Using Event-Related Potentials to Explore Processes of Change in Counseling Psychology

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The purpose of this article is to serve as a guide for counseling psychologists to learn about a neuroscience methodology that can be used to study psychotherapy change processes. Event-related potential (ERP) is a specific type of electroencephalography that can be time-locked to a stimulus and thus allows researchers to examine neural responses to specific therapeutic techniques. A conceptual overview of the method and its applicability to counseling psychologists is provided. Additionally, this article contains basic guidelines for designing an ERP study, the tools necessary for setting up an ERP lab, and an overview of data-processing strategies. Common pitfalls encountered both broadly in neuroscience research and specifically in ERP research are discussed. An integrated review of relevant literature is presented here, along with suggestions for future counseling psychology research, with a focus on establishing biomarkers of successful interventions.

Public Significance Statement
This article provides a guide for employing event-related potentials in the study of psychotherapy change processes within the field of counseling psychology. A conceptual overview of the method, current implementations and uses, and implications for the future of the field are discussed.

Keywords: event-related potentials, ERP, change processes, counseling psychology

In recent years, counseling psychologists have begun to consider the benefits of adopting neuroimaging techniques alongside more traditional research methodologies in the field (Gonçalves & Perrone-McGovern, 2014). Coutinho, Perrone-McGovern, and Gonçalves (2017) discussed advantages of neuroimaging methods for counseling psychologists. They provided an integrated review of research demonstrating the ways that psychotherapy interventions can create positive changes in patterns of brain networks for persons with psychological disorders.

A 2014 special section of the Journal of Counseling Psychology included a series of articles coauthored by interdisciplinary teams of neuroscientists and counseling psychologists that proposed ways that neuroscience research methods could be employed and used by counseling psychologists (Coutinho, Silva, & Decety, 2014; Fine & Sung, 2014; Gonçalves & Perrone-McGovern, 2014; Sampaio & Lifter, 2014; Simon-Dack & Marmarosh, 2014; Wright & Díaz, 2014). Articles detailing how counseling psychologists might use specific neuroscientific approaches are scarcer. One such methodology with utility for counseling psychologists is event-related potential (ERP), which is a specific subtype of electroencephalography (EEG). The goal of the current article was to provide an overview of ERP methodology and a description of how the ERP approach may be used by counseling psychologists to understand psychotherapy change processes.

Event-Related Potential: A Conceptual Introduction

EEG is one of the oldest forms of neuroimaging used by psychologists, with the first human EEG being recorded in the 1920s (Haas, 2003). EEG is a method of recording electrical activity occurring in cortical areas of the brain using electrodes placed noninvasively on the scalp. Specifically, EEG measures the frequency of brain waves, which are indicative of a person’s functional neural state. For example, individuals’ brain wave frequencies can reveal things such as alertness to cognitive engagement to the presence of seizure activity and origin (Teplau, 2002). ERP is a specific type of EEG method in which electrical activity at the scalp can be time-locked within milliseconds to the presentation of a stimulus, such as a word, an image, or a sound (Brandeis & Lehmann, 1986). By time-locking measurement of neural activity in this way, inferences about individuals’ neural processes in response to a specific stimulus can be made. This temporal resolution distinguishes ERPs from other neuroimaging techniques because it allows researchers to investigate questions about differ-
Overview of Literature Relevant to the Use of ERP for Counseling Psychology Research

Goss (2016) reviewed the literature on the integration of neuroscience into counseling psychology. He found 21 peer-reviewed, academic publications addressing this topic and identified four themes of the literature to date: “Biopsychosocial Topics of Discussion, Neuroscience Education, Integrating Neuropsychology, and Implications of Integration” (Goss, 2016, p. 904). He concluded, based on his review, that publications across all themes supported the potential for integrating neuroscience and counseling psychology and for offering doctoral and postdoctoral training of counseling psychologists in neuroscience. “Neuroscience can provide an evidence base for the work of scientist-practitioner-oriented counseling psychologists, which can, in turn, promote communication with medically oriented multidisciplinary colleagues” (Goss, 2016, p. 912). He also asserted that a bidirectional influence between neuroscience and counseling psychology could be beneficial for both fields, noting that counseling psychology can help neuroscientists better understand cultural factors and clinical applications of neuroscience research.

For example, a recent study (Perrone-McGovern et al., 2017) examined the relationship between dimensions of perfectionism, emotional intelligence quotient (EIQ), and an ERP component called error-related negativity (ERN). In this study, individuals engaged in a flanker task designed to elicit high error rate. ERN amplitude was studied as a function of EIQ and types of perfectionism (e.g., nonperfectionism, adaptive perfectionism). Individuals with higher maladaptive perfectionism showed larger ERN amplitudes, followed by individuals with adaptive perfectionism and finally nonperfectionists. Individuals with high EIQ showed smaller ERN amplitudes than did individuals with low EIQ (medium effect size; $\eta^2 = .13$). In addition to providing support for a two-factor model of perfectionism, the results of this study also have implications for change processes in therapies targeting maladaptive perfectionism (medium/large effect size; $\eta^2 = .21$). Specifically, EIQ is trainable (Schute, Malouff, & Thorsteinsson, 2013), and thus seeking to develop EIQ skills may help reduce the impact of error-related negativity for individuals with maladaptive perfectionism. Additionally, findings lend support for the use of psychoeducation techniques for teaching anxiety management skills.

Another recent study (Van Hoven, Perrone-McGovern, Simon-Dack, & Nicholas, 2019) examined the relationship between empathy and pain in women as a function of their attachment style. In this study, women with various attachment styles participated in a pain induction task. They were then given an artificial empathy rating for their pain from a fictional observer. Participants then completed a visual discrimination task consisting of angry and sad facial expressions.
neutral faces. Individuals with higher attachment anxiety did not need to use as many neural resources to process angry faces when they received a high empathy rating from the fictional observer as they did when they received a low empathy rating. This study, too, has implications for understanding of change processes in psychotherapy. Specifically, high pain empathy may act as a change mechanism for reducing psychopathology (e.g., depression, anxiety) for women with anxious attachment styles and chronic pain by reducing negativity bias. There were a number of reasons why the authors chose to use an all-female sample for this study. They noted that existing literature on pain suggested a greater influence of empathy or support for pain in women than in men (e.g., Chambers, Craig, & Bennett, 2002; Jackson, Iezzi, Chen, Ebnet, & Eglitis, 2005). Gender norms may also influence willingness to report pain, because past research has indicated a possible response cost for men to report pain in experimental studies because it may contradict a more stereotypical stoic gender role for men (Robinson et al., 2001). Figure 1 depicts the scalp map of electrodes and the clusters examined in this study.

**ERP, Change Processes, and Targeted Interventions**

Any discussion of psychotherapy change processes must necessarily include mention of the processes in need of change. Use of ERP methods may be able to help counseling psychologists better understand each point in the cascade of information processing when symptoms are observable, which in turn may help in understanding what types of intervention may be most useful and effective. For example, individuals with eating disorders show information-processing differences at many points in the information-processing cascade, such as in early visual processing (Groves, Kennett, & Gillmeister, 2017) and in response to food-related stimuli (e.g., Blechert, Goltzsche, Herbert, & Wilhelm, 2014) and emotional faces (e.g., Pollatos, Herbert, Schandry, & Gramann, 2008). Awareness of these differences may suggest to a clinician that there are many ways to effectively intervene in the constellation of processes maintaining disordered eating behavior.

Clinical example: Based on the empirical research, it is known that ERP may be useful when working with patients who have emotion regulation issues such as eating disorders, substance use, and longstanding interpersonal difficulties associated with borderline personality features or disorder. For example, a client may present with a history of interpersonal difficulties, a tendency to experience others as malevolent, and a coping strategy of eating when distressed. ERP can be measured before therapy begins to assess the client’s response to negative stimuli, empathy, and positive self-talk. The clinician can see how the client responds to a threat and how quickly the client can cope with the negative event. This information can guide treatment as the therapist practices emotion regulation strategies with the client during the sessions and uses the ERP to assess whether treatment is coinciding with anticipated changes in neural correlates of emotion regulation.

**ERP and Nonverbal Assessment: Facilitating Treatment for Diverse Clients**

Unfortunately, the largest premature dropout of psychotherapy is in minority populations (Mowbray, Campbell, Kim, & Scott, 2018) and those clients with longstanding eating and personality disorders (Swift & Greenberg, 2012). One may be able to mitigate these treatment failures by measuring how well clients can tolerate emotions and recover from emotional stimulation. Without assessing emotion regulation accurately, one is likely to overestimate clients’ abilities to consistently engage in treatment. The limitation in the literature is that feedback is always verbal feedback after a session. There is no research in the field of psychotherapy that includes neurological feedback regarding how well a client is regulating emotions after sessions.

Collecting nonverbal information prior to treatment and after sessions is especially important when clients may struggle to express how they are feeling to the therapist. It is known minority clients may not trust a therapist who has privilege, and these differences can interfere with positive and equitable health care experiences (Holden & Xanthos, 2009). Further, clients may come from different cultures or religions that are less accepting of psychotherapy, and this may cause clients to experience stigma related to treatment (Johnson, Saha, Arbelaez, Beach, & Cooper, 2004). In addition, minority clients often experience therapists’ microaggressions as ruptures in the therapy process (Hook et al., 2016; Lee, Tsang, Bogo, Johnstone, & Herschman, 2018). These misses may be undetected if one relies mainly on self-report assessments. ERP allows for examining whether anticipated changes to clients’ emotion regulation processes are reflected in altered neural responses to stimuli while clients are participating in therapy. If anticipated changes are not seen, it may lead one to examine what factors are contributing to treatment failure. For example, one may be able to detect ruptures during treatments that would not be identified without nonverbal assessments.

![Figure 1. Scalp map of electrode placement on the cap and highlighting the selection of left (F3, F5, AF3, AF7) and right (F4, F6, AF4, AF8) electrode clusters analyzed in Van Hoven and colleagues (2019) study examining empathy and pain as a function of attachment style.](image-url)
Clinical example: An Asian American graduate student comes to therapy to address career concerns; is ambivalent about seeking counseling; and is discreet about her complex history of trauma, which includes early attachment abandonment, discrimination in school, and social isolation. Typically, the main source of intake data is verbal and limited by the client’s desire to share vulnerable information based on a culture that does not fully accept psychotherapy. Her parents do not know that she is seeking counseling, and she feels ashamed for needing help. With ERP, one can assess her automatic responses to different stimuli and gather data that could be critical to treatment without pressuring her to disclose uncomfortable information. One may find that she does not verbally express distress, but she has intense neural reactions to stimuli meant to evoke feelings of rejection. In this instance, ERP may produce clues that suggest the client may have a difficult attachment or interpersonal history or may struggle to regulate negative emotions, all of which may plausibly contribute to concerns around the career domain. When one examines neural changes (or lack of change) over the course of treatment through repeated measurements, one may be able to hypothesize about processes that are contributing to symptom maintenance, as well as adjust the treatment strategy if necessary. For example, in this case one may begin to incorporate mindfulness of emotion practice to increase the client’s awareness of internal distress, engage her in emotion exposure in-session to increase her resilience to these feelings, or have a conversation about culturally appropriate strategies she can use to have her emotional needs addressed. When a particular treatment approach is chosen, assessment of neural response to specific stimuli is continued, one gains further information that can help in deducing whether the approach chosen is having the intended effect. In essence, ERP can be helpful in assessing how well the therapy is working and what types of interventions may be more effective for a specific client (e.g., cognitive restructuring, emotion exposure, mindfulness techniques). Regarding psychotherapy research, using ERP to assess neurological correlates of observed behavior or self-report data can help to shed light on which interventions are facilitating specific changes. If one examines changes in neural activity via repeated use of ERP before, during, and after a course of therapy, one can see how neural changes correlate with variables such as changes in symptoms and interpersonal functioning. This could lead to using ERP in randomized control trials where the effectiveness of different treatment approaches with diverse clients can be compared and contrasted.

**ERPs and Change Processes Across Treatment Modalities: Randomized Control Trial and ERP**

Another way in which use of an ERP approach may help clarify psychotherapy change processes is by comparing the neural impact of psychotherapies known to be effective for specific disorders. Indeed, many approaches to psychotherapy may yield similar changes on outcome measures, but it can be difficult to ascertain whether the change processes contained in these approaches act similarly to achieve these ends. For example, both behavioral activation and cognitive-behavioral therapy have demonstrated utility in treating depression (Cuijpers, van Straten, Andersson, & van Oppen, 2008), but the two proposed processes of change in these approaches are different. Behavioral activation is thought to work in part through pleasant activity scheduling, which results in the individual’s interrupting depressive behaviors and experiencing reinforcement from pleasant activities, ultimately decreasing depressive symptoms (Dimidjian, Barrera, Martell, Muñoz, & Lewinsohn, 2011). Alternatively, cognitive–behavioral therapy approaches suggest cognitive restructuring as a primary change process to decrease depressive symptoms, which results from individual’s challenging and altering pathogenic cognitions (Furlong & Oei, 2002). Given that the proposed change processes in these two therapies differ, but they are both effective in creating change in the same depressive symptoms, it is plausible that each therapy creates a distinct change in neural activity. If they create a dissimilar impact on neural activity, one can postulate that their mechanism of change is indeed dissimilar. Using an ERP method, one may be able to better disentangle what types of psychotherapeutic change are the result of common factors, as well as what the specific active ingredients of particular therapies are. One can also make inferences about the effects of inclusion of a particular therapeutic technique on neural processing, if all other aspects of the intervention are held constant across groups.

After reviewing the literature on common factors in psychotherapy, Cuijpers, Reijnders, and Huibers (2019) argued that the literature is full of correlational research and that few studies have focused on how these mechanisms work specifically, with attention to temporal associations, the dose–response relationship, and moderators of change. They argued that “we need research on these factors that include temporal associations, dose–response relationships, multiple alternative potential mediators, experimental manipulation, and theoretical models. Research to discover how one type of therapy works” (p. 224). In addition, they argued that studies should address within-person variance (e.g., change in the alliance or emotion regulation overtime). It is critical to use advanced methods to track change over time and link that change to outcome.

**Practical Guidelines, Tools, Data Analysis**

For a list of necessary hardware and equipment needed to set up an ERP lab, please see Table 1. In addition to the items described in Table 1, researchers will also likely need the following software programs: presentation software for data collection (e.g., E-prime from Psychology Software Tools, 2016) and software for data analysis (e.g., MATLAB by MathWorks; MATLAB, 2018). If using MATLAB, researchers can download EEGlab, which is a free interactive MATLAB toolbox for processing EEG and ERP data.

Counseling psychology researchers who are interested in designing a study using ERP methods must start with asking the right research question. As noted above, ERP is best suited for answering *when* questions rather than *where* questions, and it is therefore important to begin by developing a research question focused on the temporal aspect of information processing. When structuring temporally sensitive questions, it is also important to identify what component is of interest. Luck (2014) identified several important aspects to consider when selecting components of interest. First, he suggested selecting a single component of interest and precise manipulations when conducting ERP studies to allow for maximum clarity in interpretation. Indeed, if multiple components are found to vary across conditions in response to a task, it can become difficult to understand exactly what neural process is responsible for these differences and the importance of one’s results may...
become difficult to disentangle. Another recommendation from Luck to maximize clarity in interpretation is to select large components, because they are often less sensitive to distortion due to changes in other components compared to smaller components. A final broad recommendation of Luck’s textbook on ERP is worth noting in an overview article such as this one is the importance of using well-studied manipulations in ERP studies. The benefit of using a well-studied manipulation is it allows researchers to make cleaner inferences about their results. Specifically, if the results differ greatly from what has previously been found or if new components appear to emerge from the data, these deviations can be attributed to factors of interest in the study (e.g., characteristics of the sample) rather than to irrelevant characteristics of the manipulation.

Following identification of an appropriate research question, including component selection and study design, the next step in applying the ERP approach is implementing effective data recording. Data recording using an ERP method involves applying electrodes and conductive gel to the scalp to detect and record the electric potential shifts mentioned above. Participants are informed that conductive gel is nontoxic and can be easily washed out of hair during their next regular shower. Placing electrodes on caps for participants is generally a brief process, taking approximately 15–20 min altogether, even when using a cap with many electrodes. The number of electrodes researchers opt to use varies, but Luck (2014) encouraged use of 16–32 electrodes in most situations and discouraged use of more than 64 electrodes. Use of too many electrodes can interfere with clean data collection, because activity recorded at one site may be confounded by data recorded at a nearby site when electrodes are too numerous. The length of time spent on tasks depend on the experiment, but typical tasks may range from 15 to 30 min. Participants tend to be interested in the procedures and relaxed with the process, because experimenters engage in small talk while placing electrodes and explain each step of the procedure, answering any questions participants have throughout the procedure.

Although electrodes are meant to measure only brain activity, or what is called the “signal” one is trying to detect, they inevitably encounter irrelevant sources of electrical activity, or what is called “noise.” The most useful data are that which minimize noise and maximize signal. Jackson and Bolger (2014) separated noise into two categories—external and internal. External noise is most often attributable to the electrical power supply common to all modern buildings. The two most common ways to combat external noise are the use of shielding methods, such as using pieces of conductive metal placed around sources of electrical power supply (e.g., outlets) to block external electrical activity, and the use of an amplifier within the electrode system meant to strengthen the signal above the noise during recording. The second type of noise is known as internal noise, which refers to nonbrain electrical activity produced by participants during the study. Common sources of internal noise include things such as sweat, muscle

Table 1

Basic Equipment Needed for EEG/ERP Measurement and Recording in a Research Lab

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Description or components</th>
</tr>
</thead>
<tbody>
<tr>
<td>Base system</td>
<td>256-channel AD box with battery Eight 68-pole IDC fine-pitch electrode connectors for 32-channel electrode sets Eight 2-pole touchproof connectors for extra flat-type electrodes Three auxiliary sensor DIN connectors Aux1 connector (DIN 4-pole) with CMS/DRL reference input 2 × battery box (6-volt; 4,500 mAh sealed-lead-acid battery with shutdown circuit) Charger USA (fast charge; ≤3.5 hr) Fiber (10 m) USB2.0 receiver ST-ST style connectors (62.5–125 μM) Trigger in/out connector (16 digital in, 16 digital out) USB2.0 cables (1 m and 1.8 m) USB serial cable</td>
</tr>
<tr>
<td>Eight-channel amplifier/ converter module</td>
<td>AD conversion in 24-bit (each module has eight amplifier channels suitable for EEG, ECG, or EMG signals)</td>
</tr>
<tr>
<td>Two 32 × Pin-Type Active Sensors</td>
<td>32 × Pin-Type Active Sensor (32’EEG) on 68-pole connector (standard cable length is 140 cm) Flat-type active electrode with individual lead and touchproof connector (standard cable length is 150 cm) Sizes: small, medium, and large (one each; includes chin strap) 250-μ 8.8-oz gel tube (box of 12) 12-cc syringe with curved plastic tip (nonsterile; box of 50) Double-sided adhesive rings Surgical paper tape (1-in. width; 12 per box) 5-ft vinyl measuring tape (inches and centimeters; retractable) 6-in. Velcro cable strap (each; pack of 12) 4-qt white polyethylene container Fine noniodized salt (3.75 oz) Hydrogen peroxide disinfectant spray (32 oz) Two plastic head-cap stands for drying and storing electrode caps</td>
</tr>
<tr>
<td>Pin-type CMS and DRL electrodes on DIN connector</td>
<td>Hydrogen peroxide disinfectant spray (32 oz) Two plastic head-cap stands for drying and storing electrode caps</td>
</tr>
<tr>
<td>Consumables starter kit (includes supplies for approximately 100 participants)</td>
<td>4-qt white polyethylene container 6-in. Velcro cable strap (each; pack of 12) 4-qt white polyethylene container Hydrogen peroxide disinfectant spray (32 oz) Two plastic head-cap stands for drying and storing electrode caps</td>
</tr>
</tbody>
</table>

Note. EEG = electroencephalography; ERP = event-related potential; AD = analog to digital; IDC = insulation-displacement connector; DIN = Type of electrical connector developed by Deutsches Institut für Normung (DIN); CMS/DRL = common mode sense/driven right leg; USB = universal serial bus; ST-ST = straight tip; ECG = electrocardiography; EMG = electromyography.
tension or movement, and blinking. Although it is impossible to help participants to produce no internal sources of noise, it does help to instruct them on the importance of minimizing things such as moving during the recording. Noise that cannot be reduced during the recording process is then addressed during data processing.

Recorded ERP data are a combination of the electrical brain activity (signal) and the nonneural noise discussed above. The purpose of data processing is to remove as much nonneural noise (e.g., muscle movements) as possible without compromising the information from brain signals contained in the data. The first step in data processing is filtering out the data at frequencies higher and lower than the range of frequencies seen in electrical brain activity. For example, we collected data using ActiView data capture software (Biosemi Actiview, www.biosemi.com) at a sampling rate of 2048 Hz. Data sampling refers to the process through which the EEG signal being produced is captured. The data-sampling rate refers specifically to the number of samples taken per second. It is important to sample at a rate high enough that the full range of signal frequencies is captured; if the sampling rate is too low, important signals are thus lost. Luck (2014) noted the sampling rate should be greater than twice the highest signal frequency. In the present study, prior to analyzing the data, it was resampled to 512 Hz, to reduce the computational power requirements for data processing while preserving the integrity of the data, and a low-pass filter of 55 Hz and high-pass filter of 0.5 Hz are used offline to remove environmental electrical potentials and muscle potentials in EEGLAB (Delorme & Makeig, 2004). Nonneural noise that is not addressed by filtering is subsequently addressed by averaging across trials (when the noise is irregular) and through artifact rejection (when the noise is frequent and predictable, like blinking). Although a detailed discussion of artifact rejection methods is outside the scope of this article (see Luck, 2014, for a detailed discussion), it is important to understand artifact rejection generally. Essentially, artifact rejection is the process through which nonneural noise is identified and removed from the ERP data. This rejection can be done using a computer algorithm (e.g., Independent Components Analysis; Delorme & Makeig, 2004) or through visual inspection of the data, or both. Artifact rejection allows for the removal of nonneural noise, but it may also result in the removal of trials, compromising the integrity of the data overall. It is important to consider how many lost trials compromise the utility of any individual participant and exclude participants for those who reach the threshold. Although there is no rigid rule about how many rejected trials necessitate the exclusion of a participant, a common guideline is to exclude a participant with more than 25% of trials rejected (Luck, 2014). To our knowledge, there is no published standard rate at which participants are rejected due to unusable data. To minimize the likelihood of lost trials, participants should be instructed to be as still as possible and limit muscle movement when completing ERP tasks.

As discussed above, irregular and infrequent nonneural noise is addressed through the averaging of the many trials that constitute an ERP paradigm. It is also important to note that the final data for each participant that are used in data analysis are the grand average of many (sometimes hundreds) of trials rather than the individual information from each trial. It is the averaging of these many trials that allows for the relatively small sample sizes seen in ERP studies, because this increases the precision of measurement and reduces measurement error.

The ideal number of trials for any ERP study varies based on several factors, including sample size and effect magnitude (Boudewyn, Luck, Farrens, & Kappenman, 2018). Indeed, to merely detect a significant ERP effect, one may be able to use relatively few trials. For example, Olvet and Hajcak (2009) found as few as six–eight error trials could produce a reliable ERN component, though, whereas relatively few trials are needed to elicit a reliable ERP effect, often many more are required to detect group differences (Boudewyn et al., 2018). Boudewyn and colleagues (2018) noted statistical power increases with increased number of trials and recommended increasing the number of trials, particularly for within-subject designs, if the cost (in time and resources) for increasing the number of trials is low. If a between-subjects difference is of interest, it may be more economical to increase the overall number of participants (see Boudewyn et al., 2018, for a detailed discussion). Overall, it is important for researchers employing the ERP method to be familiar with their anticipated effect magnitude, as well as commonly used sample sizes for their component of interest, when determining how many trials to include in an ERP paradigm. Ultimately, it is the task of researchers to balance increasingly marginal escalations in statistical power with the costs associated with longer paradigms that include more trials. Luck (2014) did provide these example guidelines based on component size: 300–500 trials for smaller components (e.g., visual P1), 150–200 trials for midsize components (e.g., N2pc), and 30–40 trials for large components (e.g., P300).

Particularly relevant to the discussion of an ERP method to capture information relevant to psychotherapy process research is the question of how often ERP data should be collected. It is important to note that to ascertain the nature of change over time, assessments must be done multiple times over the course of the study, in addition to the presence of multiple trials within each assessment. At absolute minimum, a study examining the impact of psychotherapy would need a baseline, pretherapy measurement of neural activity, as well as a posttreatment measure, though this simple design would better fit the framework of psychotherapy outcome research. Indeed, a strong theory of when changes occur during a certain therapy is necessary. For example, if clients are receiving an intervention package that is split into modules related to specific skills, measurement after each module may be appropriate.

Common Pitfalls to Avoid
Both experienced and novice researchers employing an ERP method may be subject to common methodological pitfalls. Potential pitfalls can be sorted into two broad categories—design pitfalls and broad methodological pitfalls. Luck (2014) outlined several common design pitfalls that can confound ERP study results. Sensory confounds exist when aspects of stimuli vary on other than psychological dimensions, such as variance on factors such as color saturation, size, or brightness. Sensory factors impact how stimuli are initially received early in the information processing time line, which can then create confounds in later components related to cognitive and affective processes. Another common design confound is the overlap confound, which involves presenting a new stimulus before participants’ brains have had a chance to
return to baseline following the presentation of the previous stimulus. If their brains are not able to return to baseline between stimuli, their brain activity that is attributed to a second stimulus may be in response to the first stimulus, creating interpretation difficulties. Another type of confound is an arousal confound, which may be elicited when stimuli have different qualities that elicit varying levels of effort from participants. For example, if one condition is easier than another, a confound may arise from the increased arousal necessitated to complete the more difficult task.

In addition to common design confounds, neuroscientific methods in general are associated with some pitfalls that researchers should be aware of. Much of the emphasis in study design is on maximizing the rigor of the experimental structure to strengthen overall internal validity. As noted by Coutinho et al. (2017) in relation to functional magnetic resonance imaging, however, this emphasis on internal validity compromises the ecological validity of the results generated by these types of studies. Lack of ecological validity limits the generalizability of the ERP method. Attention to balancing internal and ecological validity is therefore important for those interested in developing a research program using ERP methods. Indeed, it may serve researchers best to begin with studies that emphasize internal validity and then to move down the continuum toward greater ecological validity after these foundational studies are conducted. In a related vein, it is important to note the importance of developing or identifying stimuli that are suitable proxies for experiences individuals may have outside the laboratory. Indeed, it is impossible for an ERP study with sufficient internal validity to be a perfect replica of a very complicated reality, and therefore the conclusions drawn from ERP studies should be considered carefully in the context of evidence generated using other research methods and stated with appropriate caution. Researchers beginning a research project in a previously unstudied area may need to develop their own stimuli to appropriately address the constructs of interest, and they may need to be creative with their approach to developing stimuli. For example, an individual who is interested in the social comparison therapy alliance, changes in symptoms, and interpersonal functioning (e.g., attachment style) facilitate or hinder individuals’ ability to recover responses over time, and which individual neural differences (i.e., openness to diversity, the culture or race of the client or therapist, prejudice, and group dynamics). Researchers can focus on how the brain responds to microaggressions, hate, and at posttermination follow-up. In addition to standard premeasures, researchers would include ERP prior to treatment to assess reactions to stimuli meant to evoke similar thoughts, feelings, or physical sensations that may be the focus of treatment or occur during the therapy process. Researchers would then include ERP throughout the treatment study and assess neural responses along with self-report measures of interest (e.g., symptom measures, therapeutic alliance strength). The current literature on the therapeutic alliance does not include neural correlates, and there is no study to date that explores how patterns of neural activity are impacted by alliance rupture and rupture repair. This domain is an important area of psychotherapy research within counseling psychology today. Currently self-report and observer ratings of sessions are being used, and the addition of an ERP method may provide another source of worthwhile data in examining the impact of alliance ruptures and the process of rupture repair. For example, individuals with a history of insecure attachment experience ruptures differently from those with a secure attachment history, and with which the frequency ruptures are reported also appears to differ as a function of attachment style (Eames & Roth, 2000). It may be interesting to see how these variables are associated with the neural activity evoked by rupture stimuli (e.g., sentence stems with rupture-congruent or -incongruent content) in the context of attachment primes. Perhaps even more relevant to psychotherapy process would be examining how the results of these assessments change (or do not change) following successful rupture repairs or after a series of attachment-based interventions.

In addition to psychotherapy research, counseling psychologists study diversity, social justice, and the impact of discrimination. Individuals who experience discrimination, bullying, and hatred are known to often develop anxiety and depression. Using ERP, one can study how the brain responds to microaggressions, hate, prejudice, and group dynamics. Researchers can focus on how individuals exposed to discrimination and hate respond differently to empathy from those similar to and different from the individuals who devalued them, how different interventions that address microaggressions facilitate changes in people’s automatic brain responses over time, and which individual neural differences (i.e., attachment style) facilitate or hinder individuals’ ability to recover from emotionally painful experiences. This research directly relates to the psychotherapy relationship. It allows for studying how openness to diversity, the culture or race of the client or therapist, and microaggressions in treatment affect the development of the therapy alliance, changes in symptoms, and interpersonal functioning.

Future Research Applications to Counseling Psychology

An example of using ERP in current psychotherapy research is to include this type of assessment before therapy begins, at different time points during the psychotherapy process, at termination, and at posttermination follow-up. In addition to standard premeasures, researchers would include ERP prior to treatment to assess reactions to stimuli meant to evoke similar thoughts, feelings, or physical sensations that may be the focus of treatment or occur during the therapy process. Researchers would then include ERP throughout the treatment study and assess neural responses along with self-report measures of interest (e.g., symptom measures, therapeutic alliance strength). The current literature on the therapeutic alliance does not include neural correlates, and there is no study to date that explores how patterns of neural activity are impacted by alliance rupture and rupture repair. This domain is an important area of psychotherapy research within counseling psychology today. Currently self-report and observer ratings of sessions are being used, and the addition of an ERP method may provide another source of worthwhile data in examining the impact of alliance ruptures and the process of rupture repair. For example, individuals with a history of insecure attachment experience ruptures differently from those with a secure attachment history, and with which the frequency ruptures are reported also appears to differ as a function of attachment style (Eames & Roth, 2000). It may be interesting to see how these variables are associated with the neural activity evoked by rupture stimuli (e.g., sentence stems with rupture-congruent or -incongruent content) in the context of attachment primes. Perhaps even more relevant to psychotherapy process would be examining how the results of these assessments change (or do not change) following successful rupture repairs or after a series of attachment-based interventions.

In addition to psychotherapy research, counseling psychologists study diversity, social justice, and the impact of discrimination. Individuals who experience discrimination, bullying, and hatred are known to often develop anxiety and depression. Using ERP, one can study how the brain responds to microaggressions, hate, prejudice, and group dynamics. Researchers can focus on how individuals exposed to discrimination and hate respond differently to empathy from those similar to and different from the individuals who devalued them, how different interventions that address microaggressions facilitate changes in people’s automatic brain responses over time, and which individual neural differences (i.e., attachment style) facilitate or hinder individuals’ ability to recover from emotionally painful experiences. This research directly relates to the psychotherapy relationship. It allows for studying how openness to diversity, the culture or race of the client or therapist, and microaggressions in treatment affect the development of the therapy alliance, changes in symptoms, and interpersonal functioning.
Summary

Integration of ERP methodology could have positive implications for the understanding of change processes in counseling psychology. As mentioned above, this method may allow for better understanding the transdiagnostic neural processes that underlie a variety of symptom presentations. Additionally, use of the ERP approach may allow for understanding how different therapies impact neural correlates of psychopathology, which allows for moving toward more parsimonious models of psychotherapy including only the necessary and active ingredients for successful therapy. Using a neuroimaging method to uncover the etiological processes that maintain psychopathology and the change processes in psychotherapy that allow change to occur may help psychologists establish biomarkers of successful treatment, as well as uncover predictors of relapse and treatment failure. Although some studies calling for the use of ERP in this way exist (e.g., Houston & Schlien, 2018; Luck et al., 2011), this type of research is still in its infancy, with ample room for counseling psychologists to shape its future trajectory.

References


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