwards, the experimenter checked the correct implementation of the tactics and clarified remaining questions.

The emotion regulation paradigm was adapted from previous studies (Hermann et al., 2017; Hermann et al., 2021), and the design was optimized for EEG data recording and analyses. It comprised two phases, which were the active emotion regulation and the re-exposure phase: The active

regulation phase consisted of 96 trials with 24 trials for each of the experimental conditions (reinterpretation, distancing, look aversive, look neutral). One picture of each of the four subcategories was used for each condition showing aversive pictures. Our goal was to be closer to training and therapy effects, which is why each picture was repeated six times to enhance consolidation into memory. This is indicated by previous literature, showing that repeated reappraisal of pictures (compared with applying reappraisal only once, to watching new control images and also to having repeatedly watched pictures as many times as in the repeated reappraisal condition) leads to a lasting attenuation of the amygdala response 1 week later when the stimuli were presented again (Denny et al., 2015). These results were discussed in terms of lasting changes in the neural representation of the emotional value of the respective stimuli (Denny et al., 2015).

The assignment of specific pictures of each subcategory to conditions was randomized across participants. The emotion regulation phase consisted of six blocks, whereby each block comprised each of the four conditions (16 trials). The conditions were pseudo-randomized so that the same condition was presented no more than twice in a row. Each picture was always paired with the same regulation instruction (six times in total). Each trial started with a jittered presentation of a white fixation cross centered on a black background, followed by an instruction word for 2 s, then by the picture for 6 s, and by a subjective rating of negative feelings lasting for a maximum of 4 s or until participants pressed the middle button on the rating box (seven-point Likert scale ranging from 1 = not at all to 7 = very strong). It ended with a fixation cross for 2 s. The total trial duration was 15 s.

During an approximately 30-minute break, participants completed questionnaires (e.g., movement and sports activity within the last month). They also gave post-hoc ratings for success and effort for the implementation of reinterpretation and distancing during the experimental task, respectively, as well as for the frequency and success of their daily use of both reappraisal tactics on nine-point Likert scales (results will be reported elsewhere).

Then, the re-exposure phase begun during which the 16 pictures from the active regulation phase as well as eight new pictures (4 neutral, 4 aversive) were presented, resulting in six conditions: previous look aversive, previous look neutral, previous reinterpretation, previous distancing, look new neutral, and look new aversive. Participants had not been informed that they would see the pictures from the regulation phase again and were instructed to simply attend to the pictures (they received no instruction word). The re-exposure phase consisted of 144 trials with 24 trials for each of the experimental condition and comprised six blocks (with 24 trials per block). The conditions were again pseudo-randomized so that the same condition was presented no more than twice in a row. During the re-exposure phase, stimuli were presented for 3 s each and participants again rated their negative feelings towards the stimuli (maximum of 4 s). The trials started (jittered) and ended with a white fixation cross on a black background. The total trial duration was 11 s.

Finally, participants completed a post-hoc paper-pencil awareness rating during which each picture was shown separately. They should indicate if they have seen the picture during the active regulation phase (yes or no), and if yes, with which strategy the pictures were presented before (during active regulation: look, reinterpretation, distancing, or I don't know). In case they stated that the picture was paired with reinterpretation or distancing, participants also should indicate whether they applied this strategy again during the re-exposure phase (yes, no).

Assessment of habitual use of cognitive reappraisal

The Emotion Regulation Questionnaire (ERQ, Gross and John, 2003; German version: Abler and Kessler, 2009) is a 10-item questionnaire capturing habitual use of cognitive reappraisal (6 items) and expressive suppression (4 items) of which only the reappraisal scale was used in our study. This subscale measures how emotions are habitually controlled by cognitively changing the meaning of a stimulus or situation so that the emotional impact is altered (e.g., "I control my emotions by changing the way I think about the situation I'm in."). Items are rated on a 7-point Likert scale from 1 (strongly disagree) to 7 (strongly agree). It demonstrated good psychometric properties (Gross and John, 2003). The reappraisal scale showed an internal consistency of Cronbach's $\alpha = 0.78$ in the current study.

Data recording and analyses

Continuous EEG was recorded from 32 Ag/AgCl scalp electrodes based on the 10/20 system (ANT Neuro, Hengelo, Netherlands), as well as two electrodes placed on the left and right mastoids. During recording, the CPz electrode served as online reference and AFz as ground electrode. Additionally, there was one facial electrode, which recorded the electro-oculogram (EOG) and was placed below the left eye. The recordings were sampled at 512 Hz and digitized with eego™ software (Version 1.8.2, eemagine Medical Imaging Solutions GmbH, Berlin, Germany). Impedance levels at all channels were kept below 5 kΩ. Offline, pre-processing was completed by using BrainVision Analyzer (BrainProducts, Gilching, Germany, Version 2.2.0.7383). EEG data were high-pass filtered at 0.02 Hz (order 2) and low-pass filtered at 30 Hz (order 4). For eye movement correction, an independent component analysis (ICA) was computed and EOG relevant ICs were identified by visual inspection and comparison to the EOG channel. Afterwards, a semiautomatic

data inspection was conducted, frames were marked as bad if the voltage step was >50 µV/ms, if the maximal allowed difference of values in intervals was >200 µV, or if the activity was <0.5 µV. The whole data set as well as marked intervals were manually checked and discarded if necessary. Data of each participant were only further analyzed if at least 12 remaining artifact-free trials per condition and phase (Moran et al., 2013) were available. Based on this criterion, data from one participant were excluded from analyses regarding the active emotion regulation phase and data from another participant regarding the re-exposure phase. The number of discarded trials did not differ between conditions for the active regulation phase ($F(3, 165) = 0.026$, $p = 0.994$), nor for the re-exposure phase ($F(3, 165) = 1.00$, $p = 0.396$). Then, the data were re-referenced to the average of the left and right mastoids and segmented into epochs beginning 200 ms before picture onset to 3,000 ms following picture presentation (and from 3,000 to 6,000 ms for the active emotion regulation phase for exploratory post-hoc analyses). Segments were baseline corrected using the average activity in the 200-ms time window preceding the picture onset. Separate averages were computed for each condition (active regulation phase: look aversive, look neutral, reinterpretation, distancing; re-exposure phase: previous look aversive, previous look neutral, previous reinterpretation, previous distancing, new look aversive, new look neutral). Magnitudes of the ERP components were exported via average amplitudes for time windows 300–500 ms (P300), 500–800 ms (early LPP), 800–1,400 ms (mid LPP) and 1,400–3,000 ms (late LPP) according to previous literature (DeCicco et al., 2012; Krompinger et al., 2008; Liu et al., 2019). As a few studies point to regulation effects extending the 3,000-ms time window (Qi et al., 2017; Thiruchselvam et al., 2011), we also run exploratory post-hoc analyses for the remaining 3,000–6,000-ms time window in the active regulation phase (Tables 2 and 3). Based on literature (Hua et al., 2015; Moser et al., 2014; Parvaz et al., 2012; Paul et al., 2013) and visual inspection, we quantified the LPP as the average signal amplitude collapsed across five electrodes within the posterior-parietal region (CPz, Pz, POz, O1, O2).

Statistical analyses

In their study, Qi et al. (2017) reported regulatory effects sizes of $d = 0.40$ or lager. Accordingly, a power analysis using G*Power software (Faul et al., 2007, 2009) revealed that a sample of at least 52 participants is required to detect an effect of $d = 0.40$ in a t-test for a dependent sample (two-tailed) with 80% power and an error probability of $\alpha = 0.05$.

All statistical analyses were conducted with IBM SPSS Statistics (version 28). Repeated-measures analysis of variance (ANOVA) with condition as a within-factor and the reappraisal score of the ERQ as a covariate (mean centered) were conducted separately for the (lasting) effects of emotional reactivity (conditions: (previous) look aversive, (previous) look neutral) and explicit regulation (conditions: (previous) look aversive, (previous) reinterpretation, (previous) distancing). All ANOVA results were Greenhouse-Geisser corrected if the assumption of sphericity was violated. A priori planned comparisons were performed via t-tests for dependent samples, and p-values were Bonferroni-Holm-corrected (bhc), i.e., (previous) look aversive vs. (previous) reinterpretation, (previous) look aversive vs. (previous) distancing, and (previous) distancing vs. (previous) reinterpretation. Conditions regarding new pictures within the re-exposure phase (i.e., look new neutral, look new aversive) were not analyzed for the purposes of this study. Effect sizes were presented by using partial eta-squared (η_p^2) for F-tests and Cohen's d for t-tests. When the interaction between condition and the reappraisal score of the ERQ was significant, correlational analyses followed using the difference scores (i.e., (lasting) emotional reactivity: (previous) look aversive minus (previous) look neutral; (lasting) explicit regulation: (previous) look aversive minus (previous) reinterpretation, (previous) look aversive minus (previous) distancing). All results are reported two-tailed at a significance level of $\alpha = 0.05$ and at a trend level of $\alpha = 0.10$.

Results

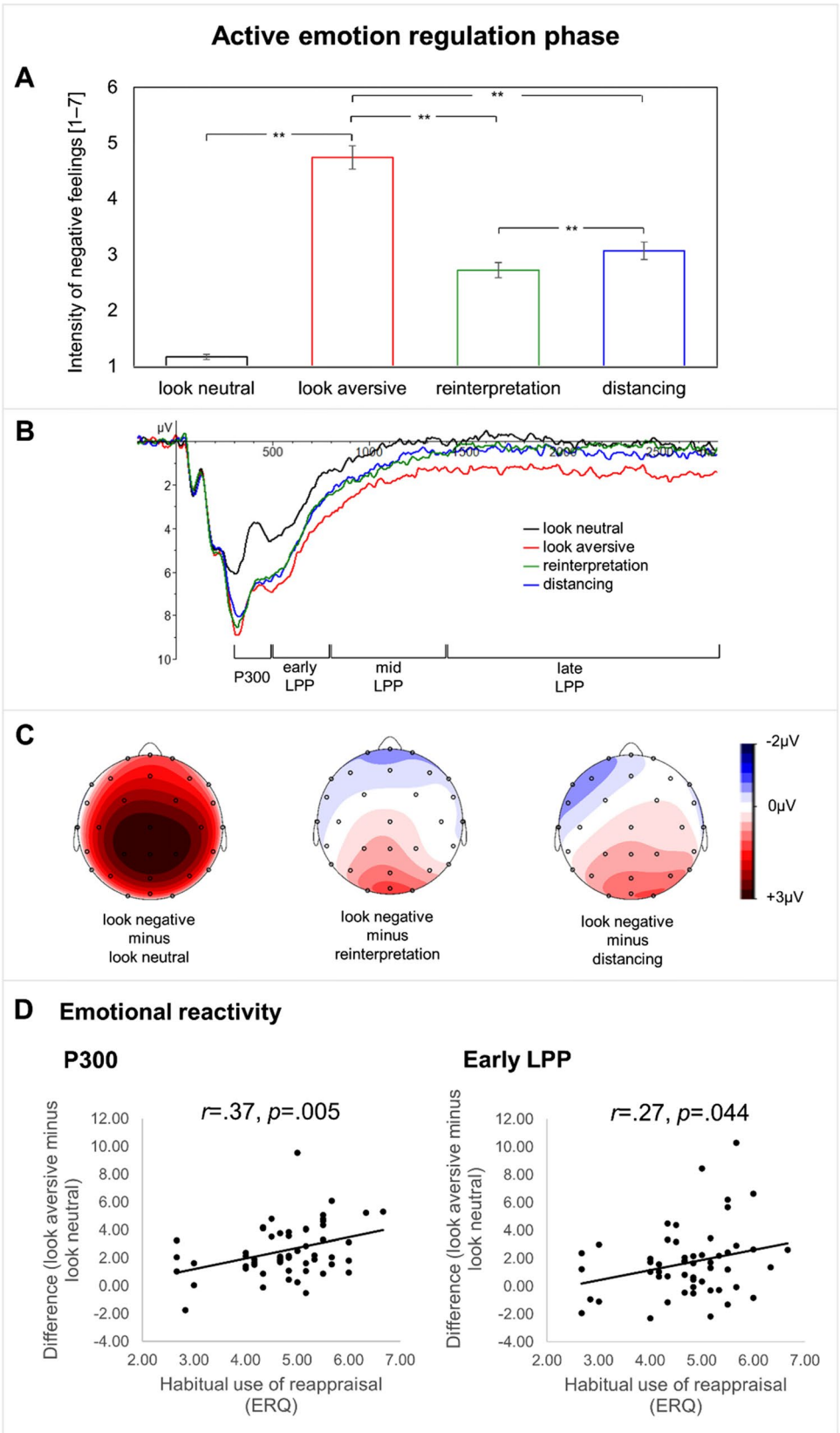
Main results

Active emotion regulation phase

Subjective rating of negative feelings

Emotional reactivity A significant main effect of condition for self-reported negative feelings was observed ($F(1, 54) = 291.11$, $p < 0.001$, $\eta_p^2 = 0.844$). The effect was not moderated by the habitual use of reappraisal (reappraisal score of the ERQ; see Table 2). The a priori planned t-test revealed that looking at negative pictures led to a higher experience of negative feelings ($M = 4.74$, $SD = 1.58$) compared with looking at neutral pictures ($M = 1.16$, $SD = 0.34$), $t = 17.21$, $p < 0.001$, $d = 2.30$.

Explicit emotion regulation A significant main effect of condition was given ($F(1.40, 75.66) = 91.93$, $p < 0.001$, $\eta_p^2 = 0.630$), which was not moderated by the habitual use of reappraisal (see Table 3). Planned t-tests showed that both cognitive reappraisal tactics significantly reduced negative feelings compared with passively looking at them (look aversive ($M = 4.74$, $SD = 1.58$) vs. reinterpretation ($M = 2.72$, $SD = 1.01$): $t = 11.11$, $p < 0.001$, $d = 1.48$; look aversive (M


Active emotion regulation phase
A
Intensity of negative feelings [1–7]
look neutral
look aversive
reinterpretation
distancing
**
B
μV
look neutral
look aversive
reinterpretation
distancing
P300
early LPP
mid LPP
late LPP
C
look negative minus look neutral
look negative minus reinterpretation
look negative minus distancing
-2μV
0μV
+3μV
D
Emotional reactivity
P300
r=.37, p=.005
Early LPP
r=.27, p=.044
Difference (look aversive minus look neutral)
Habitual use of reappraisal (ERQ)

◂**Fig. 1** **A**. Means of self-reported negative feelings during the active emotion regulation phase for each condition. Error bars depict standard errors of the means. **B.** Event-related potentials following picture presentation pooled at posterior-parietal sides (CPz, Pz, OPz, O1, O2) during the active emotion regulation phase. **C.** Topographical distribution of respective difference waves during 300–3,000 ms. **D.** Association between habitual reappraisal (measured by the ERQ) and the difference score of emotional reactivity (look aversive minus look neutral). $^{**}p < 0.001$

= 4.74, *SD* = 1.58) vs. distancing (*M* = 3.07, *SD* = 1.18): $t = 9.18$, $p < 0.001$, $d = 1.23$; Fig. 1A). Reinterpretation resulted in a significant stronger decrease of negative feelings compared with distancing (distancing vs. reinterpretation: $t = 3.77$, $p < 0.001$, $d = 0.50$).

ERP data

Emotional reactivity ERPs of the different conditions and difference maps are shown in Fig. 1B and C. Mean amplitudes at posterior-parietal sides revealed a significant main effect of condition for the P300 ($F(1, 54) = 114.93$, $p < 0.001$, $\eta_p^2 = 0.680$), the early LPP ($F(1, 54) = 28.97$, $p < 0.001$, $\eta_p^2 = 0.347$), the mid LPP ($F(1, 54) = 19.258$, $p < 0.001$, $\eta_p^2 = 0.263$), as well as for the late LPP ($F(1, 54) = 8.171$, $p = 0.006$, $\eta_p^2 = 0.131$). An explorative analysis demonstrated that the emotional reactivity lasted over the whole picture presentation (Table 2). The P300 and the early LPP were significantly moderated by the habitual use of reappraisal (P300: $F(1, 54) = 8.644$, $p = 0.005$, $\eta_p^2 = 0.138$; r(look aversive minus look neutral) = 0.37, $p = 0.005$; early LPP ($F(1, 54) = 4.25$, $p = 0.044$, $\eta_p^2 = 0.073$; r(look aversive minus look neutral) = 0.27, $p = 0.044$; Fig. 1D). Neither the mid, nor the late LPP showed a significant interaction effect (Table 2). A priori planned pairwise comparisons demonstrated that looking at aversive pictures elicited significantly larger ERPs than looking at neutral ones in all time windows (P300: look aversive (*M* = 7.31, *SD* = 3.46) vs. look neutral (*M* = 4.79, *SD* = 3.35), $t = 10.05$, $p < 0.001$, $d = 2.30$; early LPP: look aversive (*M* = 4.87, *SD* = 2.95) vs. look neutral (*M* = 3.17, *SD* = 2.70), $t = 5.23$, $p < 0.001$, $d = 0.70$; mid LPP: look aversive (*M* = 1.90, *SD* = 2.72) vs. look neutral (*M* = 0.56, *SD* = 2.54), $t = 4.40$, $p < 0.001$, $d = 0.59$; late LPP: look aversive (*M* = 1.38, *SD* = 3.74) vs. look neutral (*M* = 0.44, *SD* = 3.18), $t = 2.85$, $p = 0.006$, $d = 0.38$; and 3,000–6,000-ms time window; Table 2).

Explicit emotion regulation The amplitudes in the P3 did not significantly differ between the conditions look aversive, reinterpretation and distancing, and there was no moderation effect of the habitual use of reappraisal (measured by the ERQ; Table 3). However, a main effect of condition was given during the early LPP ($F(2,108) = 3.318$, $p = 0.040$, $\eta_p^2 = 0.058$), the mid LPP ($F(2,108) = 3.683$, $p = 0.028$, $\eta_p^2 = 0.064$), as well as the late LPP ($F(2,108) = 4.053$, $p = 0.020$, $\eta_p^2 = 0.070$). This effect also was evident at trend level during the 3,000 to 6,000-ms time window (Table 3). Habitual use of reappraisal did not moderate the regulatory effect in the inspected time windows. Planned pairwise comparisons between looking at aversive pictures and reinterpretation showed that the implementation of reinterpretation resulted in decreases of the LPP amplitudes in the early (trend), middle (trend), and late time window (early LPP: look aversive (*M* = 4.87, *SD* = 2.95) vs. reinterpretation (*M* = 4.18, *SD* = 2.81), $t = 2.28$, $p = 0.081$, bhc, $d = 0.304$), mid LPP: look aversive (*M* = 1.90, *SD* = 2.72) vs. reinterpretation (*M* = 1.25, *SD* = 2.85), $t = 2.22$, $p = 0.062$, bhc, $d = 0.297$, late LPP: look aversive (*M* = 1.38, *SD* = 3.74) vs. reinterpretation (*M* = 0.40, *SD* = 3.66), $t = 2.57$, $p = 0.039$, bhc, $d = 0.343$). After controlling for multiple comparisons, post-hoc *t*-tests did not indicate that the effect of reinterpretation lasted over the 3,000 to 6,000-ms time window.

Distancing did not significantly differ from looking at aversive pictures for the P300, for the early LPP and for the 3,000 to 6,000-ms time window (Table 3). However, distancing reduced the LPP compared to looking at aversive pictures in the mid and late LPP on trend level (mid LPP: look aversive (*M* = 1.90, *SD* = 2.72) vs. distancing (*M* = 1.00, *SD* = 2.97), $t = 2.33$, $p = 0.072$, bhc, $d = 0.311$; late LPP: look aversive (*M* = 1.38, *SD* = 3.74) vs. distancing (*M* = 0.45, *SD* = 3.23), $t = 2.16$, $p = 0.070$, bhc, $d = 0.285$).

Distancing and reinterpretation did not significantly differ from each other neither for the P300, the early LPP, the mid LPP, the late LPP, nor for the 3,000 to 6,000-ms time window (all $p > 0.467$; Table 3).

Re-exposure phase

Subjective rating of negative feelings

Emotional reactivity A significant main effect of condition was detected for self-reported negative feelings ($F(1, 54) = 191.05$, $p < 0.001$, $\eta^2 = 0.78$), which was not moderated by the habitual use of reappraisal (measured with the ERQ; Table 4). The a priori planned *t*-test indicated that looking again at aversive pictures led to increased negative feelings (*M* = 4.42, *SD* = 1.77) compared with looking again at neutral pictures (previous look aversive vs. previous look neutral (*M* = 1.16, *SD* = 0.37): $t = 13.91$, $p < 0.001$, $d = 1.86$; Fig. 2A).

Explicit emotion regulation The ANOVA revealed a significant main effect of condition ($F(1.70, 91.75) = 40.43$, $p < 0.001$, $\eta^2 = 0.43$), whereby the interaction between condition

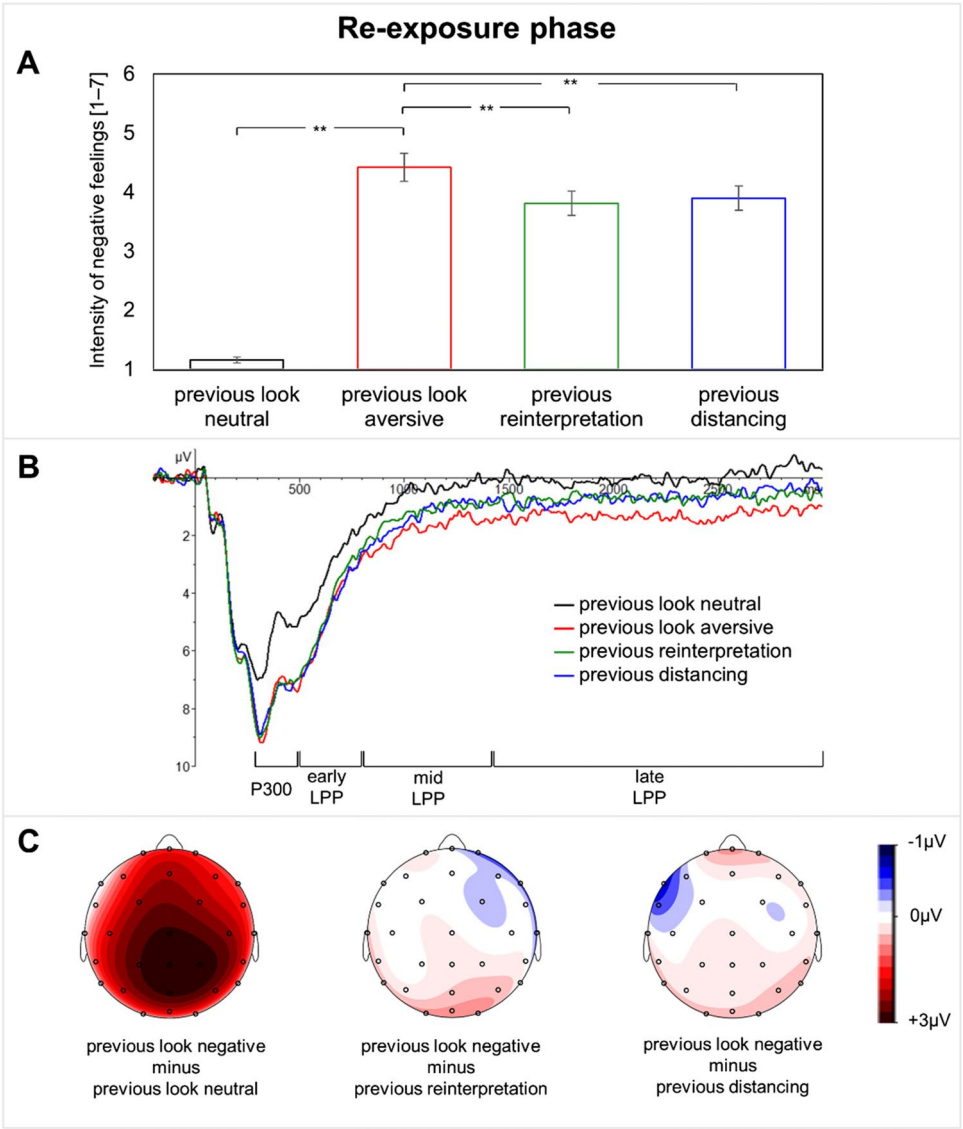


Fig. 2 **A**. Means of self-reported negative feelings during the re-exposure phase for each condition. Error bars depict standard errors of the means. **B**. Event-related potentials following picture presentation pooled at posterior-parietal sides (CPz, Pz, OPz, O1, O2) during the re-exposure phase. **C**. Topographical distribution of respective difference waves during 300–3,000 ms. $^{**}p < 0.001$

and the habitual use of reappraisal was not significant (Table 5). Planned post-hoc *t*-tests showed that both tactics had a lasting regulation effect, as indicated by reduced negative feelings for each tactic compared with previous looking at aversive pictures (previous look aversive ($M = 4.42$, $SD = 1.77$) vs. previous reinterpretation ($M = 3.81$, $SD = 1.54$): $t = 7.88$, $p < 0.001$, $d = 1.05$; previous look aversive ($M = 4.42$, $SD = 1.77$) vs. previous distancing ($M = 3.90$, $SD = 1.55$): $t = 6.37$, $p < 0.001$, $d = 0.85$; Fig. 2A). Negative feelings did not significantly differ between previous distancing and previous reinterpretation ($t = 1.53$, $p = 0.132$, $d = 0.21$).

ERP Data

Emotional reactivity ERPs of the different conditions and difference maps are shown in Fig. 2B and C. A significant main effect of condition was observed for the P300 ($F(1, 54) = 39.23$, $p < 0.001$, $\eta^2 = 0.42$), the early LPP ($F(1, 54) = 16.44$, $p < 0.001$, $\eta^2 = 0.23$), the mid LPP ($F(1, 54) = 10.83$, $p = 0.002$, $\eta^2 = 0.17$), and the late LPP ($F(1, 54) = 8.67$, $p = 0.005$, $\eta^2 = 0.14$). The interaction between condition and the reappraisal score of the ERQ was not significant (Table 4). A priori planned pairwise comparisons showed

that looking again at aversive pictures led to significantly larger ERP amplitudes than looking again at neutral ones for the P300 (previous look aversive ($M = 7.73$, $SD = 3.82$) vs. previous look neutral ($M = 5.61$, $SD = 4.07$): $t = 6.32$, $p < 0.001$, $d = 0.84$), the early LPP (previous look aversive ($M = 4.79$, $SD = 2.95$) vs. previous look neutral ($M = 3.34$, $SD = 2.85$): $t = 4.09$, $p < 0.001$, $d = 0.55$), the mid LPP (previous look aversive ($M = 2.04$, $SD = 2.71$) vs. previous look neutral ($M = 0.67$, $SD = 2.64$): $t = 3.32$, $p < 0.001$, $d = 0.44$), and the late LPP (previous look aversive ($M = 1.55$, $SD = 2.95$) vs. previous look neutral ($M = 0.20$, $SD = 2.70$): $t = 2.97$, $p = 0.004$, $d = 0.40$).

Explicit emotion regulation The ANOVA did not show a main effect of condition, demonstrating that there were no significant differences in the ERP amplitudes over the inspected time windows between previous looking at aversive pictures, previous reinterpretation and previous distancing. Furthermore, no moderation effect was given. All results are reported in Table 5.

Further Analyses

Post-hoc success and effort ratings of reappraisal tactics

Participants rated to be more successful in reinterpretation ($M = 6.42$, $SD = 1.64$) compared with distancing ($M = 5.44$, $SD = 2.36$), $t(54) = 2.78$, $p = 0.008$, $d = 0.37$) regarding the active regulation phase. There was no difference in effort ratings for the implementation of both tactics (reinterpretation: $M = 4.82$, $SD = 2.15$, distancing: $M = 5.25$, $SD = 2.41$, $t = -1.11$, $p = 0.272$, $d = -0.15$).

Post-hoc awareness ratings

Participants reported to remember having seen pictures with a reinterpretation history more often compared to look aversive ($t = 2.07$, $p = 0.044$, $d = 0.31$), but not compared to distancing ($t = 0.40$, $p = 0.688$, $d = 0.06$). Distancing and look aversive did not differ from each other ($t = 1.65$, $p = 0.105$, $d = 0.25$). Participants further correctly remembered the instruction more often for reinterpretation compared to look aversive ($t = 4.41$, $p < 0.001$, $d = 0.58$) and compared with distancing ($t = 3.83$, $p < 0.001$, $d = 0.51$). However, there was no difference in correctly remembering the instruction for distancing and look aversive ($t = 1.76$, $p = 0.084$, $d = 0.23$). If they correctly identified the instruction, they also applied the tactic during re-exposure more often (without being instructed to) for reinterpretation than for distancing ($t = 9.31$, $p < 0.001$, $d = 1.28$).

Discussion

This is the first ERP study investigating immediate and lasting effects of emotional reactivity as well as reinterpretation and distancing in association with the habitual use of cognitive reappraisal. Aversive pictures provoked stronger negative feelings and a higher amplitude in ERPs compared with the presentation of neutral pictures during both, the active regulation and the re-exposure phase. A higher habitual use of reappraisal was associated with stronger emotional reactivity in the P300 and early LPP during the active regulation phase. The implementation of both tactics led to reduced negative feelings, while reinterpretation reduced negative feelings to a higher extent compared with distancing. Reinterpretation attenuated the early, mid (both at trend level) and late LPP, distancing the mid and late LPP (both at trend level). For lasting effects, looking at previously reappraised pictures (reinterpretation and distancing) led to less negative feelings compared to looking again at aversive pictures. However, lasting regulatory effects were neither found for reinterpretation nor for distancing on the electrocortical level.

In line with a large body of research, looking at aversive compared with neutral pictures led to a stronger experience of negative feelings (Hermann et al., 2021) and ERP amplitudes (P3, LPP) during the whole presentation time of the pictures (Hajcak et al., 2010; Hajcak and Nieuwenhuis, 2006; Hermann et al., 2021; Paul et al., 2013; Qi et al., 2017; Thiruchselvam et al., 2011). On the electrocortical level, this differential effect has further shown to be stable over picture repetitions up to 60 times (Codispoti et al., 2006) as well as over time, when pictures were shown again one day later (Ferrari et al., 2020).

Moreover, both tactics successfully lowered negative feelings during active emotion regulation which also is in line with previous research (Hermann et al., 2021; Shiota and Levenson, 2012; Webb et al., 2012), with reinterpretation being more effective than distancing. Furthermore, participants rated to be more successful in reinterpretation than in distancing whereby both tactics did not differ in effort ratings. This differential effect on negative feelings might result from reinterpretation leading to more positive feelings ("imagining a happy ending") and distancing to a more neutral response (Hermann et al., 2021; Qi et al., 2017; Shiota and Levenson, 2012). This also corresponds with results of a previous study showing distancing to lead to a stronger reduction in arousal ratings and reinterpretation to a higher increase in valence ratings (both compared with each other; Qi et al., 2017). Furthermore, this possible differential effect

of reinterpretation on valence might explain differences in the success ratings, showing that participants indicated to be more successful in downregulating their emotions via reinterpretation compared with distancing.

On the electrocortical level, both tactics attenuated the LPP compared to passively looking at aversive pictures in the early (reinterpretation only), as well as in the middle time window (at trend level) and lasted over the late time window (for distancing on trend level only, both compared to looking at aversive pictures). In contrast to a previous study by Qi et al. (2017), our results did not show a stronger nor an earlier reduction of the LPP for distancing compared with reinterpretation. This missing differential effect might be due to methodological differences between both studies, e.g., repeated picture presentation in our study, possibly leading to a stronger consolidation and faster recall of the altered memory representation. As a consequence, this might cancel out effectiveness and timing differences between both tactics in the LPP. In sum, both tactics were effective in reducing negative feelings and LPP amplitudes during the active regulation phase. Stronger effects for reinterpretation were only evident on the self-report level, indicating different underlying mechanisms which were not reflected in the ERPs.

For lasting effects, we found that the implementation of both tactics led to reduced negative feelings when the pictures were presented again half an hour later. This is in line with a previous study (Hermann et al., 2021) that used the same stimulus material and demonstrated lasting effects on negative feelings even 1 week later. Differential effects of both tactics were only observed in the awareness ratings, revealing that participants recognized and correctly remembered the instruction more frequently for reinterpreted pictures than pictures passively looked at or distanced from in the first phase. This higher awareness for reinterpretation corresponds with studies showing improved memory effects for reinterpreted pictures (Willroth and Hilimire, 2016), possibly reflecting a deeper elaboration of the picture content for reinterpretation in the current study.

On the electrocortical level, we did not find substantially lasting effects of reinterpretation or distancing in the LPP. Qi et al. (2017) also found no lasting effect for reinterpretation but for distancing. Differences in the results, especially our missing regulatory findings, might come from repeated picture presentations, possibly leading to a weakening of the LPP amplitudes in the look aversive condition in the current study. In line with this assumption, attending to a picture three times led to a decrease in the LPP in a previous study (Paul et al., 2013). Therefore, as the pictures in our study were paired six times with the same instruction during active regulation, this might have reduced arousal in general upon re-exposure. Another possible explanation for the missing LPP effect of reinterpretation might stem from its impact on positive emotions, as discussed above. A positive reinterpretation of the depicted scenes might lead to enhanced arousal (and associated increased LPP amplitudes) during re-exposure, which might be comparable to the arousal evoked from looking again at aversive pictures repeatedly watched in the first phase.

While a more frequent habitual use of reappraisal has shown to be related to a decreased LPP during passively watching negative pictures (Harrison and Chassy, 2019), we found, unlike expected, a higher habitual use of reappraisal to be associated with stronger amplitudes in the P300 and the early LPP for emotional reactivity during the active regulation phase. A heightened P300 is related to threat and self-referential processing (Wang et al., 2021), whereby attention seems to be driven automatically towards salient stimuli (Hajcak and Foti, 2020). Especially the later portion of the P300 might be produced by memory updating operations necessary for top-down control of emotions (Polich, 2007). Therefore, an increased reactivity towards aversive stimuli might reflect a heightened preparedness for regulation and the initiation of automatic control mechanisms in response to salient stimuli. We found no moderation by the habitual use of reappraisal for distancing or reinterpretation, which has been reported for reinterpretation only in a previous study (Moser et al., 2014). Individuals might only differ during spontaneous responding to emotional stimuli but are capable of down-regulating negative feelings when instructed to do so. Upon re-exposure, the repeated presentation of pictures might have reduced arousal over all conditions, which is why a moderating role of habitual use of reappraisal might be missing for emotional reactivity as well as for distancing and reinterpretation.

Our study also has some limitations: Previous research suggests that different ethnic groups differ in their expression of emotions and in emotion regulation (Consedine and Magai, 2002; Weiss et al., 2022). Unfortunately, we did not collect information about ethnicity and race. Based on the composition of the population in which the study was conducted, it can be assumed that participants were predominantly of German ethnicity and Caucasian, which is why our results are limited to this sample population. Furthermore, given that the lifetime prevalence for mental disorders is high (Kessler et al., 2007), it should be noted that our sample might have been healthier than the average population, as only participants were included

who have never fulfilled the criteria for any mental disorder. However, as there exist differences in emotional reactivity (Granros et al., 2022; MacNamara et al., 2016) and regulation (Paul et al., 2016) between healthy and clinical populations, studying healthy individuals is essential to unravel observed effects. Because we did not assess valence and arousal, but negative feelings as an outcome of reappraisal, it is not possible to disentangle differential effects of reinterpretation and distancing on these dimensions. We cannot fully answer our above-mentioned questions about reinterpretation leading to an increase of positive feelings. Differences in the effectiveness of reinterpretation vs. distancing might be traced to how aversive the stimulus material is perceived by the participants. According to research in emotion regulation choice (Sheppes and Levin, 2013), individuals prefer engaging regulation strategies (such as reinterpretation) more often when the picture material is less aversive. This might be the case for our study, as we used four specific subcategories of aversive pictures and further repeatedly presented our pictures. Therefore, participants might have experienced the pictures as less aversive compared with other studies where more heterogeneous pictures were presented only once (Thiruchselvam et al., 2011). When lasting effects of explicit emotion regulation are investigated, it should be noted that a demand to regulate is given in the active regulation phase but not in the re-exposure phase, which might differentially influence the results in both phases. This might especially increase the immediate effects in the rating of negative feelings. Furthermore, on a neural level, explicit compared with implicit emotion regulation has been shown to involve common as well as different brain activation patterns (Braunstein et al., 2017), which might contribute in part to a lack of lasting ERP findings in our study. However, studies that showed pictures only once in the active emotion-regulation phase did find lasting regulatory effects on ERPs (Qi et al., 2017; Thiruchselvam et al., 2011), favoring the assumption that the missing effects in our study might be traced to repeated picture presentation as illustrated above.

Moreover, the current and previous studies used different instruction practices. In our study, e.g., participants were corrected if they imagined something that is not possible in real life. Other studies (Thiruchselvam et al., 2011) explicitly suggest individuals to imagine that the depicted scene is not real. Studies also differ in the inspected electrode or cluster as well as the observed time windows when investigating emotion-regulatory effects in ERPs making direct comparisons between findings more difficult.

In summary, our findings demonstrate the immediate effects of reinterpretation and distancing on negative feelings and the LPP. Lasting effects were only evident on a subjective level but not found in the EEG, which might result from repeated picture presentation, leading to weakened general arousal in response to the stimuli. Moreover, a higher use of habitual reappraisal was associated with stronger emotional reactivity indexed by higher P3 and LPP amplitudes for passively viewing aversive compared with neutral pictures and might be interpreted in terms of a higher preparedness to regulate. However, there was no evidence for substantial differences between both reappraisal tactics, especially regarding the LPP, probably indicating that the LPP does not fully capture underlying differential mechanisms (e.g., effects on valence). The findings of the current study might contribute to a deeper understanding of immediate and lasting effects of different emotion regulation tactics. Moreover, our results regarding the association with individual differences in the habitual use of cognitive reappraisal might be especially important for improving psychotherapeutic treatments.

Appendix

Table 1 Sample characteristics

	n = 57
Gender *N* (women / men / non-binary)	37 / 20 / 0
Age (years) *M* (*SD*), range	30.77 (12.98),18.00–59.00
Years of education *M* (*SD*), range	17.21 (4.28), 11.50–32.00
Highest level of education, *N*	
University degree or similar	17
German Abitur or similar[1]	38
Secondary school diploma	2
Employment status[2], *N*	
Currently employed	56
Other	1
Relationship status, *N*	
Single	20
Solid Partnership	25
Married	8
Married, living separately	3
Divorced	1

[1]This is approximately equivalent to an A-level degree.

[2]Further answer options were: Sick leave ($n = 0$), disability ($n = 0$), or old age pension ($n = 0$). The one participant indicating "Other" was on parental leave at that time

Table 2 Results of emotional reactivity during the active emotion regulation phase

	ANOVA (within-subject factor: condition; covariate: reappraisal score of ERQ)		Look negative *M* (*SD*)	Look neutral *M* (*SD*)	Planned comparison *t*-test look negative vs. look neutral
	Main effect of condition	Interaction condition * reappraisal score (ERQ)			
Rating	$F(1, 54) = 291.11$, $p < 0.001$, $\eta_p^2 = 0.84$	$F(1, 54) = 0.07$, $p = 0.787$, $\eta_p^2 = 0.001$	4.74 (1.58)	1.16 (0.34)	$t = 17.21$, $p < 0.001$, $d = 2.30$
P3 (300 – 500 ms)	$F(1, 54) = 114.93$, $p < 0.001$, $\eta_p^2 = 0.68$	$F(1, 54) = 8.64$, $p = 0.005$, $\eta_p^2 = 0.14$	7.31 (3.46)	4.79 (3.35)	$t = 10.05$, $p < 0.001$, $d = 1.34$
early LPP (500–800 ms)	$F(1, 54) = 28.97$, $p < 0.001$, $\eta_p^2 = 0.35$	$F(1, 54) = 4.25$, $p = 0.044$, $\eta_p^2 = 0.07$	4.87 (2.95)	3.17 (2.70)	$t = 5.23$, $p < 0.001$, $d = 0.70$
mid LPP (800–1400 ms)	$F(1, 54) = 19.26$, $p < 0.001$, $\eta_p^2 = 0.26$	$F(1, 54) = 0.81$, $p = 0.374$, $\eta_p^2 = 0.02$	1.90 (2.72)	0.56 (2.54)	$t = 4.40$, $p < 0.001$, $d = 0.59$
late LPP (1400–3000 ms)	$F(1, 54) = 8.17$, $p = 0.006$, $\eta_p^2 = 0.13$	$F(1, 54) = 1.53$, $p = 0.222$, $\eta_p^2 = 0.03$	1.38 (3.74)	0.44 (3.18)	$t = 2.85$, $p = 0.006$, $d = 0.38$
3000–6000 ms	$F(1, 54) = 6.48$, $p = 0.014$, $\eta_p^2 = 0.11$	$F(1, 54) = 2.04$, $p = 0.159$, $\eta_p^2 = 0.04$	1.97 (6.33)	1.08 (5.18)	$t = 2.52$, $p = 0.015$, $d = 0.34$

Planned post-hoc *t*-tests were only conducted, when indicated by a significant/trend level main effect in the ANOVA. ERQ = Emotion regulation questionnaire (Gross & John, 2003)

Table 3 Results of explicit emotion regulation during the active emotion regulation phase

	ANOVA (within-subject factor: condition; covariate: reappraisal score of ERQ)		look negative *M* (*SD*)	re-interpretation M (*SD*)	dis-tancing M (*SD*)	planned comparisons *t*-tests		
	main effect of condition	interaction condition * reappraisal score (ERQ)				look negative vs. reinter-pretation	look negative vs. distancing	distancing vs. reinter-pretation
Rating	$F(1.40, 75.66) = 91.93$, $p < 0.001$, $\eta_p^2 = 0.63$	$F(1.40, 75.66) = 0.05$, $p = 0.894$, $\eta_p^2 = 0.001$	4.74 (1.58)	2.72 (1.01)	3.07 (1.18)	$t = 11.11$, $p < 0.001$, $d = 1.49$	$t = 9.18$, $p < 0.001$, $d = 1.23$	$t = 3.77$, $p < 0.001$, $d = 0.50$
P3 (300–500 ms)	$F(2,108) = 1.08$, $p = 0.344$, $\eta_p^2 = 0.02$	$F(2,108) = 1.08$, $p = 0.344$, $\eta_p^2 = 0.02$	7.31 (3.46)	7.02 (3.67)	6.95 (3.99)			
early LPP (500–800 ms)	$F(2,108) = 3.32$, $p = 0.040$, $\eta_p^2 = 0.06$	$F(2,108) = 2.51$, $p = 0.086$, $\eta_p^2 = 0.04$	4.87 (2.95)	4.18 (2.81)	4.19 (3.20)	$t = 2.28$, $p = 0.081$, $d = 0.30$	$t = 1.96$, $p = 0.110$, $d = 0.26$	$t = 0.03$, $p = 0.974$, $d = 0.004$
mid LPP (800–1400 ms)	$F(2,108) = 3.68$, $p = 0.028$, $\eta_p^2 = 0.06$	$F(2,108) = 0.87$, $p = 0.421$, $\eta_p^2 = 0.02$	1.90 (2.72)	1.25 (2.85)	1.00 (2.97)	$t = 2.22$, $p = 0.062$, $d = 0.30$	$t = 2.33$, $p = 0.072$, $d = 0.31$	$t = -0.73$, $p = 0.467$, d = −0.01
late LPP (1400–3000 ms)	$F(2,108) = 4.05$, $p = 0.020$, $\eta_p^2 = 0.07$	$F(2,108) = 0.81$, $p = 0.447$, $\eta_p^2 = 0.02$	1.38 (3.74)	0.40 (3.66)	0.45 (3.23)	$t = 2.57$, $p = 0.039$, $d = 0.34$	$t = 2.16$, $p = 0.070$, $d = 0.29$	$t = 0.13$, $p = 0.894$, $d = 0.02$
3000 – 6000ms	$F(2,108) = 2.88$, $p = 0.060$, $\eta_p^2 = 0.05$	$F(2,108) = 0.99$, $p = 0.375$, $\eta_p^2 = 0.02$	1.97 (6.33)	1.05 (6.23)	1.18 (5.65)	$t = 2.17$, $p = 0.102$, $d = 0.29$	$t = 1.86$, $p = 0.136$, $d = 0.25$	t = 0.33, $p = 0.742$, d = 0.04

Planned post-hoc *t*-tests were only conducted, when indicated by a significant/trend level main effect in the ANOVA and *p*-values are Bonferroni-Holm corrected. ERQ = Emotion regulation questionnaire (Gross and John, 2003)

Table 4 Results of emotional reactivity during the re-exposure phase

	ANOVA (within-subject factor: condition; covariate: reappraisal score of ERQ)		Previous look negative *M* (*SD*)	Previous look neutral *M* (*SD*)	Planned comparison *t*-test previous look negative vs. previous look neutral
	Main effect of condition	Interaction condition * reappraisal score (ERQ)			
Rating	$F(1, 54) = 191.05$, $p < 0.001$, $\eta_p^2 = 0.78$	$F(1, 54) = 0.30$, $p = 0.587$, $\eta_p^2 = 0.01$	4.42 (1.77)	1.16 (0.37)	$t = 13.91$, $p < 0.001$, $d = 1.86$
P3 (300–500 ms)	$F(1, 54) = 39.23$, $p < 0.001$, $\eta_p^2 = 0.42$	$F(1, 54) = 0.10$, $p = 0.754$, $\eta_p^2 = 0.002$	7.73 (3.82)	5.61 (4.07)	$t = 6.32$, $p < 0.001$, $d = 0.84$
Early LPP (500–800 ms)	$F(1, 54) = 16.44$, $p < 0.001$, $\eta_p^2 = 0.23$	$F(1, 54) = 0.04$, $p = 0.843$, $\eta_p^2 = 0.001$	4.79 (2.95)	3.34 (2.85)	$t = 4.09$, $p < 0.001$, $d = 0.55$
Mid LPP (800–1400 ms)	$F(1, 54) = 10.83$, $p = 0.002$, $\eta_p^2 = 0.17$	$F(1, 54) = 0.17$, $p = 0.684$, $\eta_p^2 = 0.003$	2.04 (2.71)	0.67 (2.64)	$t = 3.32$, $p < 0.001$, $d = 0.44$
Late LPP (1400–3000 ms)	$F(1, 54) = 8.67$, $p = 0.005$, $\eta_p^2 = 0.14$	$F(1, 54) = 0.07$, $p = 0.795$, $\eta_p^2 = 0.001$	1.55 (2.95)	0.20 (2.70)	$t = 2.97$, $p = 0.004$, $d = 0.40$

Planned post hoc *t*-tests were only conducted, when indicated by a significant/trend level main effect in the ANOVA. ERQ = Emotion regulation questionnaire (Gross and John, 2003)

Table 5 Results of explicit emotion regulation during the re-exposure phase

	ANOVA (within-subject factor: condition; covariate: reappraisal score of ERQ)		Previous look negative *M* (SD)	Previous re-interpretation M (SD)	Previous dis-tancing M (SD)	Planned comparisons *t*-tests		
	Main effect of condition	Interaction condition * reappraisal score (ERQ)				Previous look negative vs. previous reinter-pretation	Previous look negative vs. previous distancing	Previous distanc-ing vs. previous reinter-pretation
Rating	$F(1.70, 91.75) = 40.43$, $p < 0.001$, $\eta_p^2 = 0.43$	$F(1.70, 91.75) = 0.001$, $p = 0.997$, $\eta_p^2 < 0.001$	4.42 (1.77)	3.81 (1.54)	3.90 (1.55)	$t = 7.88$, $p < 0.001$, $d = 1.05$	$t = 6.37$, $p < 0.001$, $d = 0.85$	$t = 1.53$, $p = 0.132$, $d = 0.21$
P3 (300–500 ms)	$F(2,108) = 0.04$, $p = 0.960$, $\eta_p^2 = 0.001$	$F(2,108) = 2.02$, $p = 0.137$, $\eta_p^2 = 0.04$	7.73 (3.82)	7.70 (4.14)	7.64 (4.36)			
early LPP (500–800 ms)	$F(1.77,95.58) = 0.20$, $p = 0.790$, $\eta_p^2 = 0.004$	$F(1.77,95.58) = 2.13$, $p = 0.130$, $\eta_p^2 = 0.04$	4.79 (2.95)	4.54 (3.13)	4.71 (3.23)			
mid LPP (800–1400 ms)	$F(1.66, 89.54) = 1.32$, $p = 0.269$, $\eta_p^2 = 0.024$	$F(1.66, 89.54) = 0.915$, $p = 0.388$, $\eta_p^2 = 0.02$	2.04 (2.71)	1.41 (3.06)	1.44 (2.64)			
late LPP (1400–3000 ms)	$F(2,108) = 2.03$, $p = 0.137$, $\eta_p^2 = 0.04$	$F(2,108) = 1.17$, $p = 0.315$, $\eta_p^2 = 0.02$	1.55 (2.95)	0.74 (2.73)	0.74 (2.99)			

Planned post-hoc *t*-tests were only conducted, when indicated by a significant/trend level main effect in the ANOVA. ERQ = Emotion regulation questionnaire (Gross and John, 2003)

Acknowledgments The authors thank E. Cantekin, M. D'Aloia, A. Enseroth, L. Gentner, Z. R. Goll, V. Jacobs, M. K. Krause, L. Kühling, E. Ossowski, L. Rosenplänter, A. Sölva, A. Sprave, K. Ulrich, A.-L. Vedi, B. Wolf, and H. Yapar for their help in participant recruitment and data collection. Thanks to H. Gebhardt, Dr. U. Ott, and Dr. C. R. Blecker for technical support. The data were collected in the psychophysiological laboratory at the outpatient center (Verhaltenstherapeutische Ambulanz) of the Justus Liebig University Giessen, Germany.

Funding Open Access funding enabled and organized by Projekt DEAL. This research was supported by "The Adaptive Mind," funded by the Excellence Program of the Hessian Ministry of Higher Education, Science, Research and Art. The Hessian Ministry of Higher Education, Science, Research and Art had no further role in study design, collection, analysis, and interpretation of data, in the writing of the manuscript, or in the decision to submit the paper for publication.

Data availability All data are available upon request to the corresponding author. The experiment was not preregistered.

Declarations

Conflicts of interest The authors have no competing interests to declare that are relevant to the content of this article.

Ethics approval Approval was obtained from the ethics committee of the Justus Liebig University Giessen. The procedures used in this study adhere to the tenets of the Declaration of Helsinki.

Consent to participate Informed consent was obtained from all individual participants included in the study.

Consent for publication Not applicable.

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