
Chapter 4

Skin Conductance in the Study of Politics and Communication

Stuart N. Soroka
University of Michigan, Ann Arbor, MI, United States

INTRODUCTION

The last decade has seen a marked increase in the use of skin conductance in social scientific research, both as a real time measure of reactions to stimuli, and as an indicator of underlying predispositions connected to a range of political, economic and social behaviors. Recent work explores, for instance, psychological responses to “liking” and sharing on social media (Alhabash, Almutairi, Lou, & Kim, 2018); asymmetries in the impact of losses versus gains in economic experiments focusing on the “Monty Hall Problem” (Massad, dos Santos, da Rocha, & Stupple, 2018); and the relationship between threat sensitivity and politicians’ preferences for government spending (Arceneaux, Dunaway, & Soroka, 2018). There is increasing interest in the use of skin conductance as a measure of unconscious, real-time psychophysiological activation, across the social sciences.

This chapter provides an introduction to the use of skin conductance in social scientific work, with a particular emphasis on political science and communication studies. It begins by describing what we mean by the term “skin conductance.” The chapter then considers some of the most common interpretations of skin conductance in the social sciences, and outlines some of the advantages—both methodological and substantive—of skin conductance over some more typical measures in the study of political science and communication. We then turn to an expository example of the use of skin conductance in

★ This work draws on ongoing collaborative projects with Patrick Fournier, Lilach Nir, and Johanna Dunaway. Data gathering was supported by the Social Sciences and Humanities Council of Canada and the LSA at the University of Michigan. Research assistants for this project were Amanda Hampton, Sydney Foy, Heidi Fayer, and Autumn Szczepanski.

Biophysical Measurement in Experimental Social Science Research. https://doi.org/10.1016/B978-0-12-813092-6.00007-1
© 2019 Elsevier Inc. All rights reserved.
work on political communication, using data from recent psychophysiological experiments on reactions to negative versus positive network news in the United States.

WHAT EXACTLY IS SKIN CONDUCTANCE?

Skin conductance is one element of a broader psychophysiological quantity, electrodermal activity (EDA), which refers to changes in electrical activity at the skin surface. The study of EDA has a long legacy, including Carl Jung's (1969[1906]) word-association experiments, but the recent period of research using EDA, following somewhat more systematic methods of recoding and measurement, started in the early 1970s (see, for example, Lykken & Venables, 1971; Prokasy & Raskin, 1973). Most recent work focuses on skin conductance (SC), one measure of electrodermal activity focused on the ease with which an electrical current passes through the skin. Because water is a good conductor, changes in the moisture produced by eccrine sweat glands, typically on a participant's fingers or hand, produce differences in conductance (see Fig. 1). Increases (or decreases) in sweat gland activity are interpreted

FIG. 1 Cross-section of skin.

1. An alternative measure of a similar quality can be captured through the analysis of skin potential (SP) rather than skin conductance (SC), although the former is less frequent in the social sciences.
in psychophysiological work as increases (or decreases) in “activation” or “arousal,” broadly defined.

What exactly does “activation,” as captured by skin conductance, reflect? Why consider a measure of skin conductance in social scientific research? In short, skin conductance reflects changes in both information processing and/or emotional arousal; and as an implicit (i.e., not requiring active consideration by participants), automatic (i.e., not easily open to manipulation or reporting bias), and low-cost measure of real-time reactions to stimuli, skin conductance is able to capture these quantities in real time and without the need for conscious feedback from participants. SC thus has both methodological and substantive appeal for researchers interested in, for instance, attentiveness, information processing, and the effects of exposure to media messages. Substantive contributions offered by work on SC are the focus of the section that follows. This section focuses first on the methodological strengths and weaknesses of using SC as an indicator of psychophysiological activation.

Where measurement is concerned, the advantages of SC are straightforward. First, in comparison with some other physiological measures such as heart rate and facial myography, there is a relatively clear connection between SC and the sympathetic nervous system (SNS). The SNS, along with the parasympathetic nervous system (PNS), is a component of the autonomic nervous system (ANS), which regulates unconscious actions. The primary function of the SNS is mobilization, or “fight-or-flight.” This is in contrast with the PNS, the primary function of which is “rest-and-digest.” (For a particularly clear description of the physical mechanics of skin conductance, including its connection with the SNS, and the particular importance of eccrine sweat glands on the hand, see Dawson, Schell, & Filion, 2007.) Some psychophysiological measures, including heart rate, are governed jointly by the SNS and PNS. This can make the interpretation of these measures complicated as the SNS and PNS can pull in opposite directions, often in complex, interactive ways (see for example, work on autonomic space, e.g., Bernston, Cacioppo, Quigley, & Fabro, 1994). This is not a problem where SC is concerned—SC is governed predominantly by the SNS, and changes in SC are thus a clear signal of activation within the SNS. (And, as the next section describes, there are good reasons for social scientists to be interested in sympathetic activation.)

The second advantage is that measurement of SC is both inexpensive and straightforward. Most physiological encoders—i.e., the machines used to capture physiological measures such as SC—monitor a very small electrical current passed between two electrodes placed on the ends of two fingers (more specifically, the distal phalanx, typically on a respondent’s nondominant hand). If the voltage is held constant, changes in the current flow capture conductance, which fluctuates with sweat. The placement of electrodes will vary based on the technology being used; so too will the need for electrode paste (or not), and the complexity of the computer system required to both capture the physiological measure and present the stimuli. This chapter does not go into the details of data
gathering methods given the extensive variation in available systems. Suffice to say that SC data can be captured at a very high frequency using a relatively simple encoder attached to no more than a standard laptop computer. Fig. 2 offers an illustration of the measurement of SC with the kind of simple sensors and physiological encoder used for the experiments described below. For a more detailed discussion of the biological and physiological sources of SC, and further mechanics of measuring it see, for example, Andreassi (2007) and Dawson et al. (2007).

Most importantly, as with other psychophysiological measures, SC allows social scientists the opportunity to capture attitudes both implicitly and in real time. Survey responses and self-reports are limited in their ability to capture nonconscious predispositions. They also face constraints when the focus is on attitudes that participants may be uncomfortable revealing. (For a useful discussion, see Wagner et al., 2014.) SC is not limited in these ways. In addition, SC allows researchers to capture reactions in real time, without the need for any pausing or conscious effort on the part of participants. This facilitates, for instance, the study of activation in the context of decision making games, or second-by-second as a person views a news video.

There are some measurement-related weaknesses to the use of SC as well, of course. It is of some significance that SC activity is often but need not necessarily be related to emotion or affect. As we shall see below, there is a good deal of work that interprets heightened SC as an indication of affective or emotional arousal, but there also is work suggesting that heightened SC can reflect interest, attention, or cognitive effort (e.g., Lang, Greenwald, Bradley, & Hamm, 1993).

Relatedly, there is evidence that captures the activity of SC in response to positive or negative events, but not to neutral events, (e.g., happiness or sadness). However, the specific mechanisms underlying these effects are not well understood. A recent study (Dawson et al., 2007) found that participants who were asked to imagine a positive event (e.g., a happy event) had lower SC than participants who were asked to imagine a negative event (e.g., a sad event). This finding suggests that SC is sensitive to emotional states, but further research is needed to clarify the specific mechanisms involved.

**WHAT**

What have we learned from these studies? One key finding is that SC has a broad range of applications in social science research. It is both a powerful tool for measuring emotional states and a sensitive indicator of cognitive processes. This makes it a valuable tool for researchers interested in understanding the dynamics of human behavior. However, there are also some limitations to consider. For example, while SC is sensitive to emotional states, it may not be as sensitive to cognitive processes. This means that researchers need to be careful when interpreting SC data and considering the specific research question at hand.

---

2. Note also the response to it
Relatedly, it also matters that when SC captures emotion, it captures the intensity but not what is termed the valence of affect. In more common language, SC captures the magnitude of a reaction, but not whether that reaction is positive (e.g., happiness) or negative (e.g., fear). Heightened SC may thus reflect both interest and affect, and if it reflects affect, that affect may be either positive or negative. Any interpretation of SC must consequently recognize this potential blending of attention and affect. In particular, when valence matters for research hypotheses, the identification of valence in SC measures must rely either on (1) additional psychophysiological measures such as EMG (electromyography) data, which by capturing a smile or a furrowed brow can point towards positive or negative affect, or (2) stimuli that are very clearly valenced, such as a photo that pretests suggest consistently evoke disgust (vomit), fear (an attacking snake), or happiness (a puppy), as is the objective of work relying on the International Affective Picture System (IAPS; see, for example, Bradley & Lang, 2007). The selection of stimuli that are clearly valenced can in many instances be straightforward, and assumptions about the valence of SC reactions can be similarly straightforward. Furthermore, a good number of research questions exist for which simple physiological activation—i.e., evidence of a reaction (or not) from the SNS—is all that is required.

WHAT CAN WE LEARN FROM SKIN CONDUCTANCE?

What have existing literatures learned from measures of skin conductance? SC has been an especially relevant quantity for researchers interested in affective activation, and particularly negative affective activation. Work in psychophysiology typically considers SC as a measure of responsivity to what Schell, Dawson, and Marinkovic (1991) refer to as “potentially phobic” or “fear relevant” stimuli. The tendency for fear-inducing stimuli to produce a reaction in SC has been well established, in large part by early work by Öhman and colleagues (e.g., Öhman, Fredrikson, & Hugdahl, 1978). This link to negativity fits well with the fact that the SNS is concerned with fight-or-flight reactions. Heightened SC in response to negative rather than positive stimuli fits with recent work linking SC to activity in the amygdala, a section of the brain linked to emotional reactions, particularly those related to fear and anxiety (e.g., Cheng, Knight, Smith, & Helmstetter, 2006; Phelps et al., 2001).²

SC has thus featured prominently in psychological work focused on negative reactions to stimuli. For instance, Dotsch and Wigboldus (2008) explore “impulsive prejudiced behavior,” based on measures of SC recorded while participants interacted with White versus Moroccan avatars in a virtual environment, where heightened SC is interpreted as indicating higher levels of prejudice. (Note this is a particularly valuable example of the advantages of

---

². Note also that SC has played a central role in the argument for an evolutionary basis of emotional response to information (Öhman, 1986).
using SC to capture attitudes that participants may not reveal through standard questionnaires. For a review of earlier work in this area, see Guglielmi, 1999.) Romero-Martínez, Lila, Williams, González-Bono, and Moya-Albíl (2013) find that participants with a history of violence towards intimate partners show higher SC levels during periods surrounding a stress test (in this case, involving a verbal presentation and a mental math problem), and suggest that there may be biological correlates of abusive behavior. Hein, Lamm, Brodbeck, and Singer (2011) find that participants who exhibit higher levels of SC activation while observing another person’s pain are more likely to choose to help in subsequent rounds, even when that help is costly (see also Krebs, 1975).

Work spanning the fields of psychology and economics has used SC as a means of exploring the role of affect in decision making. There is a considerable body of work linking SC to various aspects of decision making under risk (e.g., Bechara, Damasio, Tranel, & Damasio, 1997; Tchanturia et al., 2007; Tomb, Hauser, Deldin, & Caramazza, 2002). Studer and Clark (2011) offer a recent example, in which they explore SC during a gambling task, and find links between SC and the need to make an active choice, the magnitude of wins or losses, and the chances of winning. Here, and in related work (e.g., Dawson, Schell, & Courtney, 2011; Palomäki, Kosunen, Kuikkaniemi, Yamabe, & Ravaja, 2013), high-risk and/or negative outcomes are associated with higher activation. The same is true for work exploring skin conductance during the ultimatum games commonly played in economic experiments (e.g., Hewig et al., 2011; Wu, Luo, Broster, Gu, & Luo, 2013).

The emphasis on SC as an indication of information processing or cognitive effort is especially evident in work in communication studies. Work by Lang and colleagues has been particularly influential in this area. They find, for instance, that participants exhibit higher levels of activation when confronted with risky rather than nonrisky products, and that this heightened activation is correlated with increased recall of those products. The link between physiological activation and information processing is especially clear in these authors’ interpretation of their results: “risky products are capable of eliciting arousal in viewers that, in turn, results in the automatic allocation of mental resources to processing the messages” (Lang, Chung, Lee, & Zhao, 2005, p. 297). Earlier work using video stimuli similarly finds that arousal is positively related to recall (Lang, Dhillon, & Dong, 1995, p. 1999).

Where politically-focused work is concerned, Wang, Morey, and Srivastava (2014) use skin conductance as an indication of attentiveness to political ads from those who both support or do not support the advertised party; while Daignault, Soroka, and Giasson (2013) use skin conductance to explain what appears to be the heightened impact of negative advertising. For news content, Soroka (2014) and Soroka and McAdams (2015) use skin conductance to explore how recent responses and threats, all of which hibbing, in the field.

The emphasis on SC as an indication of information processing or cognitive effort is especially evident in work in communication studies. Work by Lang and colleagues has been particularly influential in this area. They find, for instance, that participants exhibit higher levels of activation when confronted with risky rather than nonrisky products, and that this heightened activation is correlated with increased recall of those products. The link between physiological activation and information processing is especially clear in these authors’ interpretation of their results: “risky products are capable of eliciting arousal in viewers that, in turn, results in the automatic allocation of mental resources to processing the messages” (Lang, Chung, Lee, & Zhao, 2005, p. 297). Earlier work using video stimuli similarly finds that arousal is positively related to recall (Lang, Dhillon, & Dong, 1995, p. 1999).

Where politically-focused work is concerned, Wang, Morey, and Srivastava (2014) use skin conductance as an indication of attentiveness to political ads from those who both support or do not support the advertised party; while Daignault, Soroka, and Giasson (2013) use skin conductance to explain what appears to be the heightened impact of negative advertising. For news content, Soroka (2014) and Soroka and McAdams (2015) use skin conductance to explore how recent responses and threats, all of which hibbing, in the field.

3. For an introduction to the use of SC in this area, see Dawson et al. (2011).

4. Note the that SC res.
explore heightened attentiveness to negative news content as one account for the prevalence of negative news. Other work explores gender differences in reactivity to news content as a means of explaining the gender gap in political interest and knowledge (Grabe & Kamhawi, 2006; Soroka Gidengil, Fournier, & Nir, 2016).

A recent body of work in political science focuses on skin conductance not just as a measure of real time reactivity to information, or as an indication of either affective or cognitive processes, but rather as a measure with which to explore underlying predispositions in reactivity to information. Most prominent is recent work by Hibbing and colleagues, which uses skin conductance responses to images to capture either threat sensitivity or disgust sensitivity, and then explores the political correlates of each. There is a small but growing body of work that connects threat and/or disgust sensitivity to conservative political attitudes in the United States (e.g., Dodd et al., 2012; Hibbing Smith, & Alford, 2014; Oxley et al., 2008; Smith, Oxley, Hibbing, Alford, & Hibbing, 2011; see also Arceneaux et al., 2018). (This is line with early work in the field focusing on skin conductance as measure of reactivity to racial threat, although results in that case led researchers to be somewhat skeptical of psychophysiological measures; see Wahlke & Lodge, 1972.) Other recent work highlights a connection between heightened reactivity to images and increased political participation (Gruszczynski, Balzer, Jacobs, Smith, & Hibbing, 2012), as well as a correlation between heightened skin conductance levels in response to images of Barack Obama and the expressed intensity of attitudes towards both the candidate and his health care policy: “...our findings,” Wagner et al. (2014, p. 313) note, “suggest that people’s opinions of the job being done by President Obama or of health-care reform are shaped not just by conscious feelings but by unconscious subprocesses.”

The existing literature thus highlights many different interpretations of SC. One might distinguish views of SC as being on the one hand about measuring affective reactions or cognitive activation, and on the other hand about measuring real time information processing or “nonconscious subprocesses.” These approaches are not contradictory. Given the importance of emotion to “rational” thinking (see in particular Damasio, 2005), there is no reason to expect psychophysiological activation to capture just one or the other. Additionally, the fact that SC captures automated physiological reactions is what facilitates both the real-time information-processing perspective and the notion that SC indicates something subconscious that regular survey questioning (and answering) cannot reveal.

The value of SC as a measure in communication and political science hinges then on whether psychophysiological activation, representing some combination of affective and/or cognitive reactivity, is of importance in the study of

---

4. Note the parallels between Damasio’s seminal work and Potter and Bolles (2011, p. 31) argument that SC research hinges on a belief that “cognitive processes can be inferred from bodily reactions.”
information processing, media effects, and/or political preferences. It clearly is. There are large groups of literature focused on attentiveness to political news content, the impact of political advertising, and the ways in which people remember (or do not remember) political information. There is a growing body of work on the importance of emotion in news choice, in political decision making, and on subsequent behavior. SC measures offer an opportunity to further explore how affect is important in decision making, or the situations for which, or individuals for whom, affect is likely to play a greater or lesser role. It may also capture deep-seated, otherwise unmeasurable reactions that structure how we react to our (political) world. SC also offers an unobtrusive way to capture reactivity to information over time. It is for these reasons that SC has been of increasing interest in research on communications and political behavior.

NEGATIVITY BIASES IN REACTIONS TO NETWORK NEWS

The sections that follow offer an expository analysis of SC, focused on reactions to television news programming. There is a good deal of work in political communication documenting high and/or increasing levels of negativity in news content (e.g., Cappella & Jamieson, 1997; Farnsworth & Lichter, 2007; Patterson, 1994; Sabato, 1991). There is also research suggesting that people are more activated by, and pay more attention to, negative news (e.g., Soroka, 2014; Trussler & Soroka, 2014). Whether this prevalence of, and attraction to, negative news is problematic is unclear. On the one hand, negativity may encourage attentiveness to political issues, particularly problematic issues that require attention. There is evidence that cynicism may be positively rather than negatively related to mobilization (de Vreese, 2005), and that conflict may increase participation (Martin, 2008; Schuck, Vliegenthart, & de Vreese, 2014).

On the other hand, it may be that biases in human information processing are enhanced by media organizations, whose primary purpose is after all to produce news that will attract an audience. The end result may be the provision of disproportionately negative information, and as a result, decreasing political interest and engagement. (The debate about the direction of the relationship between negative versus positive information and turnout has been particularly rich in work on political advertising. See, for example, Ansolabehere, Iyengar, Simon, & Valentino, 1994; Brooks, 2006; Finkel & Geer, 1998; Lau, Sigelman, Heldman, & Babbitt, 1999.)

There is accordingly a need for work that seeks to better understand (1) the widespread tendency for news consumers to be more attentive to negative information, and (2) what this tendency means for the encoding and recall of political information, and for political behavior more broadly. The sections that follow focus on (1), exploring the possibility that American television news viewers will be more psychophysically activated by negative than by positive news content. Stronger psychophysiological activation in response to negative news content may help account for the decidedly negative nature of news content and political attentiveness, the negative findings in an area for future issues in...
political campaigns. If the aim of news programs is to find an activated and attentive audience, and if negativity tends to increase psychophysiological activation, then it makes sense that news programs would come to focus more on negative information. Considering this possibility and understanding how these findings matter for political psychology and behavior more broadly, is a critical area for future work. In a concluding section, results are discussed with these issues in mind.

METHODS

This study replicates and extends recent work exploring skin conductance in response to television news content (Soroka & McAdams, 2015). While this past work focuses on a relatively small student sample in Canada, the analyses that follow rely on a larger, more representative sample in the United States. Analyses are based on 116 female and 69 male respondents, where 110 were recruited from an undergraduate student participant pool, and 75 were recruited from a more representative pool managed primarily for medical research.

The experimental protocol combines a physiological study and a computer-based survey. We focus here on variations in skin conductance during the physiological study, a video experiment involving seven randomly-ordered BBC television news stories. A list of all stories used in the experiment is shown in Table 1. All respondents are shown the two domestic stories, one of which is positive and one negative. They also see a random draw of five of the international stories. As there are a total of eight possible international stories, four positive and four negative, respondents can end up with a broadcast that is predominantly positive or negative; but each will see at least two positive and two negative stories. Most see three of one valence and four of the other. The order of stories is entirely randomized, so that effects of one story are not influenced by any single preceding story. Stories range from roughly two and a half to under four minutes long. Depending on the randomization, the entire study takes between 20 and 30 minutes.

Stories are coded for valence in several ways. They are first categorized by research assistants as either predominantly negative or positive; this is done as part of the story selection stage. After stories are selected, they are coded second-by-second on a five-point scale of valence by three expert coders. (Details on coding are available in Soroka & McAdams, 2015.) The average tone is then the averaged either across the entire story, or five second interval, depending on the level of analysis. This coding of stories is further confirmed by postexperimental questions asking respondents to rate each story on several dimensions, including negativity. Subjects’ mean ratings, on a scale of one to seven, are in the last column of Table 1. The correlation between the two sets of ratings is 0.95.

Coder-rated valence is thus the principal independent variable in our analysis. The dependent variable is skin conductance level (SCL). An illustrative
TABLE 1 Video Stimuli

<table>
<thead>
<tr>
<th>Title</th>
<th>Description</th>
<th>Valence</th>
<th>Coder Rating (−2 to 2)</th>
<th>Participant Rating (1 to 7)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peru</td>
<td>Small town of Chimbote burns down</td>
<td>Negative</td>
<td>0.859</td>
<td>4.783</td>
</tr>
<tr>
<td>May Day</td>
<td>May Day protests following economic downturn</td>
<td>Negative</td>
<td>0.688</td>
<td>3.161</td>
</tr>
<tr>
<td>Niger</td>
<td>Food Shortages in Niger</td>
<td>Negative</td>
<td>1.071</td>
<td>5.082</td>
</tr>
<tr>
<td>UN Sri Lanka</td>
<td>UN investigations in war crimes in Sri Lanka</td>
<td>Negative</td>
<td>1.253</td>
<td>5.157</td>
</tr>
<tr>
<td>Gorillas</td>
<td>Gorillas are released into wild</td>
<td>Positive</td>
<td>−1.053</td>
<td>1.541</td>
</tr>
<tr>
<td>Folding car</td>
<td>New electric, folding car intended to reduce congestion</td>
<td>Positive</td>
<td>−0.356</td>
<td>1.456</td>
</tr>
<tr>
<td>Young director</td>
<td>11-year old makes stop-motion films</td>
<td>Positive</td>
<td>−1.053</td>
<td>1.073</td>
</tr>
<tr>
<td>Cured liver disease</td>
<td>Young child recovers from liver disease</td>
<td>Positive</td>
<td>−0.540</td>
<td>1.625</td>
</tr>
<tr>
<td>Domestic</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Homeless</td>
<td>A homeless man is battered and shot by police</td>
<td>Negative</td>
<td>1.059</td>
<td>5.739</td>
</tr>
<tr>
<td>Bagpipes</td>
<td>A US man learns how to make bagpipes</td>
<td>Positive</td>
<td>−0.693</td>
<td>1.184</td>
</tr>
</tbody>
</table>

SCL time series is shown in Fig. 3, from one participant, over the first 150 five-second intervals of the experiment. (Note that SCL values typically lie somewhere between 2 and 20 microseimens.) The task of the current project is to explore to what degree the increases and decreases evident in Fig. 3 are related to the experimental stimuli—in this case, news content.
Skin conductance is captured using a ProComp encoder from Thought Technology and is originally sampled 256 times per second. The data is first downsampled by taking averages over 125-ms intervals, and then smoothed slightly, using Lowess smoothing. The smoothing matters relatively little in this case given that the analysis focuses on five-second and full story intervals. For work that explores skin conductance responses at much smaller time intervals, however, appropriate smoothing and the removal of outliers can be critical. Indeed, the construction of SC measures will in some instances be much more complex than what is presented here.

Where more complex analyses are concerned, it is worth distinguishing between work on skin conductance levels (SCL) and skin conductance responses (SCR), where the latter involves a counting of spikes in the SC signal, and/or a detailed analysis of the shape of individual SCR. Indeed, Dawson et al. (2007) review a range of different possibilities where the analysis of SC is concerned, including levels, changes, frequency of SCR, SCR amplitude, habituation, and so on. Some work also uses a combination of SCL and SCR as means of distinguishing different cognitive processes (e.g., Cacioppo & Sandman, 1978). (The spikes in Fig. 3 reflect SCRs, although we do not see the full shape of individual SCRs when data are averaged over five-second intervals.) It is also generally true that SCL and SCR are associated with the tonic (long-term) and phasic (short-term) components of SC respectively; and for those using SC as a millisecond-to-millisecond signal of cognitive processing, separating SC levels from responses, and responses from each other, can be a complex statistical problem (e.g., Bach, Flandin, Friston, & Dolan, 2009; Benedek & Kaernbach, 2010; Lim et al., 1997). Much like the study that follows, however, a good deal of work in political science, communications, and economics has focused on mean levels of SC over longer time periods (from five-second periods upwards), lumping together a combination of tonic and phasic components.

"Normalizing" the skin conductance signal is crucial regardless of time interval. The objective of this procedure is to take into account the fact that
different individuals will exhibit rather different mean levels of skin conductance, due not just to demographic differences but also time of day and room temperature (e.g., Venables & Mitchell, 1996). Not taking these inter-individual differences into account can make identifying stimulus effects rather difficult. The bare minimum standard approach to normalizing SC data—and the one used here—is to use measures of a participant’s skin conductance during the stimulus relative to skin conductance levels recorded during a prestimulus period.

In the current experiment, the first news story is preceded by two-minutes of gray screen, and then for 40 seconds a gray screen appears between each succeeding pair of stories. The options given this setup are to express skin conductance levels relative to either (1) the first two-minute baseline period, or (2) the baseline period that precedes each story. The advantages of the latter are twofold: not only does it remove individual-level differences in skin conductance levels, by allowing the baseline level to change between stories, but it also partly accounts for the tendency of SCL to decrease over the course of longer experiments. This may be a consequence of measurement issues with the electrode, and/or it may be related to participants’ habituation to the experimental environment or the decreasing impact of stimuli. Regardless, one simple correction is to detrend the SCL measure (e.g., Soroka & McAdams, 2015). Another is to include the impact of time in regression models. Another still is to allow the baseline to shift from one story to the next, which will, at least in part, remove trends in SCL over the course of an experiment. This is one major advantage to normalizing stimulus period SC using the baseline period that precedes each story. (There is a long-standing and valuable literature on different approaches to normalizing SC measures, in terms of both baselines and variances. For early work, see, for example, Ben-Shakhar, 1985; Lykken, 1972; Stemmler, 1987.)

The estimation used here is relatively simple, in part because a good deal of work in the social sciences takes a similarly simple approach. We explore the effects of story valence on SCL by estimating a panel model in which each respondent-video combination is a case. There are seven stories for each respondent, and each of those stories is associated with both a mean valence, and mean SCL. The analyses that follow explore the within-subject relationship between these two mean values. This approach prevents us from looking in detail at what exactly in a video provokes a skin conductance response; it only explores the possibility that, overall, a negative story will provoke higher levels of activation than a positive story. More detailed analyses are certainly possible, connecting SCL to specific moments in videos, and/or modeling individuals’ reactions using more complex time-series methods. There also may be interesting differences in either levels or reactivity of SCL across gender, age, political interest and so on, but those are not the focus of the analysis that follows.

The simple model used here is as follows:

\[ SCL_{i,t} = \alpha + \beta_1 \text{valence}_{i,s} + \beta_2 \text{order}_{i,s} + \beta_3 \text{length}_{i,s} + e_{i,s}, \tag{1} \]

where \( SC \) above: or

of stories reactions

length is in each st

able to also beca
difference normali

RESULT

A simple the mean are negati

a news st

SCL dur decrease is \(-2.94\),

that SCL

The ii

from the

Hausman

effects. (c

of course.) 1

ated with

sured on

averages

\(-1.5\) to of this ra

This is i

5. The san

"normalize:

(fo each in

tit assumes t

reach durin

this work a
where $SCL$ and valence for individual $i$ and story $s$ are as they are described above; order is an ordinal variable representing the place of story $i$ in the series of stories viewed by the participant, to capture the possibility that respondents' reactions change based on the number of stories they have seen thus far; and length is an interval-level variable counting the number of five-second intervals in each story, in case the length of a story leads to lower or higher average $SCL$. (We might, for instance, imagine that longer stories eventually become less engaging, and lead to lower average $SCL$.) We do not add demographic variables to the model, partly because they are not the focus of our analysis, but also because they should not be critical to revealing the impact of valence: level differences that are a consequence of demographics will be accounted for by normalizing the SC signal within subject.\(^5\)

**RESULTS**

A simple $t$-test comparing $SCL$ during positive versus negative stories finds that the mean of the former is $-0.69$ while the latter is $-0.001$. Note that both values are negative, reflecting the tendency for $SCL$, following activation at the start of a news story, to decrease over the course of the story. However, the decrease in $SCL$ during negative stories is marginal, in comparison with the notable decrease during positive stories. (The $t$-statistic for a difference in means test is $-2.94$, which is statistically significant at $P < .01$.) Already, this is evidence that $SCL$ is higher for negative than for positive news stories.

The impact of valence is further explored in Table 2, which shows results from the panel model described above. The model was estimated with both fixed and random effects, but only the latter are included here, because a Hausman test suggests no significant difference with the addition of the fixed effects. (This is as we should expect given that the data is normalized, of course.) Estimates suggest no impact of story length on mean $SCL$. The order of videos does matter however: each additional story in the newscast is associated with a decrease in $SCL$ of $-0.051$. Valence also matters. Valence is measured on a five-point scale, from $-2$ to $+2$, but these estimates are based on averages across whole stories, so the observed range of tone is closer to $-1.5$ to $+1.5$. Based on the estimates in Table 1, moving from one extreme of this range to the other is associated with a roughly $-0.15$ change in $SCL$. This is illustrated in Fig. 4, where the black line shows the estimated $SCL$

---

5. The same is not true for differences in variance across subjects, of course. Some work "normalizes" to account for different variances as well, expressed all SC in standard deviations (for each individual), above or below the baseline period. The difficulty with this approach is that it assumes that all respondents exhibit equal levels of activation, i.e. the highest (lowest) level they reach during the experiment is the height of their activation. This is a rather strong assumption, so this work avoids normalizing variances across individuals.
TABLE 2 The Impact of Story Valence on SCL

<table>
<thead>
<tr>
<th></th>
<th>DV: SCL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valence</td>
<td>-0.050* (0.025)</td>
</tr>
<tr>
<td>Order</td>
<td>-0.051*** (0.011)</td>
</tr>
<tr>
<td>Length</td>
<td>-0.001 (0.003)</td>
</tr>
<tr>
<td>Constant</td>
<td>0.161** (0.061)</td>
</tr>
<tr>
<td>N</td>
<td>1183</td>
</tr>
<tr>
<td>Rsq</td>
<td>0.026</td>
</tr>
</tbody>
</table>

*Cells contain OLS regression coefficients with standard errors in parentheses.
* P < .05; ** P < .01; *** P < .001.

FIG. 4 The impact of story tone on SCL.

and the shaded area shows 95% confidence intervals, and where negative values for valence indicate negative valence.

Fig. 4 offers a simple illustration of the tendency for Americans to be more activated by negative than by positive news content. Note that the regression line captures the average effect over the entire story, so a predicted value of just over zero when valence is -1.5 combines (1) typically very high activation at the beginning, and then intermittently over the course of the story, and (2) other periods during which SCL is declining. The figure thus gives a highly averaged and highly stylized view of the communication process. As noted above there are ways to look in more detail at the impact of news coverage on psychophy measures: five-second length of second interest from view and decre complex for Soroka and

Rather models in within-individual approach offers sim

averaged:

where tim model est every five for one ne

These are active or pe here. Thes SC during to levels of positive story. Results he than posit

FIG. 5 The
psychophysiological activation. One approach is to move to a repeated-measures structure in which each respondent is his or her own panel, and every five-second interval is an observation. Given the number of participants and the length of the news stories, this leads to a rather large dataset (~50,000 five-second intervals for each of 175 respondents). The estimated impact of valence in a time-series panel estimation relying on these data is not statistically different from what we have seen above—activation increases with negative content and decreases with positive content—although the estimation must be more complex to deal with the existence of multiple observations per subject; see Soroka and McAdams (2015) for an example using similar data.

Rather than estimate the impact of valence, however, we can also explore models in which SCL, across all respondents, is estimated as a function of within-story time, included as a categorical variable. The advantage of this approach is that it makes no assumptions about what affects activation—it offers simple descriptive information on the impact of news content on SCL, averaged across all respondents. Each story is modeled separately, as follows,

$$SCL_{i,t} = \alpha + \beta_1 \text{time}_t + \epsilon_{i,t},$$

(2)

where time simple counts through the five-second intervals $t$. To be clear, the model estimates average SCL and margin of error across all participants for every five-second interval in each story. Fig. 5 shows the estimated trends for one negative (Sri Lanka) and one positive (Young Director) story.

The difference between the negative and positive story in Fig. 5 is very clear. These are among the clearest examples. Stories that are not as consistently negative or positive will produce trends that are not quite as clear as what we see here. These two stories are included because they are paradigmatic examples of SC during a negative and positive story: the negative story about Sri Lanka leads to levels of SC that are marginally higher than the baseline value; while the positive story about the young director leads to a steadily declining activation. Results here thus confirm the tendency for negative news to be more activating than positive news.

![FIG. 5](image-url) The impact of story tone on SCL, at five-second intervals.
DISCUSSION

Results as shown in Fig. 5 are exactly as we should expect given what we know about the impact of negativity on skin conductance in other fields, but Fig. 5 offers an especially clear illustration of why we might expect news content, and perhaps political campaigns as well, to focus more on negative than on positive information. Insofar as skin conductance reflects not just physiological activation, but an affective reaction, or a change in the way in which we process information, or both, there may be good reason for news producers to focus primarily on negative news—i.e., it generates larger audiences, and/or holds people's attention longer, and/or has a more lasting impact.

This conclusion depends on the belief that physiological activation will be positively correlated with news selection, or consumption, or recall. Whether this is actually the case is unclear, however. Past work in psychophysiology and neurology gives us good reason to connect heightened skin conductance with affect. As discussed above, there is a considerable body of work that finds a connection between skin conductance and other measures of heightened (primarily negative) affect. There is also good evidence that heightened skin conductance reflects a change in information processing. As we have seen, work in economics and psychology has shown how decisions change when information is interpreted during heightened activation, and there is a good amount of evidence suggesting that recall is better when activation is higher. Nevertheless, we do not yet fully understand the degree to which actual news consumption and political behavior are affected by whether or not news content is physiologically activating.

One might imagine several possibilities. Negative content might prove more interesting and be better remembered, and provoke an active consideration of political attitudes, or even participation. Alternatively, negative content might be activating, but in a way that encourages avoidance and disengagement, so that citizens withdraw not just from news content but from politics more broadly. Existing work focused on information processing would seem to suggest the former, insofar as negative information seems to be more activating, and more easily recalled. However, none of the existing literature has focused explicitly on political stimuli.

We thus cannot be sure whether increased activation as a consequence of negative news content will produce more or less political engagement and participation. This is of some significance, as one predominant modern concern in politics and political communication is that negative content is leading to disaffection and withdrawal from politics. Work using SC is not yet well-equipped to offer answers on this critical issue, because our ability to link skin conductance to behavior outside the lab has been limited.6

---

6. Note that asking people about their intentions where political behavior is concerned is straightforward, but the link between intended and actual subsequent behavior is rather weak.
SC-focused work can nevertheless offer valuable information on the aspects of media content that provoke activation, affect, information processing, and/or cognitive effort. The fact that SC captures reactions in real time is of special importance for those interested in work on media effects, or in information processing during games (i.e., during economics experiments). The additional fact that SC captures reactions implicitly means that researchers avoid the problems of self-assessments, at least for quantities that are indicated through nonconscious psychophysiological reactions. For these reasons, the analysis of SC provides a uniquely simple means by which to explore the ways in which affect and information processing matter for learning and decision making, not just in political science and communication but across the social sciences.

REFERENCES


Skin Conductance in the Study of Politics and Communication


Wang, Z., Morey, A. C., & Srivastava, I. (2014). Motivated selective attention during political ad processing the dynamic interplay between emotional ad content and candidate evaluation. *Communication Research, 41*(1), 119–156.