

RUNNING HEAD: SOCIAL EVALUATION THROUGH SHARED EMOTIONS

On the Same Wavelength: Shared Emotions as Information for Social Evaluation

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### **Abstract**

Many of people's most profound social connections with others occur during shared emotions, or situations where people experience the same emotions in response to the same event. But how does sharing an emotion, especially a negative one like anxiety, bring people together? We propose a mechanistic account of the binding effects of shared emotional experiences called Affective Wavelengths. According to Affective Wavelengths, people evaluate one another based on the overlap, or lack thereof, in their emotional reactions to shared experiences. 6 studies leveraged a variety of emotions including anger, anxiety, amusement, disgust and embarrassment to suggest that any shared emotion can bring people together, and that unshared emotion increases social distance. Participants did not need to experience the same situation to evaluate each other based on shared emotions (studies 1+2). And the social benefits of shared emotions persist when technology prevents people from hearing and seeing each other (study 3) and when perceptions of others are distorted (study 4). Shared emotions were even potent enough to overcome ideological differences, connecting liberal participants to a conservative confederate at a time when political divisions were at an apex. But, shared emotions did not connect participants when their social implications were contradicted by the situation that brought them about (study 6). We close by introducing a mechanistic theory of Affective Wavelengths, applying that theory to explain other psychological phenomena, and suggesting future research directions and applications for research on Affective Wavelengths.

### **On the Same Wavelength: Shared Emotions as Information for Social Evaluation**

We refer to situations where two individuals feel similarly about an event as shared emotional experiences, or shared emotions for short. Whether we are watching movies with friends, relating past experiences, or telling stories, shared emotional experiences are ubiquitous. We propose that people rely on shared emotional experiences to evaluate and prioritize social partners.

Imagine someone leaves a theater delighted by a movie he has just seen. The director portrayed a budding romantic relationship between two young women in a nuanced and tasteful manner, and innovatively characterized the state of their relationship through their love-making. While leaving the theater, he runs into a stranger who smiles when he unintentionally makes eye contact with her. He decides to strike up a conversation and asks her about the movie they have both just seen. When asked how she felt about the movie, the woman's smile is replaced by a disgusted look, and she tells him that she is glad the movie is over and that she deeply regrets that she will never get the last several hours of her life back. Why would anyone spend their hard-earned money on a contrived coming of age story with long segments of lesbian pornography? The woman then asks him to join her for a cup of coffee across the street. Would he be likely to join her?

While the man in this vignette knows little about the woman he just met, her reaction is informative at multiple levels and is likely to shape his decision to get coffee with her. First, the man might feel hurt or rejected by the woman's disagreement with his feelings about the movie. On another level, the man may also infer, for example, that the woman is close-minded and leans toward the conservative end of the spectrum, which may cast doubt about their social compatibility. But, before either of these two processes can unfold, a third might already negatively color the man's impressions of the woman. Given his positive disposition moments earlier, a disgusted expression that sharply contrasts with his own would be jarring and unexpected. The man would likely need a few additional moments to make sense of the woman's reaction.

This third, automatic, computationally lightweight and immediate phenomenon is the subject of this paper. Borrowing from a common idiomatic expression where two people are said to be 'on the same wavelength' when they easily understand each other, we will refer to the theory that people evaluate social partners based on whether social partners' emotions are immediately consistent with one's own emotions or immediately violate one's expectations, as 'Affective Wavelengths Theory'. And we refer to the phenomena characterized by this theory as 'Affective Wavelengths'.

We hypothesize that when two people encounter a situation together and the other person's reaction makes sense in light of one's own, then one feels closer to that person. However, when one is surprised, meaning that expectations (or predictions) are violated,

additional mental acrobatics are needed to interpret another person's reaction and one consequently feels more distant from that person.

### **The Evolutionary Significance of Social Evaluation**

As a social species, most outcomes, and therefore people's ability to survive and reproduce, depend on their ability to navigate their social environment. At the coarsest level, interacting with the wrong people can mean betrayal and death, while interacting with the right people can lead to a variety of benefits including aid in the acquisition of resources, alerts to threats, and aid in coping with life's challenges. There is also variability in the quality of social partners, including availability and the degree to which a partner is able to successfully coordinate their behavior with a particular individual. Because they are limited in their resources, e.g. time, energy and material goods like food, people need to preferentially invest their limited resources in the best partners possible. Positive interactions with a particular partner can set the stage for future interactions, whereas negative interactions discourage future partnerships. Moreover, social interactions have what economists refer to as "opportunity costs". Interacting with a given individual does not just cost the resources invested in that situation, but also the resources that could have been gained from investing one's resources elsewhere. To further complicate things, others also have choices in social partners, so people need to be confident that those they choose as friends will choose to interact with them over social alternatives.

The challenges presented by the social environment place a high premium on minds equipped with mechanisms for accurately evaluating others as potential social partners. We will argue that others' emotional reactions during shared emotional experiences offer important insights into people's value as social partners, and that the human mind exploits this information. In the section that follows, we discuss the importance of shared emotions, and more specifically Affective Wavelengths, for evaluating social partners.

### **Affective Wavelengths as a Cheap and Valuable Means for Social Evaluation**

The evolutionary importance of identifying and selectively interacting with good social partners places selective pressure favoring mechanisms that improve the accuracy with which we evaluate others. Prior research has also discussed other means through which people can connect, including work on similarity dating back to Tajfel (1970) and recent work examining buying gifts for people we would like to impress (Griskevicius, et al, 2007). Where do shared emotions fit in the context of other affiliative behaviors?

Though the downstream social evaluative effects of shared emotions are not necessarily different from the effects of reciprocity or similarity, shared emotions, including Affective Wavelengths, offer unique value as informative and cheap social signals:

**Shared Emotions are naturally imbued with social significance.**

Emotions are people's naturally occurring embodied evaluations of their surroundings. Because people rely on their own emotions to navigate their surroundings in real time, both one's own emotions and others' emotions are frequently and spontaneously available as sources of information in one's normal, everyday surroundings.

The meaning of a particular situation is shaped by a lifetime of social and cultural experiences. People feel happy when they feel their situation has improved, saddened when they experience losses, and are angered by injustice. Therefore, when people feel similarly about an event, which is suggestive of similar assumptions about the world, they are more likely to get along, discover additional commonalities, and cooperate effectively together.

**Emotional reactions provide rich, hard-to-fake, easily detectable cues.**

When people respond to situations, emotions automatically manifest in multiple modalities (e.g. facial expressions, body posture, hand gestures, tone, verbal content, etc.) simultaneously. While the majority of these behavioral responses are designed to help the person experiencing an emotion appropriately respond to his or her surroundings, emotional reactions also provide observers with numerous, redundant and readily available clues for understanding the experiencer's perspective. Because these behaviors occur largely automatically, they are hard to fake.

**Affective Wavelengths are cheap.**

When people experience an emotion, they rely on pre-existing assumptions and expectations about the nature of the triggering event. Since human interactions are naturally full of emotional experiences, one's emotional experiences can frequently be compared with others'. And since Affective Wavelengths are intuitive and almost effortless, they are cheap.

**Low-Costs and lots of cues make Affective Wavelengths rapidly cumulative.**

Because emotions are rich sources of information, occur naturally in the world, and are readily perceptible, people can use their own emotions to quickly and cheaply evaluate those around them at minimal cost. This allows people to constantly fine-tune their closeness or distance to others in their social environment.

**Emotions can scaffold more costly social investments.**

While other, potentially more powerful, ways to build and maintain relationships exist, investing resources in others tends to be a zero-sum proposition. The time, energy, or resources (e.g. gifts) provided to one individual preclude providing the same benefits to another person. Given the costs and risks associated with investing one's finite resources in the wrong individual,

shared emotional experiences, which come at little cost beyond spending time with another person, can provide initial evaluations before higher-risk interactions and transactions take place. And in ongoing close relationships, shared emotional experiences can be a means through which people fine-tune and re-prioritize physical and social resources depending on their best bet for future success.

In summary, others' emotions can function as cheap, hard-to-fake, readily available, cumulative indicators (or clues) for navigating the social world by establishing social priorities, i.e. determining which relationships to cultivate and which to avoid.

### **Shared Emotions Research, Past and Present**

Past studies have made claims about the roles of specific emotions, e.g. awe and pain, in binding people together, but drew their hypotheses from the social and cultural contexts in which these emotions serve this function. For example, Bastian et al predicted that pain can strengthen social bonds based on its prevalence in various rituals and rites of passage throughout human history (2014). Similarly, Haidt claimed that the awe induced by religious revelations is an adaptation for bringing groups together during intergroup conflict (Haidt, 2012). Both Bastian et al and Haidt remained agnostic about the causes of their findings from a mechanistic standpoint.

Schachter also discusses the binding role of Shared emotions in his book, the "Psychology of Affiliation" (1959). Schachter found that women who were threatened with shock sought solace in one another. This study emphasized deliberate affiliative behavior, including conversation and reassuring physical contact. The theory we outline below predicts affiliative feelings and tendencies without any kind of affiliative behavior taking place. The processes proposed in Affective Wavelengths Theory are automatic and require only that people perceive others' emotions while they are experiencing their own. In study 1 described here, participants who anticipated electric shock felt closer, more similar, and more inclined to interact with an individual whose emotional reaction was recorded. Participants never interacted or met in person.

### **Affective Wavelengths Theory is Broad, Mechanistic and Lightweight**

We believe Affective Wavelengths Theory offers several advantages over past approaches. First, we expand the scope of past claims about the binding roles of specific emotions, to make a broader, categorical claim. We do not deny additional social functions for specific emotions, but we will argue that all emotions connect people at least through the mechanism we describe. The categorical nature of the claim stems from an evolutionary argument grounded in the nature of emotion.

In addition to being unique in addressing the 'why question', Affective Wavelengths Theory, to our knowledge, is also the only mechanistic explanation for the binding effects of shared emotional experiences. Beyond providing more complete explanations at more levels of

analysis, mechanistic theories can help us better understand how psychological phenomena fit together within a single limited space inside our heads.

Grounding this mechanism in existing theories from the cognitive and affective sciences rather than positing new structures in the mind's cognitive architecture makes our account parsimonious and ontologically light. Because natural selection typically builds on existing structures rather than reinventing the wheel, mechanisms that co-opt existing parts of the mind are also more evolutionarily plausible, meaning they are more likely to have evolved.

We will return to discussing a possible mechanism behind Shared Emotional Experiences in the discussion section.

## **A Roadmap**

In the sections that follow, we test Affective Wavelengths Theory, propose further studies, and discuss its bright future in providing a mechanistic backbone for many descriptive phenomena in psychology.

### **Current empirical directions.**

We will describe 6 empirical studies testing predictions of Affective Wavelengths theory, along with its mechanism and boundary conditions.

6 studies, examining a diverse range of emotions including anxiety, embarrassment, amusement, disgust, anger, and pleasure, strengthen our hypothesis that any shared emotional experience can bring people together (studies 1-6). Two studies suggest that this social connection or, when expectations are violated, aversion, typically occurs regardless of the situational cause (studies 1+2).

The mechanism underpinning social evaluation through shared emotions does not require for individuals to directly see or hear each other (study 3). This suggests that people can also evaluate others based on emotional reactions through technologies like text messaging, social media, and email. Insensitivity to visual and auditory information suggests that Shared Emotions, including Affective Wavelengths, might rely on meta-cognitive cues like ease of understanding someone's emotional reaction rather than the specific means through which an emotion is perceived. Two studies attempted (and failed) to interrupt meta-cognitive cues with disfluency created through auditory and visual distortion (study 4) and cognitive load (study 6), underlining the resilience of Affective Wavelengths; we suggest potential explanations for this failure.

Finally, we examined boundary conditions. We found that Affective Wavelengths can connect, or disconnect, people despite ideological differences (study 5). While the social adhesive effects of shared emotions were robust throughout studies 1-5, shared emotions did not connect people when contradicted by situational context (study 6).

### **A theoretical account and future directions.**

After discussing our past studies, we posit a mechanistic account of Affective Wavelengths grounded in existing ideas in the cognitive sciences. The mechanism accounts for our findings and explains the means through which shared emotions change our representations of others in our social environment.

A theory's value stems not just from being ontologically light and consistent with existing findings, but from its explanatory power. To begin to demonstrate the utility of Affective Wavelengths Theory, we will show how the theory highlights existing connections between otherwise disparate psychological phenomena. We will also suggest possible applications in human-computer interaction and artificial intelligence.

Finally, we will suggest future empirical research directions including examining how multiple shared emotional experiences combine to shape social evaluation, potential tools for measuring the output of shared emotions behaviorally, and methods for studying the role of shared emotional experiences in existing relationships.

### **Study 1: Is Anxiety a Social Glue?**

Whereas past research emphasized the sociocultural roles of specific emotions, e.g. pain, Affective Wavelengths ascribes socially binding effects to all shared emotions. The goal of the current study is to demonstrate that any shared emotional experiences, not just those investigated in the past, can bring people together and to see whether or not the situational cause matters. While examining every emotion would not be feasible, we begin to shift the burden of proof to theories that propose special roles for specific emotions by testing several emotions, starting with ones that would not be expected to bind people together.

#### **Shared Anxious Reactions**

We began with a negative emotion traditionally associated with avoidance: anxiety. Anxiety's negative valence precludes association-based explanations for the binding effects of shared emotional experiences according to which people become closer simply by associating one another with the positive emotions they feel. Additionally, the avoidant aspect of anxiety reduces the plausibility of motivational accounts e.g. that people felt more sociable because of the emotion that was shared rather than the shared aspect of the emotional experience. We predict that participants will feel closer to a recorded participant who shares their anxious or calm reaction (Shared Emotion) than participants whose reactions are not shared (Unshared Emotion) regardless of whether or not the shared emotion is elicited by the same (Same Situation) or a different (Different Situation) situation.

#### **Are the Binding Effects of Shared Emotions Situation-Invariant or Situation-Attuned?**

If the value of shared emotions stems from their usefulness in predicting future successful interactions, then it would be natural to assume that the situational cause matters. After all, if a student is anxious about an upcoming exam, while her introverted roommate is simultaneously anxious about attending a party, then there is little reason to assume that these two individuals



would respond similarly to future events. But, because of the improbability of two people simultaneously experiencing emotions for different reasons at the same time and location, the cost of an occasional misfiring, where people connect through emotions evoked by different situations, may be offset by the economy of not having to infer the cause of another person's emotion. To infer the cause of a second individual's emotion, a situation-attuned mechanism would necessarily be more computationally complex, which would have metabolic costs. A situation invariant mechanism where individuals evaluate others during shared emotional experiences regardless of cause would be more economical at the cost of occasional mistakes. Which mechanism, situation-invariant or situation-attuned, is actually instantiated within the human mind is an empirical question. Therefore, study 1 includes an additional independent variable: whether participants' emotions are caused by the same situation (Same Situation) or a different situation that should lead to a similar emotional reaction (Different Situation). If shared emotions are implemented in a situation-invariant way, the cause of an emotion should have no effect on the connection participants feel after a shared experience. From a statistical standpoint, we only expect a main effect for Emotion (Shared vs Unshared). There should be no main effect for Situation (Same or Different) and no Situation X Emotion interaction. In contrast, people with situation-attuned minds would only feel more connected when a shared emotion is elicited by a common cause. In other words, a Situation X Emotion interaction would suggest that people possess situation-attuned minds.

### **The Experimental Paradigm Common to All Studies**

This research effort includes a series of 6 consecutive studies designed to test the theory of Affective Wavelengths. For the sake of brevity, we will briefly discuss aspects of the experimental paradigm that are common to all of the studies described here rather than repeating them for each of the six experiments. In studies 1 and 5, experimenters randomly assigned to participants to condition based on random number generation, but the researchers were not blind to condition. The other 4 studies were fully automated to eliminate the possibility of experimenter bias and expedite data collection.

Every experiment began with obtaining consent from participants. To obscure the purpose of the study and explain why participants were recorded, participants were told that they would be randomly assigned to a task and that the researchers were interested in their response to this task in the context of other people's experiences.

### **Real emotion inducing situations.**

We initially assumed that people evaluate others based on observable cues from their emotional reactions to situations (although study 3 challenges this assumption). This means participants need to have full-blown, perceivable emotional reactions for the mechanism to function. Rather than having participants mentally simulate an emotional reaction, which is a common practice in emotion research, we identified situations that reliably induce emotions in a lab setting.

We also wanted the shared emotional experiences to shape social evaluation through Affective Wavelengths rather than inferences participants made about their partners. To limit the effects of inference, we selected experiences with relatively low diagnosticity - where participants could glean very little information about the confederate.

### **Participant reactions are always dichotomized and constrained.**

To maximize our signal to noise ratio, our goal was for reactions to be visceral, unambiguous, and easily perceived. After experiencing an emotionally provocative situation, participants labeled their reaction as one of two emotions, e.g. by reporting whether they felt embarrassed or amused. Participants also elaborated on why they felt the way they did in a sentence or two to cement their own reaction and to create parity with the confederate's recorded reaction, which followed the same format. The dichotomized reactions allowed us to experimentally manipulate whether a previously recorded participant shares or does not share the participant's reaction.

If we evaluate others based on shared emotions, we might expect people to have ways to minimize the extent to which they alienate others through unshared reactions. Indeed, participants frequently used hedge words/phrases such as “kind of”, “maybe”, “somewhat”, etc. For example, they would report feeling “somewhat nervous” or “calm, but maybe also a bit anxious”. While hedging might be effective in the real world, the ambiguous reactions they afford interfere with selecting appropriate videos (whose role is described in the next section) for the purposes of these studies. For simplicity, participants and confederates are specifically instructed to avoid “hedging.”

### **Recorded confederate's reaction.**

To elicit a shared or unshared emotional experience, participants saw a video of a second individual (usually a participant from an earlier phase of the study) who responds with the same emotion or with a different emotion. The confederate's reactions are always recorded, which has two advantages. First, recordings boost internal validity because the confederate is always the same person and always responds in the same manner. Recordings also control for the effect of disagreement. If a participant reports feeling a particular emotion and an actual confederate immediately replies that she felt a different emotion, then it could seem like the confederate is deliberately being difficult or disagreeable. In contrast, if participants know the confederate was recorded at an earlier time, participants cannot attribute an unshared emotional reaction to their partner being disagreeable.

To make emotional reactions as believable as possible, the confederate in studies 1-4 was an actual participant from an earlier phase of the study who was experiencing the stimulus, e.g. threat of electric shock, for the first time. Because participants can respond with one of two emotions, we needed a recording of the confederates responding with each emotion. After they reacted to the video naturally, we asked potential confederates to relax for a few minutes and

then mentally simulate experiencing the other emotion. For example, if the recorded participant responded to shock with anxiety, she imagines not being anxious about shock and then is recorded a second time claiming that she felt calm. Many potential confederates were recorded. We chose a single one that avoided hedge words, responded clearly, and whose real reactions could not be differentiated from her simulated reactions.

### **Dependent measures.**

Once a participant and a confederate have shared or not shared an emotional reaction, one needs to measure the effects of this experience. We measured social connection by asking a wide array of items on a 5 point likert scale ranging from “not at all” to “extremely”, e.g. “I felt \_ close to the other participant.” We selected dependent measures that we believed would tap into various aspects of the participant’s connection with the confederate including:

- Closeness
- Similarity/Overlap
- Inclination to interact
- Preference for the same vs a different partner in a hypothetical future study
- Interest in getting to know the confederate

To hide the true purpose of the study, these items were preceded by the following instructions in all 6 studies:

We will now ask you a series of questions concerning your feelings about the previous participant who you saw on video. We are considering recruiting some of the participants from this study for a follow up study that will include more involved social interactions that will take place in person such as deep conversations and performance on tasks that require participants to act as a team to accomplish a common goal. The next study will include pairs of participants who have seen each other on video and ones who will be seeing each other for the first time. Participation in this subsequent study is not mandatory, but in the event that we decide to contact you, please rate the following statements:

Rather than aggregating variables based on top-down, pre-theoretical considerations, we ran an exploratory factor analysis and simply averaged variables that loaded on the same factor. Analyses were always conducted on these aggregate variables. Before reporting these analyses, we provide a table with the loadings for each factor. The loadings table also includes brief descriptions of each of the original dependent measures.

## **Study 1 Method**

### **Participants.**

The participants were 201 undergraduate women from the University of Virginia. Because the experiment included shocks and measures of closeness, the participant,

“confederate”, and experimenter were always female to minimize the influence of chivalry and machismo on participants’ behavior. All participants provided informed consent and participated for course credit. 1 participant dropped out of the study to avoid electric shock. 3 participants were excluded because their prior relationship with the experimenter would obscure the effects of the independent variable. 12 participants were excluded because of procedural issues with the study: intoxicated participants, interruptions by cleaning staff, the experiment crashing, language barriers, experimenter errors, etc. 4 participants were excluded from analysis because their ambiguous reactions precluded appropriate assignment to conditions. The remaining 181 participants were included in analysis.

### **Procedure.**

Study 1 was a 2x2 situation by emotion between subjects design with a hanging control group. The control group consisted of individuals who see someone else having an anxious reaction without experiencing an anxiety-inducing situation (Sympathy).

#### ***Creating the illusion of participation in the Same Study.***

Upon arriving at the lab, participants were greeted by the researcher. Participants learned that they would see videos of an earlier participant who may or may not have completed the same task as the participant. Participants signed a waiver so that their reactions could also be recorded and shown to subsequent participants. Recording the participants gave them the impression that their videos might also be used in the future so that they felt like they were participating in the same study as the confederate.

#### ***Introducing the participant’s emotional experience.***

We elicit anxiety with electric shock. Shocks are palpable and reliably induce anxiety (e.g. Coan, Schaefer, & Davidson, 2006). Furthermore, most participants have little experience with shock, so the stimulus leaves little room for assumptions and interpretations. To avoid conflating shock and pain, participants are threatened with electric shock without receiving any electric shocks after an initial “sample shock”.

After giving consent, the researcher told participants that they have been assigned to receive electric shocks and that the researchers were interested in responses to shock and in the anticipation of electric shock. There would be a 1 in 5 chance of being shocked every 20 seconds. The bottoms of participants’ wrists were connected to a shocking apparatus, or “shock box”, powered by a 9 volt battery and participants received a single sample shock. While the function of the sample shock was to make the shock interval believable, participants were under the impression that the purpose of the sample shock was to ensure that the electrodes were making proper contact with their skin. No additional shocks were administered for the remainder of the study. To further intensify the situation, participants were warned not to touch anything while they were connected to the shock apparatus. A switch on the shocking apparatus was flipped to “remote” to give the computer displaying the shock interval control of the shocking apparatus.

Participants in the sympathy condition were not threatened with shock. Instead, they wrote about what they had done a day earlier.

***Introducing same vs different situations through confederate instructions.***

After receiving instructions regarding their own task, participants saw videos of the instructions that the confederate received. Participants randomly assigned to experience the same situation as the confederate, as well as those in the sympathy condition, saw the confederate receive instructions identical to those received by the participants in the instruction phase (including the confederate receiving a sample shock). Participants randomly assigned to experience a different situation than the confederate saw a confederate receiving instructions for a public speaking task.

For the different situation condition, we needed a second, anxiety-provoking stimulus. For an especially stringent test, we selected public speaking, which can also elicit anxiety, but has little in common with electric shock. Participants in the different situation condition saw a video where the confederate is assigned to a public speaking task. In the video, the confederate hears that she will have 2 minutes to type notes for a 4 minute speech arguing whether or not homeless people should be allowed to live in public areas in the college town where she lives. To maximize similarity with anticipating (rather than experiencing) electric shock, the confederate anticipated a public speech that she never actually had to deliver.

***Creating concurrent experiences.***

To approximate a real world shared emotional experience where two individuals respond to a common external event, participants experienced their situation, which was the shock interval or writing task, while concurrently watching a confederate getting threatened with shock or preparing for a public speech. A camera mounted on top of the participant's computer monitor recorded the participant to give the impression that the participants' videos might be shown to future participants.

Participants saw a shock timer counting down from zero displayed next to a video of the confederate. To minimize distraction from the participant's own timer, participants encountering the same situation as the confederate always heard the buzz from the confederate's computer (indicating that she might be shocked) 5 seconds after the participant's own timer reached 0.

Participants experiencing a situation that differed from the confederate's saw a video of the confederate frantically typing notes for the speech she would have to give.

Participants in the sympathy condition wrote about their day on a computer, while seeing the confederate threatened with shock.

***The participant's emotional reaction.***

Because there is no way to know how the participant will respond to the stimulus, the participant always provides her reaction to the shock interval first. As mentioned earlier, emotional reactions were deliberately dichotomized, so that we could cleanly manipulate whether or not the participant's reaction was shared. Participants reported whether they felt "anxious" or "calm" during the shock interval and explained why they felt the way they did in a sentence or two, e.g. "I was really nervous because I kept thinking I might get shocked". Participants in the sympathy condition reported whether writing about their day made them feel

“relaxed” or “stressed out”. Before responding, participants were asked to avoid hedging, meaning using qualifying remarks like “kind of”, “maybe”, etc.

***Creating shared and unshared emotions through confederate responses.***

After reporting their reaction to the shock interval, participants were reminded of the confederate’s task, e.g. “this is a recording of the earlier participant’s reaction to being threatened with electric shock”. These instructions also reminded participants that they were seeing a recording, so that they would not feel like the confederate was being disagreeable or difficult when she did not share their reactions. Participants then saw a recording of the confederate’s reaction. The confederate’s reaction depended on the participants’ own reactions and the emotion (shared vs unshared) condition to which they were randomly assigned. For example, anxious participants saw a calm confederate in the Unshared Emotion condition and an anxious confederate in the Shared Emotion condition. We recorded separate videos of the same confederate reacting to public speaking and electric shock, so that the emotional reactions would be specific to the relevant situation, e.g. public speaking.

Participants in the sympathy condition always saw a video where the confederate reported feeling anxious during the shock interval.

***Self-report measures of social connection and manipulation checks.***

The goal of study 1 was to see whether shared anxiety could bring individuals together. Participants therefore answered a series of questions tapping into how close, similar, and inclined to interact with their partner they felt.

All dependent measures were answered on a unipolar Likert Scale from “not at all” to “extremely”. The same likert scales were also used for a series of manipulation checks asking about participants’ reactions to the sample shock and shock interval, as well as to double check that participants noticed which task the confederate completed and whether or not their emotional reaction was shared. These questions were always answered after participants evaluated the confederate.

**Results**

181 female participants were included in the analysis. Our analysis consisted in several stages. First, we constructed composite variables based on an exploratory factor analysis. We then used a pair of ANOVAs to test our hypothesis that shared emotions, specifically anxiety in study 1, connect individuals regardless of the situation that elicited them. We also compared the sympathy condition to the shared emotion conditions, and examined our manipulation checks to see whether there was evidence for emotions intensifying when shared.

**Factor analysis for the creation of composite variables.**

Because we had no a priori hypotheses about which of our dependent measures would cluster together, we began with an exploratory factor analysis. This approach has several advantages. A factor analysis can help identify the latent (or unmeasured) variables underlying a series of dependent measures, so we could see whether shared emotions alter a single latent construct or several. Furthermore, factor analysis involves a rotation, or transformation, toward

simple structure so that each indicator (dependent variable), loads as highly as possible on one factor (latent variable), while loading minimally on all others. The advantage of this kind of structure is that we can take all the dependent variables that load onto a single factor and average them together. By looking at the indicators that load onto each factor, we can understand roughly what each factor means and name it.

We began with a scree plot, which is a useful heuristic for identifying the number of factors that should be extracted in an exploratory factor analysis. There is a line at an Eigen value of 1 in the plot below. Anything below 1 explains less variance than the average original dependent variable and would consequently not amount to an interesting factor.

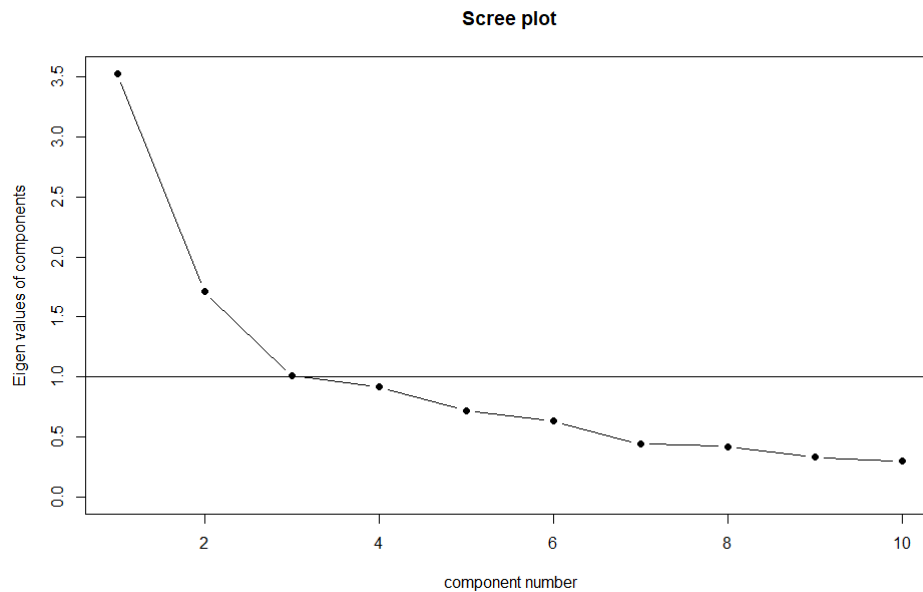


Figure 1. Scree Plot of Dependent Measures from Study 1

Based on the 3<sup>rd</sup> eigen value being around 1 and the first two values being very different from the rest, we extracted two factors. Because psychological variables, latent or not, are rarely uncorrelated, we used an oblique rotation, specifically “promax”. For the sake of being thorough, we also tried extracting 3 factors and using different rotations. Adding a third factor did little to reduce complexity or improve fit statistics. And changing the rotation made little difference, so we stuck with extracting two factors using a promax rotation. Table 1 contains loadings, uniqueness, and complexity.

Dependent variable	Connection	Aversion	h2	u2	complexity
Can Imagine as Friend	0.82	0.16	0.61	0.39	1.1
Get to Know	0.79	0.22	0.56	0.44	1.2
Get Along	0.67	-0.01	0.45	0.55	1.0
Closer after video	0.60	-0.03	0.37	0.63	1.0

Things In Common	0.59	-0.08	0.39	0.61	1.0
Feel Close	0.48	-0.16	0.31	0.69	1.2
Prefer Same Partner	0.45	-0.06	0.22	0.78	1.0
Prefer Different Partner	0.07	0.81	0.63	0.37	1.0
Would Not Get Along	0.01	0.61	0.37	0.63	1.0
Feel Distant	-0.02	0.42	0.18	0.82	1.0

*Table 1.* Loadings used to construct composite variables.

Two factors were extracted. One included all of the positively framed questions (e.g. “I would prefer the same partner in a future study”), so we will refer to it as “connection to the confederate”. The other includes all the negatively framed variables (e.g. “I feel distant from my partner”) and was named “aversion to the confederate”. The two factors have a correlation of -.3. The low complexity tells us that most of the indicators load onto one factor or the other, but not both. U2, which is uniqueness, corresponds to how much of the variance is not explained by either factor. The high uniqueness is not surprising considering that the dependent variables were all meant to tap into different aspects of the connection participants might feel following a shared emotional experience rather than a single monolithic construct. The separate factors suggest that shared emotions might be separately influencing how connected and averse participants feel toward the confederate. One possibility is that the ease (fluency) with which participants interpret the confederate’s reaction leads to an increase in the connection variable, whereas violations of expectations, i.e. surprise, leads to aversion. Another is that a single process, e.g. fluency, influences different downstream processes to different degrees. Because different factors were extracted in study 4 where the confederate was an out-group member, we find the latter explanation for two factors more convincing. More research would be needed to understand exactly how people adjust others’ values as social partners based on shared emotional experiences. All analyses that follow use the connection and aversion composite variables as outcome variables.

### **Shared anxiety is a social glue, even when anxiety has different causes.**

Earlier we distinguished between the predictions made by Situation-Invariant and Situation-Attuned accounts of Affective Wavelengths. If minds are Situation-Invariant with respect to shared emotional experiences, then anxious participants should feel more connected and less averse to a confederate that shares their experience regardless of whether the confederate is anxious about public speaking or shock. If correct, a two-way ANOVA should only yield a significant main effect for shared vs unshared emotion. But, if minds are Situation-Attuned, shared experiences should only make participants feel more connected or less averse to the confederate when the confederate is anxious for the same reason (there should be a significant Situation X Emotion interaction). We analyzed connection to the confederate in a two-way between-subjects factorial ANOVA with Emotion (Shared Emotion, Unshared



Emotion) and Situation (Same Situation, Different Situation) as between subject variables. The main effect of emotion on connection with confederate was significant,  $F(1, 142) = 17.22, p < .001$ ). Participants were more connected with the confederate when reactions were shared ( $M=2.68$ ) than unshared ( $M=2.27$ ). The main effect of situation on connection to the confederate was nonsignificant ( $F(1, 142)=.56, p=.455$ ). The situation x emotion interaction was also not significant,  $F(1, 142) = .28, p = .598$ ). A two-way between-subjects factorial ANOVA for Aversion to the confederate yielded similar results. The main effect of emotion on aversion to confederate was also significant,  $F(1, 142) = 13.08, p < .001$ ). Participants were more averse to the confederate when emotions were unshared ( $M=1.62$ ) than shared ( $M=1.27$ ). As with connection, the main effect of situation on aversion to the confederate was not significant,  $F(1, 142) = .71, p = .400$ ). The situation by emotion interaction was also not significant ( $F(1, 142)=1.31, p=.26$ ).

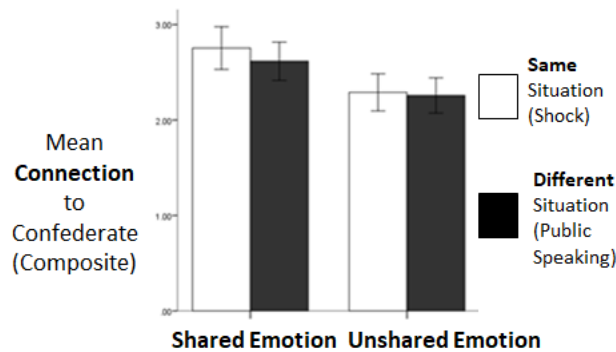


Figure 2. Effects of cause of and reaction to a shared emotion on social connection.

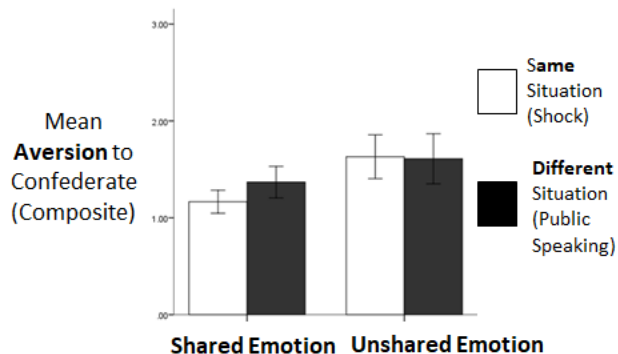
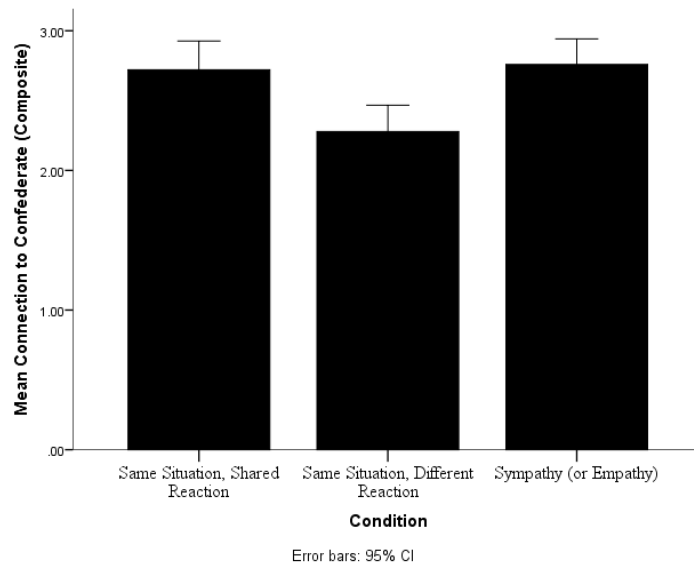


Figure 3. Effects of cause of and reaction to a shared emotion on social aversion.

Consistent with a Situation-Invariant Affective Wavelengths, participants who share an anxious reaction with the confederate feel more connected and less averse to her than participants who do not share a reaction with her regardless of whether or not there is a match between the cause of the participant's anxiety and the cause of the confederate's anxiety.

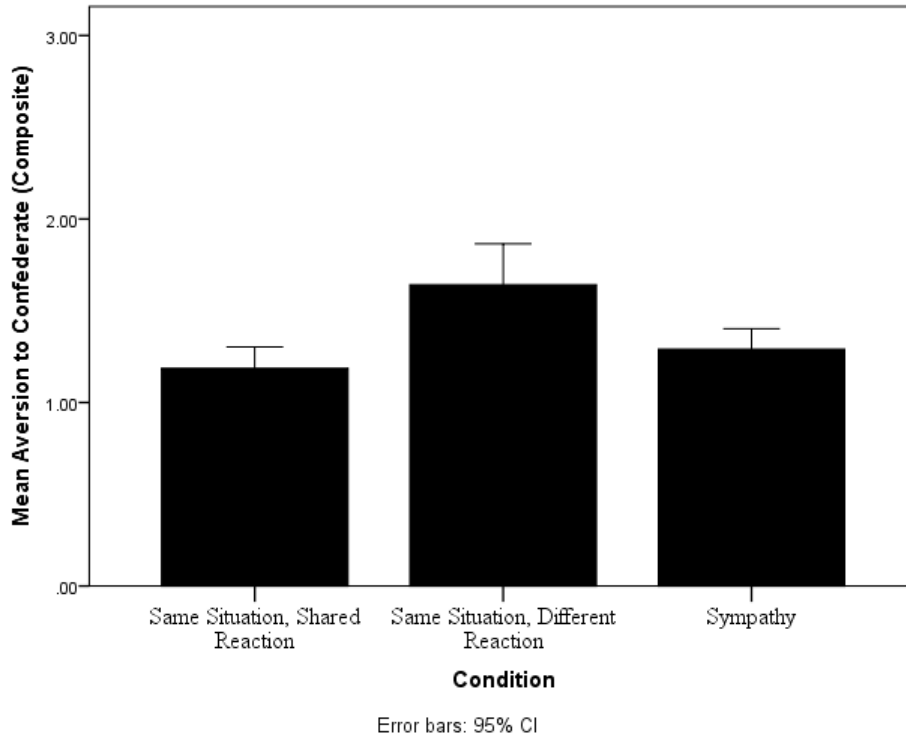
### **Both sympathy and shared emotions can connect people.**

Because all participants in the sympathy condition saw a video of a confederate anticipating electric shock, the sympathy condition was compared to other conditions where the confederate was also threatened with electric shock, specifically Same Situation Shared Emotion and Same Situation Unshared Reaction. A one-way ANOVA revealed a significant effect of condition on both participants' connection ( $F(2, 119) = 7.67, p = .001$ ) and aversion ( $F(2, 119) = 9.38, p < .001$ ) to the confederate. Based on a Tukey HSD post hoc test, participants in the sympathy condition felt more socially connected to the confederate ( $M=2.77, SD=.57$ ) than participants in the Same Situation Unshared Emotion condition ( $M=2.29, SD=.58$ ). But, participants in the sympathy condition did not differ in connection to the confederate from participants in the Same Situation Shared Emotion condition ( $M=2.75, SD=.66$ ).



*Figure 4.* Social Connection with confederate in Sympathy and Same situation Conditions

Similarly, participants in the sympathy ( $M=1.31, SD=.35$ ) and Same Situation Shared Emotion ( $M=1.17, SD=.35$ ) felt less averse to the confederate than participants in the Same Situation Different Emotion condition ( $M=1.63, SD=.68$ ).



*Figure 5.* Social Aversion to confederate in Sympathy and Same situation Conditions

These results are difficult to interpret because the Sympathy condition may be inducing connection through sympathy or empathy. Sympathetic participants would feel bad for someone who is, for example, threatened with electric shock, whereas empathic participants imagine how they would feel if they were the ones threatened with electric shock. Neither sympathy nor empathy is an alternative explanation for a shared emotional reaction's effects on social connection. By definition, sympathy occurs when the sympathizer is not in the same psychological situation as the person with whom one is sympathizing. And if the effects of the sympathy condition are explained by empathy, which involves taking the confederate's perspective, then the participant is interpreting the confederate's reaction in terms of her emotional reaction to the situation she is imagining. This suggests Affective Wavelengths would provide a mechanistic explanation for the binding effects of empathy rather than the other way around. In short, the effects of Affective Wavelengths are characterized mechanistically, whereas theories about the role of empathy in social connection are descriptive. So the former can explain the latter, whereas the latter cannot explain the former.

Another issue is a lack of parity between confederate reactions in the Sympathy condition and other conditions. Because the purpose of the sympathy condition is to capture sympathetic (or empathic) reactions to another person's anxiety, the confederate always reports feeling anxious in the sympathy condition. But, in the shared emotion conditions, the confederate reported feeling calm any time the participant reported feeling calm.

Both of the above issues make the sympathy condition difficult to interpret, which is why it was dropped from subsequent studies.

### **No evidence for a relationship between sharing emotions and emotional intensity.**

In a recent study by Boothby, Clark and Bargh, participants enjoyed chocolate more in the presence of others eating the same chocolate than alone (2014). The authors infer that shared experiences are amplified, so we decided to run some exploratory analyses to check for similar findings in our own data: would manipulation checks measuring stress about shock, anxiety about the shock interval, or pain from the sample shock be different when an experience is shared (meaning in the shared situation condition)? Even without adjusting for multiple comparisons, a series of independent samples t-tests comparing all three of these emotions in the shared situation vs unshared situation conditions was not significant. The t-tests were also nonsignificant when we compared the Same Situation Shared Emotion Condition to the Different Situation Unshared Emotion Condition to maximize the likelihood of finding differences. While interesting, this would not constitute a failed conceptual replication because our stimuli were more complicated and protracted over time, and because we manipulated shared and unshared emotional reactions in addition to whether or not a situation was shared.

### **Study 1 Discussion**

Study 1 provides preliminary evidence that even sharing negative, avoidant emotions can bring people together, making them feel closer, more similar, and more inclined to interact with one another. The binding effects of shared emotions appear to be independent of the situation that gave rise to them: two people still feel closer when experiencing the same emotion for unrelated reasons. The factor analysis from study 1 suggests that the benefits of shared emotional experiences may have separate positive and negative components, although 1 of the 6 studies here (see study 5) did not yield the same factors. Sympathy seems to have a similar effect to shared emotional experiences, but the meaning of this finding is difficult to interpret in this context.

This study has several limitations. First, the researchers were not blind to conditions. While the data were collected on computer, the researchers loaded the appropriate confederate reaction video. The researchers also delivered the instructions for the Same Situation versus Different Situation manipulation. Another potential limitation is that electric shock is an unusual stimulus. While participants' lack of familiarity with shock makes for a clean study, the same lack of familiarity also makes shock different from many naturally occurring situations. Furthermore calmness is more like an absence of anxiety than a different emotion. While this is not necessarily a drawback because people can also have fairly neutral reactions to events that trigger intense emotions in others in the real world (e.g. phobic vs non-phobic individuals' reactions to spiders), opposing (or differing) reactions to shared experiences would also be interesting. Study 2 addresses these limitations.

## **Study 2: Do People Evaluate Others based on Shared Vicarious Embarrassment?**

Affective Wavelengths proposes that any shared emotional experience can bring people together, whereas different responses to the same emotion-eliciting situation pull people apart. In study 1, participants felt a stronger connection with a confederate after sharing an avoidance-motivating, negative emotion (anxiety). Anxiety even acted as social glue when participants and confederates experienced anxiety for unrelated reasons.

Our goal for study 2 was to conceptually replicate the findings from the first study to provide further support for a situation-invariant Affective Wavelengths.

Beyond increasing the generalizability of our claims, study 2 is also designed to address some of the limitations of study 1. First, the study was completely automated to eliminate any possibility of experimenter bias. *Note that all subsequent studies, with the exception of study 5, were similarly automated to eliminate experimenter bias.* Additionally, study 2 was designed to resemble a shared experience where someone reacts to a situation and later hears about someone else's reaction. We then changed the situation (stimuli) to not only elicit different emotions, but also to more closely resemble many real-life situations. We chose shock as the stimulus for study 1 because it is novel, unambiguous, and reliably provokes a strong reaction. But the simplicity of electric shock as an experimental stimulus also limits its relevance to real-world contexts, where stimuli (1) are often familiar from one's past experiences or knowledge acquired from others and (2) may be divisive, which could increase diagnosticity for determining social compatibility. We still selected relatively uninformative situations to maximize the effect of Affective Wavelengths relative to inferences about the confederate. While shock either leads to anxiety or fails to elicit anxiety, a stimulus like a violent movie could lead to divergent responses, e.g. excitement or disgust. Similarly, a "deep" philosophical lecture about the connectedness of all things may induce awe in one person, but eye-rolling in another. For study 2 we decided to use an embarrassment evoking video. Like anxiety, embarrassment is also an emotion that would be less likely to connect people outside of the context of shared emotions. We pre-tested the embarrassment-evoking video from study 2 to ensure that it lead to dichotomous responding.

### **Study 2 Method**

#### **Participants.**

The participants were 170 undergraduate women from the University of Virginia. All participants provided informed consent and participated for course credit. 8 participants were excluded because of a prior relationship with the confederate. The data from the 162 remaining participants were analyzed.

#### **Procedure.**

Study 2 was a situation by emotion (2x2) between subjects design.

***Setting the stage for the experimental paradigm.***

Participants read that they would be seeing a video and then seeing another participant's reaction to the same video or a different video. While participants would not see their partner's video, they would read a brief description of it. Though participants were under the impression that they were randomly paired up with an individual who was in the lab during an earlier part of the study, all participants saw videos of the same participant, recorded during an earlier phase of the study.

***Inducing vicarious embarrassment or amusement.***

We induced vicarious embarrassment through a singing audition on a reality television show known as "the X-Factor". The situation is more familiar and less unusual than electric shock, making it more ecologically valid. The stimulus is also polarizing: about  $\frac{3}{4}$  of participants reported feeling embarrassed for the singer, while  $\frac{1}{4}$  reported feeling amused by her.

Participants in all conditions read that they will be seeing a video of a woman singing for a reality television show. To maximize the emotional impact of the stimulus, participants were not warned about the nature of her performance. The video's impact is further strengthened by the deliberately misleading introduction to the young woman's singing. The audition begins with an interview with the singer, who says that her lifelong dream is to be a professional singer. The scene then shifts to the young woman's mother who says that her daughter brings her to tears with her singing and that she cannot believe how talented her little girl is. After building anticipation and expectations, the young woman turns out to be so terrible that she is difficult to watch.

***Recording the participant's response.***

Participants watch the audition video and then report whether they felt more amused by the singer's performance or embarrassed for her. To reinforce participants' responses, participants confirm the emotion they felt and then rate the extent to which they felt the emotion they selected. Participants then briefly explained their response in a sentence or two.

***Introducing same vs different situations through confederate instructions.***

We created same vs different situation conditions through the instructions participants receive. Participants did not actually see the confederate's video.

Participants in the same situation conditions were informed that the confederate saw the same video they did:

"We are interested in the way people interpret the reactions of others who saw the same video that they did. The participant in the video below saw the same video you

did. In the video from the X Factor, a woman sings in front of 3 judges and a large audience.”

Participants in the different situation conditions read that the confederate saw a different video along with a description of that video:

“We are interested in the way people interpret the reactions of others who saw a different video from the one they saw. The participant in the video below saw a different video from the one you did. In the video, a high school valedictorian is giving a graduation speech with her classmates and family present. The crowd is engaged. Two minutes in, the valedictorian farts loudly. Some people in the crowd have a disgusted look, while others are laughing.”

A manipulation check at the end of study verified that participants remembered whether or not the confederate saw the same video. None of the participants failed the manipulation check.

#### ***Creating shared and unshared emotions through confederate responses.***

We deliberately selected a set of earlier participant recorded reactions that were ambiguous enough to make sense regardless of the video the recorded individual purportedly saw. In other words, the confederate’s amused or embarrassed reactions were identical whether the confederate saw the graduation video or the singing audition.

Participants in the shared emotion condition see a video of the confederate reporting that she felt the same emotion as the participant. Participants in the unshared emotion condition see a video where the confederate says she felt the other emotion, e.g. the confederate says she felt embarrassed for the singer if the participant was amused.

#### ***Self-report measures of social connection and manipulation checks.***

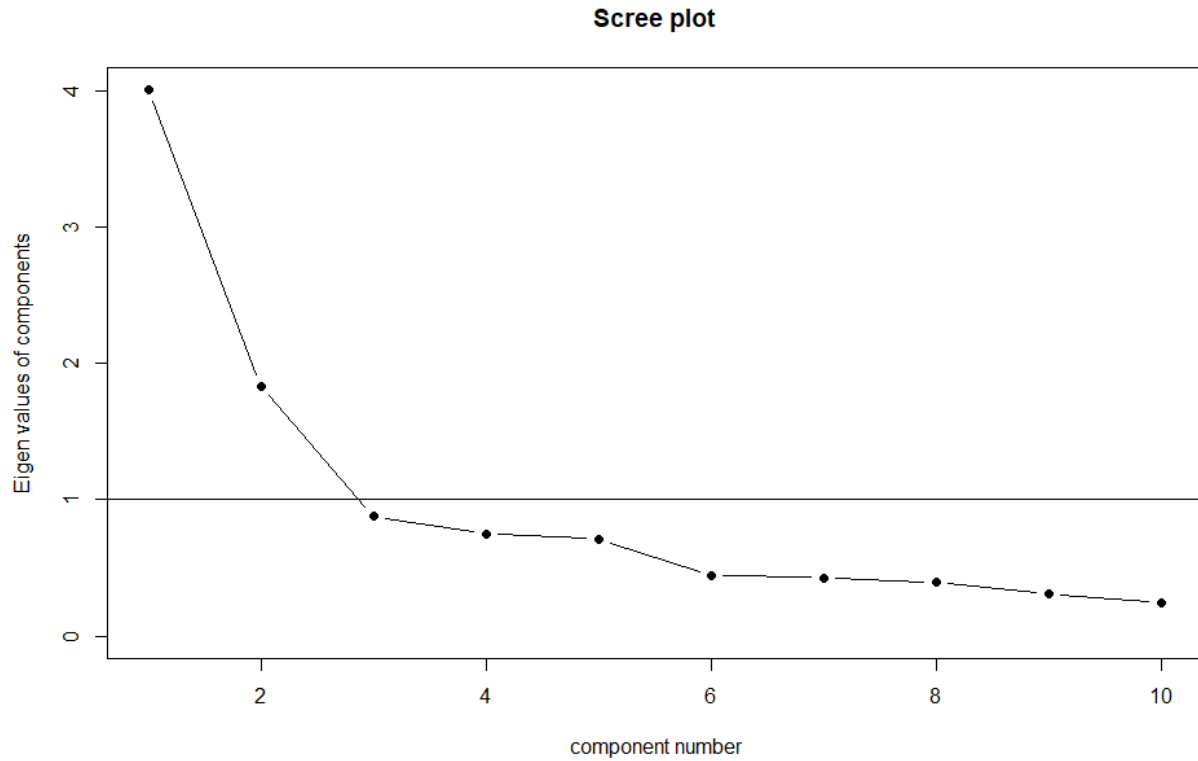
To examine the binding effects of shared or unshared emotional experiences, all participants in study 2 answered questions tapping into their feelings about and social interest in the confederate. After reading the prompt claiming that participants might be invited to a future paid study with the same partner or a different partner, participants rated the confederate on a 5 point likert scale.

### **Results**

Results were analyzed from 162 participants. We followed the same analysis strategy as study 1.

#### **Creating composite variables based on factor analysis.**

A scree plot (see figure 6) suggested that there were two factors that explained more variance than the average dependent measure (eigen value > 1), so we extracted two factors.



*Figure 6.* Scree plot with dependent Variables from Study 2

We used the same oblique rotation from study 1, promax, to extract two factors. Table 1 contains loadings, uniqueness, and complexity.

Dependent variable	Connection	Aversion	h2	u2	complexity
Can ImagineAs a Friend	0.80	-0.10	0.71	0.29	1.0
Feel Some Connection	0.77	0.16	0.53	0.47	1.1
Interest in Getting to Know	0.72	0.03	0.50	0.50	1.0
Things In Common	0.70	-0.02	0.50	0.50	1.0
Feel Close	0.63	0.11	0.36	0.64	1.1
Would Get Along	0.63	-0.09	0.45	0.55	1.0
Prefer Same Partner	0.31	-0.30	0.26	0.74	2.0
Would Not Get Along	0.12	0.81	0.60	0.40	1.0
Feel Distant	0.09	0.70	0.45	0.55	1.0
Prefer Different Partner	-0.07	0.68	0.51	0.49	1.0

*Table 2.* Loadings used as basis for constructing composite variables.



The same connection and aversion factors from study 1 were extracted. As seen in Table 2, the first factor, which was used to construct the “Connection” composite variable, contained all the positive questions, e.g. “I feel close to my partner”. An “Aversion” composite variable was constructed by averaging negative items, e.g. “I would prefer a different partner in a future study.” The two factors were negatively correlated ( $r=-.39$ ).

### **Shared embarrassment and amusement bind people together regardless of their cause.**

In study 1, participants threatened with shock felt closer to a confederate that shared their emotional reaction, even when the confederate was anxious about public speaking. The main effect for Emotion condition, along with the absence of a main effect for the emotion’s cause or a situation X emotion interaction, was consistent with the claim that minds are not sensitive to the cause of a shared emotional experience. We predicted that we would find the same evidence for the binding effects of shared emotions and situation-invariance in study 2.

A two-way between subjects factorial ANOVA revealed a significant main effect of Emotion (Shared Emotion, Unshared Emotion) on the degree to which participants felt connected to the confederate,  $F(1, 159) = 11.65, p < .001$ . Participants felt a greater degree of connection when emotions were shared ( $M=2.55$ ) than when they were not ( $M=2.17$ ). The main effect of Situation on Connection was nonsignificant  $F(1, 159) = 3.12, p = .079$ . The Situation X Emotion interaction was non-significant as well  $F(1, 159) = .27, p = .601$ . There were similar results for Aversion to the confederate. The main effect of Emotion (Shared Emotion, Unshared Emotion) on Aversion was significant,  $F(1, 159) = 12.49, p < .001$  with participants feeling more averse to the confederate in the unshared emotion condition ( $M=2.05$ ) than in the shared emotion condition ( $M=1.57$ ). As with the Connection variable, the main effect of Situation (Same Situation, Different Situation) on Aversion,  $F(1, 159) = .58, p = .449$ , and the Situation X Emotion interaction,  $F(1, 159) = 1.48, p = .225$ , are nonsignificant.

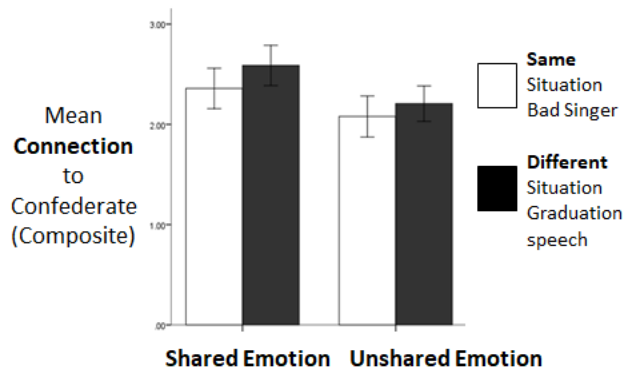


Figure 7. Effects of cause of and reaction to a shared emotion on social connection.

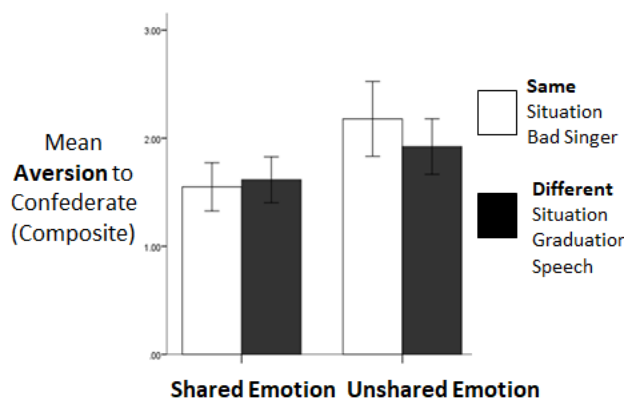


Figure 8. Effects of cause of and reaction to a shared emotion on social aversion.

Together, studies 1 and 2 support a Situation-Invariant account of Affective Wavelengths according to which the effects of shared and unshared emotions are independent of their situational causes.

#### **No evidence for a relationship between sharing emotions and emotional intensity.**

We still find no evidence for significant changes in emotional intensity.

#### **Study 2 Discussion**

From studies 1 and 2 we see increasing evidence that people rely on whether emotional reactions are shared or unshared to evaluate and prioritize social partners. And rather than worrying about the source of the shared emotion, people seem to take an informational shortcut by assuming any shared or unshared emotional reaction is diagnostic with respect to social partners.

The differences between studies 1 and 2 are also of interest. The predictions of Affective Wavelengths apply to both emotional experiences that are unique to lab settings, e.g. electric shock, and more externally valid situations like vicarious embarrassment from watching an embarrassing singing audition. Thus, two people do not need to experience an emotional situation concurrently to learn about a social partner from a shared emotional experience. In study 2, participants did not even see the experience that lead to the confederate's emotion. This suggests that shared emotional experiences can also occur when an emotional situation is not physically proximate. In the real-world, Affective Wavelengths may also apply in situations where people are experiencing an emotion by taking another individual's perspective or remembering a past emotional experience. We will return to this idea at the end of the paper.

A final point of interest is that the same factors were extracted in both studies 1 and 2, suggesting that the connection and aversion that occur as a result of a shared emotional

experience may reflect two concurrent processes. During the introduction, we suggested that a shared experience is characterized by mental ease, whereas an unshared experience can lead to a violation of expectations or surprise. Perhaps each of these is a separate pathway with the former leading to connection and the latter leading to aversion. With the current data, it is impossible to tell whether the two factors reflect multiple changes in the way we evaluate social partners or more downstream process that influences participants' responses to our dependent measures.

With mounting evidence for Affective Wavelengths, we next turn to a pair of studies designed to look at the mechanism behind Affective Wavelengths.

### **Study 3: Do People Need to Perceive Others to Benefit from Shared Emotional Experiences?**

Studies 1 and 2 demonstrated that people evaluate and prioritize others based on shared emotional experiences. An open question concerns the mechanism through which people translate overlap between their own emotions and those of others into changes in the way they think about and interact with others. In other words, what is the mechanism behind Affective Wavelengths?

According to Affective Wavelengths, emotions provide useful information about an individual's perspective precisely because they are a rich source of information about that person's interpretation of events. But, what happens when the other person cannot be seen or heard, as happens in technologically mediated social interactions? Would such interactions fail to trigger cognitive structures that arise in face-to-face interactions, which would then preclude connection through shared emotional experiences? Or are the remaining cues so powerful that digital interaction has the same effects as face-to-face interaction?

We examine partial cue availability by stripping away visual information or both auditory and visual information from a recorded participant's emotional reaction.

#### **Study 3 Method**

##### **Participants.**

238 female undergraduates from the University of Virginia participated in study 3 for course credit.

##### **Procedure.**

Study 3 employed a 2 X 3 Emotion (Shared Emotion, Unshared Emotion) x Cues (Audio+Visual, Audio Only, Transcript) between subjects design.

*Removing cues from the confederate's emotional reaction to create cue conditions.*

The same situation conditions of study 2, where both the participant and the partner saw a young woman embarrass herself on a reality television show, served as the baseline (Audio+Visual) condition in study 3. Auditory and visual information were systematically removed from the recorded participant's emotional reaction to determine the effects on shared emotional experiences. The conditions were designed to mirror real world mediums for communication including communicating through video (e.g. Skype), over the phone, or via text.

In the Audio Only condition, participants heard a recording of the confederate's reaction to emulate a phone call. The recorded confederate's reaction videos from the audio + video condition were re-encoded as audio files so that participants in this condition were not aware that there was originally a video accompanying her response. Participants in this condition never saw the confederate.

Participants in the Transcript condition read a verbatim transcript of the confederate's emotional reaction in her exact words that included filler words (e.g. "um") and pauses to communicate her reaction as clearly as possible. Participants in this condition never saw or heard the confederate.

## **Results**

The analysis strategy from the previous 2 studies was applied to the participants in study 3. Composite variables were created based on an exploratory factor analysis. The results were then analyzed using two-way between subjects ANOVAs with the composite scores as dependent variables.

### **Composite variables based on exploratory factor analysis.**

We extracted two factors with eigen values well above 1 based on the scree plot (see figure 9).

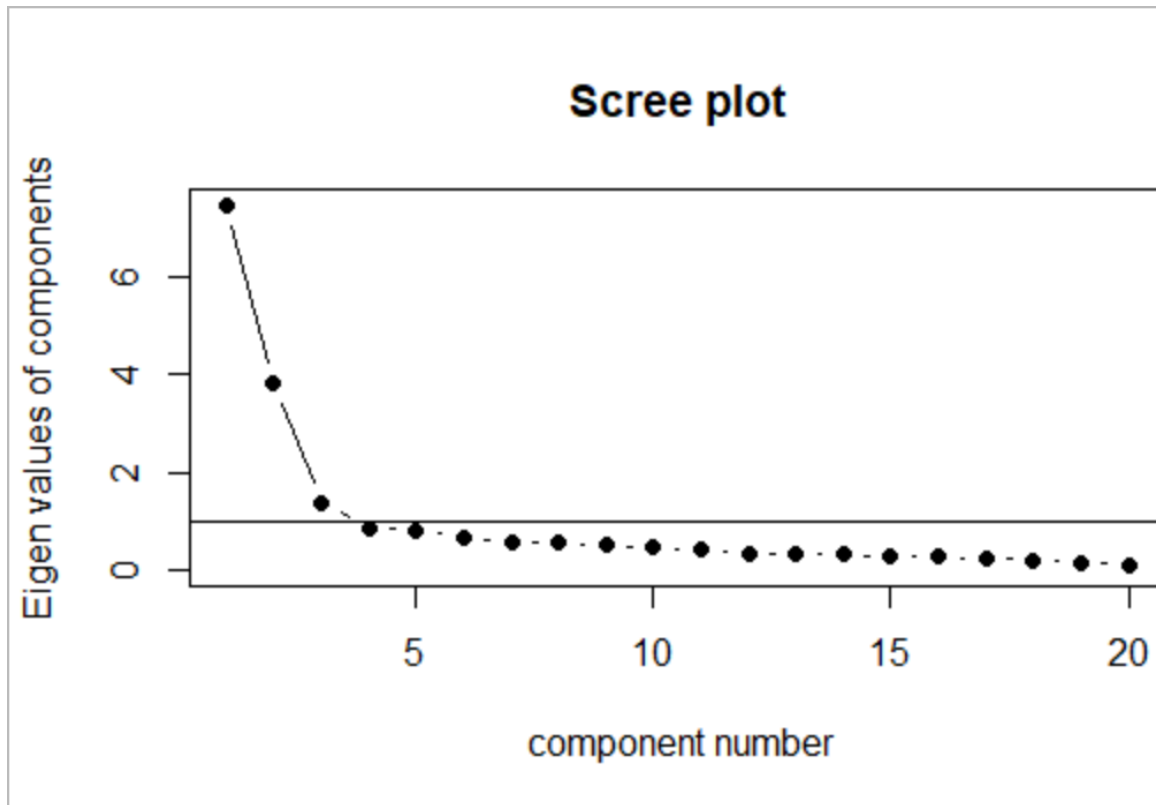


Figure 9. Scree plot from Study 3's dependent variables.

Table 3 contains descriptions of the dependent variables from study 3 along with loadings, uniqueness and complexities of the extracted factors.

Dependent variable	Connection	Aversion	h2	u2	complexity
Expect overlapping interests	0.84	0.08	0.67	0.33	1.0
Would connect with partner	0.83	0.08	0.66	0.34	1.0
Felt similar to Partner	0.80	-0.02	0.65	0.35	1.0
Felt Some Connection	0.77	0.07	0.57	0.43	1.0
Would enjoy spending time	0.76	0.02	0.57	0.43	1.0
Things in common	0.76	-0.09	0.61	0.39	1.0
Would enjoy chatting	0.73	0.03	0.52	0.48	1.0
Closer after study	0.72	0.04	0.50	0.50	1.0
Would get along	0.71	-0.12	0.56	0.44	1.1
Can imagine as a friend	0.68	0.02	0.45	0.55	1.0
Would like to get to know	0.58	0.13	0.32	0.68	1.1
Felt close	0.57	-0.08	0.35	0.65	1.0
Prefer same partner	0.46	-0.25	0.34	0.66	1.6
Feel distant from partner	-0.01	0.81	0.66	0.34	1.0
Would not get along with partner	0.04	0.81	0.63	0.37	1.0
Prefer a random partner to current	0.05	0.73	0.52	0.48	1.0
Would get along better with a stranger	-0.01	0.71	0.50	0.50	1.0
Prefer different partner	0.05	0.69	0.47	0.53	1.0
Cannot imagine being friends	0.03	0.65	0.41	0.59	1.0
Different from partner	-0.06	0.65	0.44	0.56	1.0

Table 3. Loadings used as basis for constructing composite variables.

Given the loadings in Table 3, we constructed a “Connection to Partner” composite variable from all the positive items and an “Aversion to Partner” variable from the negative items. The two factors are negatively correlated:  $r = -.25$ ).

### **Shared embarrassment and amusement connect people regardless of cues.**

Because study 3 effectively replicates the vicarious embarrassment study (study 2) with the same stimuli, we predicted that participants would feel more connected and less averse to a recorded participant who shared their emotional experience compared to one that did not. Of greater interest is the Emotion X Cue interaction. A significant interaction would suggest that the binding effects of shared emotional experiences require information gleaned from directly perceiving others’ emotional reactions. The absence of this interaction would instead suggest that merely knowing about another individual’s reaction is sufficient for a shared emotional experience to bring people together.

Two-way between subjects ANOVAs suggest that perceiving another individual’s emotion is not a necessary condition for social evaluation through shared emotional experiences. Neither the Emotion X Cue interaction for Connection  $F(1, 232) = 1.12, p = .291$ ), nor the Emotion X Cue interaction for Aversion  $F(1, 232) = .49, p = .484$ ), were significant. The main effects for Cue on Connection  $F(1, 232) = .64, p = .425$ ) and Aversion  $F(1, 232) = .10, p = .747$ ) were also non-significant. But, study 3 did replicate the significant main effect for Emotion on

both Connection  $F(1, 232) = 16.14, p < .001$ ) and Aversion  $F(1, 232) = 24.60, p < .001$ ). As in previous studies, participants sharing an emotional experience with the confederate felt more connected ( $M=2.52$ ) than those that did not ( $M=2.19$ ). Aversion to the confederate was greater in the Unshared Emotion Condition ( $M=2.51$ ) than in the Shared Emotion Condition ( $M=2.00$ ).

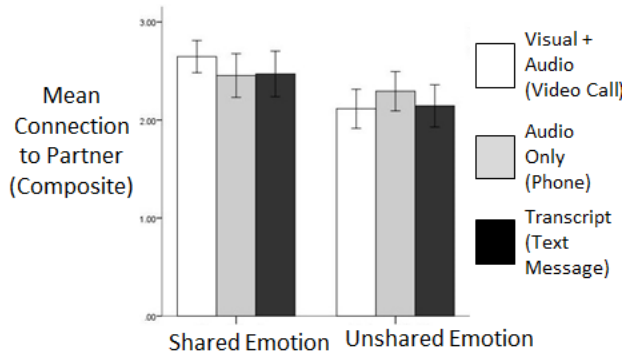


Figure 10. Effects of fluency and sharing emotions on social connection.

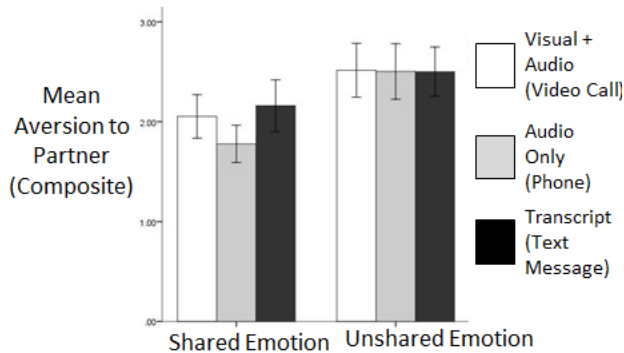


Figure 11. Effects of fluency and sharing emotions on social aversion.

### Study 3 Discussion

The findings from study 3 suggest that individuals do not need all the cues gleaned from an observed individual's emotional reactions to evaluate others based on shared emotional reactions. While the current findings do not eliminate the possibility that participants imagined the particulars of the confederate's response when they could not see and/or hear her, this seems unlikely given that participants had never saw or heard her. The lack of motivation of participants in experimental settings divorced from their day-to-day realities casts further doubt on their willingness to expend resources to mentally simulate a shared emotional experience with a complete stranger. However, in real-world settings where people know their partner,

imagining one's partner may further mitigate differences between communication in-person and communication via technology.

A recent survey by a non-profit organization, Common Sense Media, found that texting has surpassed meeting in person as teens' preferred method of communication (2018). The findings from study 3 may explain these kinds of trends in social interactions among young people. Study 3 found no significant social evaluation cost for technologically mediated social evaluation based on shared emotional experiences, but there are practical advantages for communicating through technology. An individual communicating via text or social media does not have to reply in real time. This provides precious time for impression management; people can carefully curate the information others use to judge them. There is also a convenience factor: one can sit in one's underwear, while sipping on Margaritas when sending a text message.

#### **Study 4: Can Shared Emotions be Interrupted with Disfluency?**

The results of study 3 suggest that shared emotional experiences can shape social evaluation without directly perceiving another individual's emotional reactions. Because direct comparison of one's own emotions to those of others would be computationally inefficient and metabolically costly, people may rely on a meta-cognitive process instead. Earlier, we suggested that people may rely on the ease with which they can make sense of another individual's emotional reaction in the context of their own emotional reaction to evaluate social partners. Past research found relationships between fluency, a term for processing ease, and judgment in a variety of high-level domains from evaluating the truth of statements to deciding how much a stimulus is liked (Oppenheimer, 2008). Reber, Winkielman, & Schwarz found that a low-level perceptual manipulation of fluency, figure-ground contrast, affected the degree to which a stimulus is liked and found appealing (1998). If people rely on fluency to evaluate others as social partners, then disfluency during a shared emotional experience should interrupt Affective Wavelengths, decreasing the connection participants feel with confederates. In study 4, we induce perceptual disfluency through auditory and visual distortions.

#### **Study 4 Method**

##### **Participants.**

130 undergraduate women from University of Virginia provided informed consent and participated for course credit. 1 was excluded because of a prior relationship with the confederate. The other 129 participants were included in analyses.

##### **Procedure.**

Study 4 was a 2x2 Fluency by Emotion between subjects design.

*Inducing disgust or amusement via a vulgar practical joke.*



One of our goals for study 4 was to strengthen our claim that any shared emotional experience can shape social evaluation by showing that the effects from our previous studies generalize to disgust. People often differ in the kinds of humor they prefer. Some people prefer more low-brow slapstick comedy, whereas others prefer more satirical approaches. People also differ in their affinity for vulgar humor. The stimulus for study 4 was a video of a polarizing, disgusting prank that elicits disgust in some individuals, while amusing others. The video begins with several individuals standing in an elevator. A young man walks onto the elevator, while grasping his stomach with a pained look on his face. The young man groans and turns away from others on the elevator as though he is trying to avoid looking at them. The man then begins flatulating in the direction of the other individuals on the elevator. As his flatulence continues, he begins to emit a yellow gas that is meant to resemble diarrhea. Others on the elevator are visibly uncomfortable as they wave their hands in front of their noses and wait for a chance to leave the elevator. When the prank is repeated a second time in the same elevator, a flamboyant male victim flails his hands in an animated fashion, screams in a high-pitched voice and darts around the elevator in an effort to maximize his distance from the prankster.

Participants in all conditions saw the prank video.

***Participant's response.***

Participants indicated whether they felt more disgusted or amused by the prank video. Of 130 participants, 82 felt more disgusted and the other 48 were more amused.

***Creating fluent and disfluent experiences during confederate responses.***

As in the prior studies, participants saw a video where the previously recorded participant reported experiencing the same emotion in the Shared Emotion condition or a different emotion in the Unshared Emotion condition.

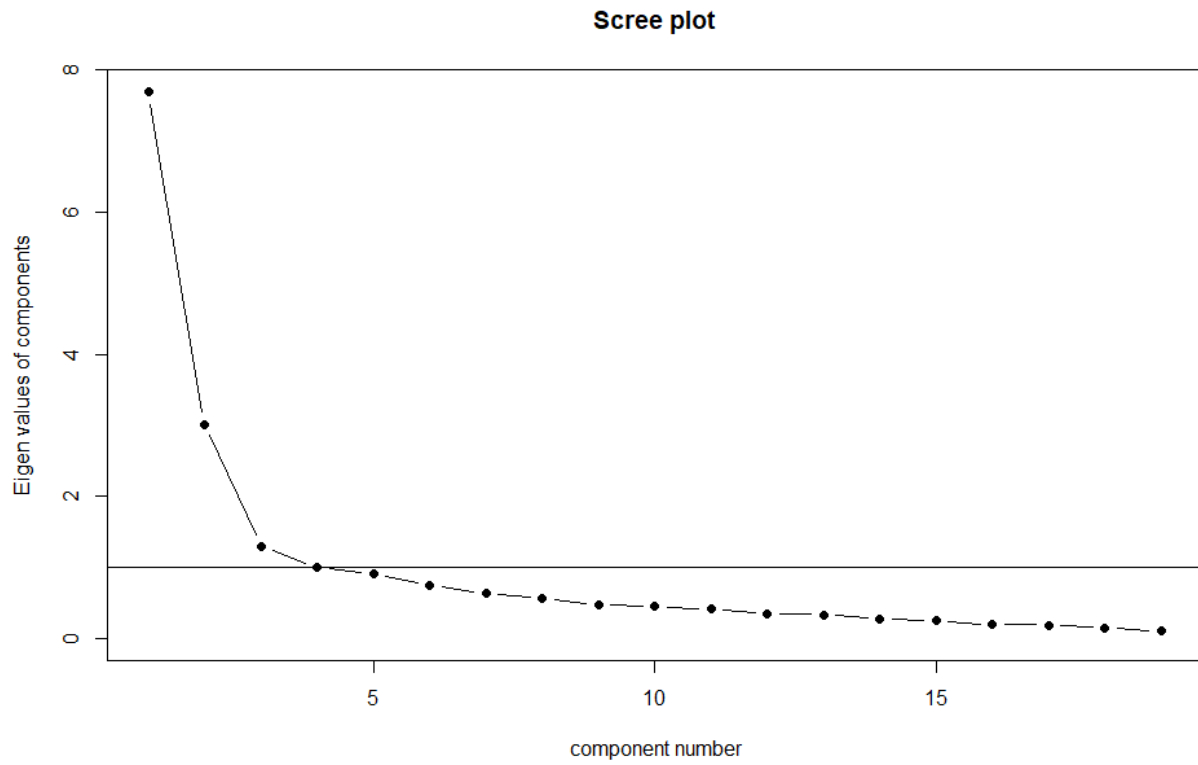
Fluency and disfluency were manipulated via distortions of the aforementioned emotional reaction videos. Participants in the Fluent conditions saw the reaction video with no distortions. Participants in the disfluent conditions saw a distorted version of the confederate's reaction. A few seconds after the reaction video began, the video became blurry and the participant's voice was altered so that she sounded like a robot.

**Results**

The analysis strategy from the previous studies was applied to the participants in study 4.

**Composite variables based on exploratory factor analysis.**

Dependent variables that loaded onto the same factor in an exploratory factor analysis were averaged to create composite variables. Based on a scree plot (see figure 12), we extracted two factors with eigen values well above 1, meaning that they explained more variance than the average dependent variable.



*Figure 12.* Scree plot from Study 4's dependent variables.

An oblique rotation, promax, was used to extract two factors. The loadings, uniqueness and complexities of these factors can be seen in Table 4.

Dependent variable	Connection	Aversion	h2	u2	complexity
Would enjoy Spending Time with Confed	0.82	-0.03	0.68	0.32	1.0
Would enjoy chatting with Confed	0.80	-0.05	0.65	0.35	1.0
Interested in Getting To Know	0.80	-0.02	0.64	0.36	1.0
Similar To Confederate	0.79	0.03	0.62	0.38	1.0
Can Imagine As Friend	0.78	-0.13	0.65	0.35	1.1
Overlapping Interests	0.76	0.05	0.56	0.44	1.0
Feel Closer After Video	0.75	-0.06	0.57	0.43	1.0
Feel Some Connection	0.74	0.12	0.54	0.46	1.1
Have things in Common	0.71	0.06	0.49	0.51	1.0
Would Connect Outside Experiment	0.70	0.06	0.48	0.52	1.0
Feel Close in General	0.69	0.12	0.46	0.54	1.1
Prefer Same Partner	0.64	-0.16	0.46	0.54	1.1
Would Get Along	0.57	-0.03	0.33	0.67	1.0
Prefer Different Partner	-0.19	0.77	0.67	0.33	1.1
Would Get Along Better With Stranger	0.11	0.75	0.56	0.44	1.0
Would Not Get Along	-0.01	0.64	0.41	0.59	1.0
Feel Distant	0.02	0.60	0.36	0.64	1.0
Would Not Be Friends	-0.09	0.54	0.31	0.69	1.1
Different From Confederate	0.09	0.42	0.18	0.82	1.1

Table 4. Loadings used as basis for constructing composite variables.

Based on the loadings in Table 3, the first composite variable we created was a “Connection” Variable, like the one from studies 1 through 3, which was the mean of all the positively framed questions, e.g. “I could imagine being friends with the person in the video”. An “Aversion” variable was computed from the mean of the negatively framed questions, e.g. “I believe I am more likely to get along with a randomly chosen partner than the previous participant I just saw.” The Aversion and Connection variables are negatively correlated ( $r = -.14$ ).

### **Shared embarrassment and amusement connected people and were robust to fluency.**

Based on the findings from the previous studies, we predicted that participants that had the same emotional reaction as the confederate would feel more connected and less averse to her than those that felt a different emotion than the confederate. We also predict that disfluency would interrupt and therefore reduce the difference between the shared and unshared emotion conditions. In short, we predict a significant Emotion X Fluency interaction.

Results from two-way between subjects ANOVAs did not support our predictions. The Fluency (Fluent, Disfluent) by Emotion (Shared, Unshared) interaction was nonsignificant for

both Connection,  $F(1, 124) = .06, p = .810$ ), and Aversion,  $F(1, 124) = .25, p = .620$ ). The main effects for Fluency (Fluent, Disfluent) on Connection,  $F(1, 124) = .44, p = .508$ , and Aversion,  $F(1, 124) = .68, p = .412$ , were also nonsignificant. But, the effects from studies 1 and 2 were conceptually replicated. There was a significant main effect of Emotion (Shared, Unshared) on Connection,  $F(1, 124) = 7.80, p = .006$ . The main effect of Emotion (Shared, Unshared) on Aversion was also significant,  $F(1, 124) = 10.36, p = .002$ . Participants in the Shared Emotion condition felt more connected to the confederate ( $M=2.61$ ) than participants in the Unshared Emotion condition ( $M=2.25$ ). Participants sharing an emotion with the confederate also felt less aversive to the confederate ( $M=1.88$ ) than ones who did not share an emotion with her ( $M=2.30$ ).

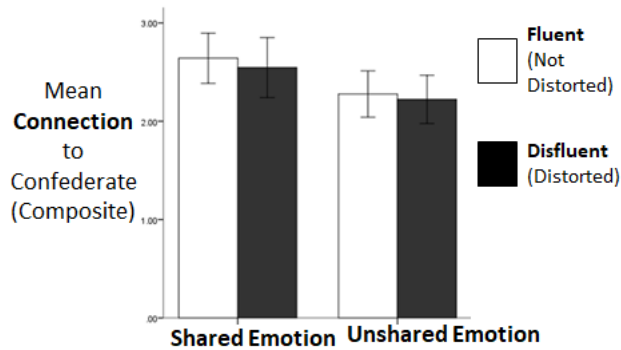


Figure 13. Effects of fluency and sharing emotions on social connection.

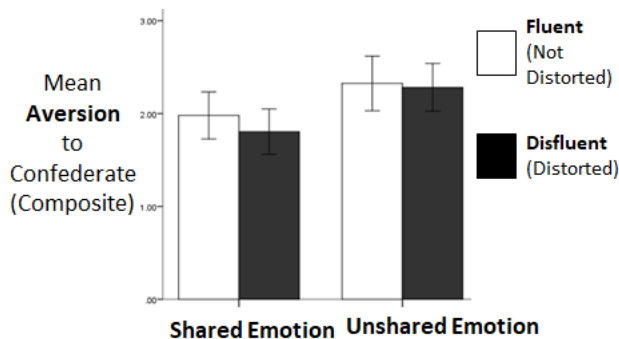


Figure 14. Effects of fluency and sharing emotions on social aversion.

While study 4 did not support mechanistic predictions concerning the role of fluency in shared emotional experiences, study 4 did conceptually replicate findings from studies 1 and 2 supporting the basic claim from *Affective Wavelengths*: Shared emotions bind people together; unshared emotions increase social distance.

#### **No evidence for an effect of shared emotions on dimensions of social perception.**

Past research suggests that people perceive one another along two basic dimensions: warmth and competence (Cuddy, Fiske, & Glick, 2008). Warmth corresponds to whether a person should be approached or avoided, whereas competence is about a person's ability to bring

about particular social outcomes. To see if shared emotional experiences affect participants' perceptions of the confederate, participants were asked to rate the confederate's warmth and competence at the end of study 4. We did not find any evidence for a relationship between shared emotions and the aforementioned dimensions of social perception in study 4.

#### **Study 4 Discussion**

Study 4 further supports the role of shared emotions as social glue. But, study 4 failed to attenuate the effects of shared emotional experiences through disfluency. There are several explanations for why the fluency manipulation failed. First, the fluency manipulation may have been too subtle. None of the participants reported that the fluency manipulation interfered with their ability to understand the confederate's reaction. Furthermore, as a video, the stimulus unfolds in real-time. Past studies manipulated fluency through unclear fonts, a lack of contrast between written material and background, etc (see Alter & Oppenheimer, 2009 for a review). Because these manipulations do not unfold over time, participants can spend more time concentrating on disfluent stimuli. To the extent that expending additional time interacting with a stimulus contributes to a sense of disfluency, video distortions would not be an effective means for inducing disfluency. Another possibility is that we manipulated the wrong kind of disfluency. In the context of shared emotional experiences, fluency presumably stems from others' emotional experiences being easy to interpret in terms of one's own, whereas disfluency occurs when others' reactions do not make sense. Perceptual manipulations of disfluency, such as the distortions in study 3, may simply manipulate disfluency in the wrong modality. Alternatively, fluency may not be the mechanism driving the effects of shared emotional experiences that we have observed.

On a final note, our research suggests that the binding power of shared emotional experiences is very robust. Across several studies, shared emotional experiences did not interact with disfluency (study 4), different situational causes (studies 1+2), and even persisted in shaping social evaluation when shared emotion experiences were distilled to their bare elements by removing video or replacing both the video and audio with a written transcript (study 3). Importantly, these manipulations did not affect our dependent measures directly either, meaning that there were no main effects. Perhaps natural selection favored social evaluation mechanisms that are resilient to virtually all outside noise with the exception of a few highly relevant sources of information such as shared emotional experiences.

In studies 1-4, participants knew nothing about the confederate before having a shared or unshared emotional experience, but in the real world people frequently share experiences with people they know. Next, we further inquire into the boundary effects of shared emotional experiences by examining the effects of shared emotions when people are not complete strangers.

### **Study 5: Can Shared Emotions Overcome Ideological Dissimilarity?**

In studies 1-4, participants who shared an emotional experience with a confederate felt more connected and less averse to her than those who did not share an emotional experience with her. To control for the effects of prior relationships on our dependent variables, participants in the first 4 studies always shared an experience with a stranger. But, in the real world people frequently interact and spend time with the same people (e.g. co-workers, family members, etc.). Even strangers may be evaluated before a shared experience unfolds based on cues from their appearance or the context in which one encounters them. Studies 1-4 also do not speak to the power of shared emotional experiences when compared to that of other social glues like similarity. Earlier, we suggested a special role for shared emotional experiences because emotions are fast, informative, and hard-to-fake indicators of how individuals see the world. This suggests shared emotional experiences may be more potent than comparatively mundane similarities. Study 5 addresses both of these limitations by pitting shared emotional experiences against a particularly strong dissimilarity: ideological dissimilarity.

The potency of ideological differences stem from their informative and polarizing nature. Ideological views are highly socially informative due to their correlation with many social views and preferences. From political views, people can make inferences about everything from views about gun control to preferences in the consumption of alcoholic beverages. Political views can also be regarded as a strong stimulus because people tend not to like those who do not share their moral views (e.g. Haidt, 2012). The divisions between liberals and conservatives in the United States were at a high point when study 5 was conducted, shortly after Trump won the presidential election.

#### **A quick overview**

In study 5, liberal participants experienced a shared or unshared emotional experience with a conservative confederate who espoused some of Trump's more controversial views. Besides shedding light on the power of shared emotional experiences, study 5 is also interesting because one can imagine multiple plausible outcomes. For example, ideological differences might be so powerful that shared emotional experiences would cease to have a detectable effect on the relationship between the participant and the confederate. If shared emotional experiences do still affect the relationship between ideological out-group members, then the direction of that effect is difficult to predict. A shared emotional experience may improve a liberal participant's connection with a confederate as in the previous studies. Alternatively, people might find sharing an emotional experience with a disliked political out-group unsettling, increasing dislike.

#### **Study 5 Method**

##### **Participants.**

189 undergraduate women from the University of Virginia who identified as liberal or very liberal in a pre-screen participated in study 5 for course credit. 9 were excluded due to

experiment errors (researchers unintentionally deviating from script, computer crashes, etc.). 3 more were excluded for vacillating between two possible emotional reactions rather than committing to one. 1 was excluded because she had encountered the stimulus before the study. 3 participants were excluded because of a prior relationship with the confederate. 5 were excluded because they self-identified as independent or very moderate at the time of the experiment. And 3 were excluded because they correctly suspected that the confederate was an actress. Data from the remaining 165 participants were analyzed.

### **Procedure.**

Study 5 had 3 between-subjects conditions. Two were shared and unshared emotion conditions akin to those from the previous studies. The third was a control condition where participants and confederates saw the same video, but participants did not perceive the confederate's reaction. We will refer to this additional condition as the "Unknown Emotion" condition. This condition acts as a baseline to capture participants' attitudes toward the confederate in the absence of sharing or not sharing an emotional experience.

### ***Setting the stage for the experimental paradigm.***

Unlike the previous studies that used recordings of a real participant from an earlier phase of the study, the confederate in study 5 was an actress. In the beginning of study 5, participants filled out a form to give the researchers permission to record and reuse their materials in future studies. The recordings were actually not intended for future use. Instead, the purpose of the recordings was to give the participants the impression that they were participating in the same study as the confederate and to reduce suspicion that the confederate was an actress.

### ***Confirming and affirming the participant's political views.***

Next, participants were interviewed about their political views. Participants were allowed to see the interview questions and write their answers before they were interviewed and recorded by a researcher. Participants first provided their first name, hometown, and political affiliation (liberal or conservative). The rest of the interview consisted of questions about polarizing political issues that participants were likely to encounter shortly after Donald Trump became president. Participants were asked the following questions:

- The president has recently taken steps that will prevent traveling to and from certain Middle Eastern countries. How do you feel about that?
- And what about the border wall between the United States and Mexico?
- How do you feel about illegal immigration more generally?

Participants typed their answers to these questions before the recorded interview for several reasons:

- To confirm the participant's liberal political views and that the participant is familiar enough with the political issues to react appropriately to the confederate's conservative views.
- To affirm the participant's views, which further separates the participant from the conservative confederate.
- To reduce suspicion that their partner is a confederate. If the participant is adequately prepared for the interview, the confederate is less likely to seem rehearsed.

***Introducing the ideologically opposed confederate.***

Participants in all conditions saw a video of the confederate answering the same interview questions. The purpose of this interview is to establish that the confederate has ideological views opposed to the participant's. The confederate, who is an actress, claims she is conservative, supports the travel ban, etc.

***Inducing vicarious embarrassment or amusement.***

Participants in all conditions see the video of the young woman performing terribly during a singing audition on the X-factor from studies 2 and 3.

***Recording the participant's response.***

While recorded, participants report whether they felt more embarrassed for the singer or amused by her performance. Participants then elaborated on their feelings in a sentence or two.

***Shared, unshared, and unknown emotion conditions via confederate responses.***

Before seeing the confederate's reaction, participants are reminded that the confederate saw the same singing audition video. Participants in the shared emotion condition see a video where the confederate claims that she felt the same emotion as the confederate. In the video seen by participants in the unshared emotion condition, the confederate reported feeling the emotion that the participant did not select. And in the Unknown Emotion condition, participants did not see a reaction video.

***Self-report measures of social connection and the Need for Cognition Scale.***

Participants read the prompt from earlier studies claiming that they might be selected for a future paid study where they would be paired with the same partner or a new partner. Participants then indicated their feelings about and connection to the confederate using a 5 point likert scale.

Participants also filled out Cacioppo, Petty, and Kao's Need for Cognition Scale (1984). The need for cognition scale measures an individual difference in the extent to which people spend time thinking and enjoy doing so. Those with a high need for cognition may closely reflect on political differences between themselves and the confederate resulting in a negative



reaction to a shared emotional experience. Those lower in the Need for Cognition may feel closer to the confederate like participants in previous studies.

## Results

As in the previous studies, composite variables were created by averaging dependent variables that loaded onto the same factors in an exploratory factor analysis. The results were analyzed with a one-way between subjects ANOVA. When one-way ANOVAs were significant, Tukey post-hoc tests were used to identify the specific conditions that differed. Finally, we ran a regression predicting the composite variables from Need for Cognition scores and Emotion Condition (Shared Emotion, Unshared Emotion, Unknown Emotion) to see if need for Cognition changed the way participants responded to Emotion conditions (i.e. whether or not there was an interaction between emotion condition and individual differences in need for cognition).

### Composite variables based on exploratory factor analysis.

Dependent variables loading on the same factor in an exploratory factor analysis were averaged to construct composite variables. The scree plot from this study differed from previous studies. The factor that accounted for the most variance contained less variance than the factor with the highest loadings in the previous studies. The next 3 highest eigen values were all barely above 1. Because the first factor did not account for as much variance as we wanted and the eigen values of the other factors that were above 1 were very similar, we extracted 4 factors.

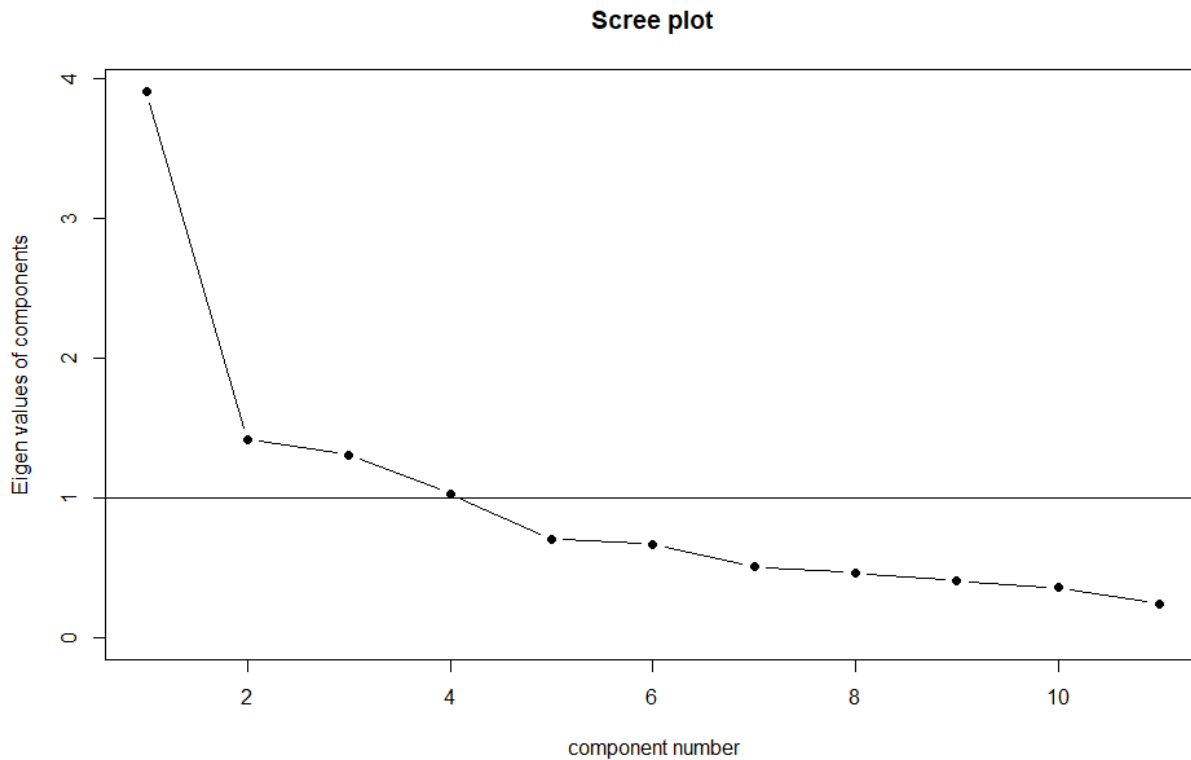


Figure 12. A Scree plot of the dependent variables from study 4.

An oblique rotation was used to extract 4 factors. The loadings, uniqueness and complexities of these factors can be seen in Table 4.

Dependent variable	Compatibility	Closeness	Partner Preference	Affiliation	h2	u2	complexity
Not Get Along	0.92	0.31	0.14	-0.08	0.80	0.20	1.3
Get Along	-0.58	0.04	0.11	0.31	0.58	0.42	1.6
Feel Distant	0.51	-0.12	0.32	0.31	0.47	0.53	2.5
In Common	-0.32	0.27	0.09	0.11	0.30	0.70	2.4
Feel Connection	-0.02	0.79	0.13	-0.01	0.59	0.41	1.1
Feel Close	0.17	0.68	-0.16	0.01	0.46	0.54	1.2
Closer Than in Neutral Context	0.05	0.58	-0.06	-0.01	0.33	0.67	1.0
Different Partner	0.20	0.02	0.80	-0.12	0.82	0.18	1.2
Same Partner	0.05	0.06	-0.64	0.17	0.48	0.52	1.2
Get To Know	0.06	-0.05	-0.24	0.72	0.53	0.47	1.2
Imagine As Friend	-0.24	0.09	0.04	0.56	0.55	0.45	1.4

*Table 5.* Loadings for the factors from study 5.

A quick glance at the loadings above reveals that the composite variables in Table 5 differ from the “connection” and “aversion” variables in studies 1-4. Recall that the “connection” and “aversion” variables in studies 1-4 contained semantically disparate items, e.g. preferring the same partner and interest in getting to know one’s partner, that shared the same valence (e.g. all the positive items). The composite variables in study 5 are very differently organized containing dependent measures similar in meaning, but varying in valence. Given the loadings in Table 5, the first composite variable, which contained items such as “I feel like my partner and I would not get along outside of an experimental setting” and “the individual in the video and I seem to have a lot in common,” was named “Compatibility.” The second composite variable, containing dependent variables including “After seeing the video I feel some connection with the participant” and “After seeing the video I feel close to the other participant” were averaged into a variable called “Closeness”. Questions about preferences for the same or a different partner were aggregated into a “Partner Preference” variable. The last variable, “Affiliation”, included “I could imagine being friends with the person in the video” and “I would be interested in getting to know the person in the video better outside of the experiment”. Below is a correlation matrix of the composite variables from study 5 (see *Table 6*)

		PartnerPreference	Compatibility	Affiliation	Closeness
PartnerPreference	Pearson Correlation	1	.501**	.420**	.365**
	Sig. (2-tailed)		.000	.000	.000
	N	198	198	198	198
Compatibility	Pearson Correlation	.501**	1	.471**	.389**
	Sig. (2-tailed)	.000		.000	.000
	N	198	198	198	198
Affiliation	Pearson Correlation	.420**	.471**	1	.406**
	Sig. (2-tailed)	.000	.000		.000
	N	198	198	198	198
Closeness	Pearson Correlation	.365**	.389**	.406**	1
	Sig. (2-tailed)	.000	.000	.000	
	N	198	198	198	198

\*\* . Correlation is significant at the 0.01 level (2-tailed).

Table 6. Correlation matrix of composite variables from study 5.

### Ideologically opposed individuals feel closer to and more compatible with one another following a shared emotional experience.

In between subjects one-way ANOVAs, there were significant effects of emotion condition (Shared Emotion, Unshared Emotion, Unknown Emotion) on both Closeness ( $F(2,162) = 3.99, p = .020$ ) and Compatibility ( $F(2,162) = 3.44, p = .035$ ). A Tukey HSD Post-hoc test revealed that mean closeness was significantly different in the Shared Emotion ( $M=1.51, SD=.64$ ) condition than in the Unknown Emotion Condition ( $1.26, .42$ ). The Shared emotion condition was also marginally different from Unshared Emotion ( $M=1.30, SD=.44$ ). And post-hoc comparison tests using Tukey HSD showed that participants in the Shared Emotion condition ( $M=2.28, SD=.73$ ) felt more compatible with the confederate than participants in the Unshared Emotion Condition ( $M=1.96, SD=.64$ ).

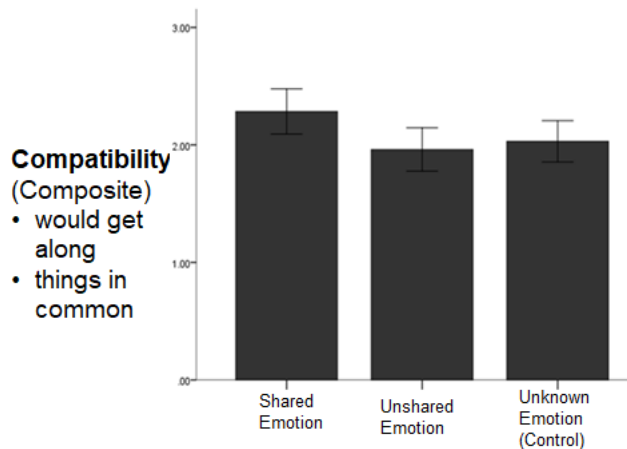


Figure 13. Effects of emotion sharing on compatibility.

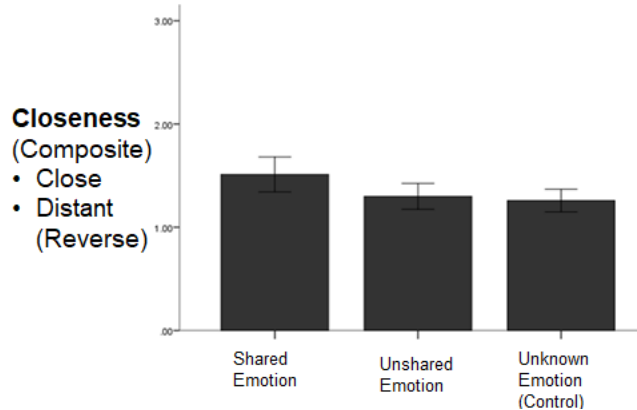


Figure 14. Effects of shared emotions on closeness.

As seen in figures 13 and 14, these findings suggest that shared emotions even promote feelings of closeness and compatibility among individuals with different moral views.

**No evidence that shared emotions influence one's inclination toward interacting with a moral out-group member.**

There were no significant effects of emotion condition (Shared Emotion, Unshared Emotion, Unknown Emotion) on Partner Preference ( $F(2,162) = .64, p = .530$ ) and Affiliation ( $F(2,162) = .67, p = .515$ ).

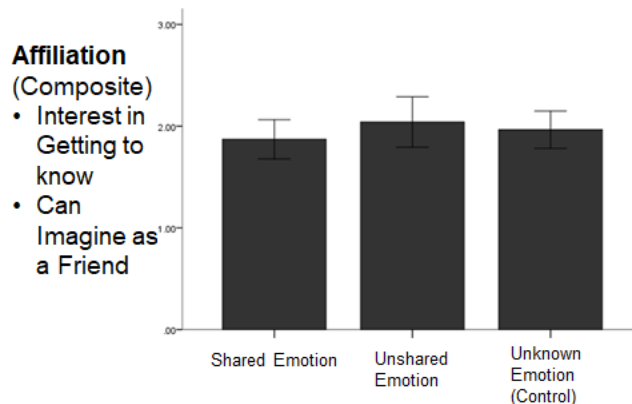


Figure 15. Shared Emotions did not increase desire to affiliate.

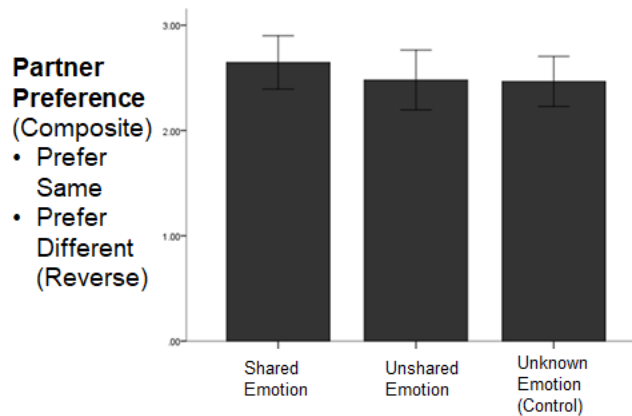


Figure 16. Shared Emotions did not significantly alter partner preferences.

Collectively, the findings from study 4 suggest that people feel closer and more similar to, but not more inclined to interact with, ideologically dissimilar individuals following a shared emotional experience.

**The effects of shared emotional experiences do not appear to be affected by one's need for cognition.**

Earlier, we raised the possibility that participants' connection to ideologically opposed confederates following a shared emotional experience might depend on individual differences in Need for Cognition. Having shared an emotional experience with a moral out-group member, participants high in Need for Cognition might feel uncomfortable and consequently distanced from the out-group member. In contrast, individuals low in Need for Cognition might not give their partner's views much thought and still react to a shared emotional experience with feelings of closeness and connection. Results of a multiple regression predicting the 4 composite variables from Need for Cognition were non-significant. When the emotion conditions were added to the regression, the interaction between Need for Cognition and Emotion condition (Shared Emotion, Unshared Emotion, Unknown Emotion) was also non-significant in predicting the four composite variables. The current study found no evidence that individual differences in the extent to which people enjoy and engage in thinking affect liberal participants' reactions to shared emotional experiences with a conservative confederate.

### Study 5 Discussion

Participants in studies 1-4 felt more connected and less averse to a confederate following a shared emotional experience regardless of the causes that gave rise to the shared emotions. Study 5 expanded on these studies by demonstrating that even mundane shared emotional experiences, like seeing a singer's embarrassing audition, continue to have a measurable impact when individuals do not share ideological views. More generally, this suggests that shared

emotions continue to shape social evaluation when people have pre-existing knowledge and/or feelings about social partners.

But study 5 also has some limitations. The first issue is that the results from the control condition are ambiguous. While the control condition where participants did not see their partner's reaction tended to resemble the unshared emotion condition, there are at least two plausible explanations for this finding. One possibility is that the shared emotions brought people together, whereas unshared emotions had little or no impact. The control condition and unshared emotion conditions would both behave like baselines. But, a more compelling interpretation is that participants inferred that their partner would not share their reaction based on the stark differences suggested by the political interview

Study 5 also deviated from the previous studies in important ways that will have to be illuminated through future studies. To start, the same composite variables were created from exploratory factor analyses in studies 1-4, yet some aspect of study 5, which was presumably the ideological dissimilarity expressed through the political interview, resulted in variables correlating differently. While 4 factors were extracted, two of them were significantly affected by shared emotional experiences, whereas two were not. The two composites that did significantly differ as a result of the experimental manipulation tapped into feelings about the confederate, more specifically how close and similar participants felt to the confederate. The other two composite variables, 'Affiliation' and 'Partner Preference', indicated the extent to which participants were willing to interact with the confederate in a future study and the degree to which the participant could imagine a continued relationship with the confederate. In short, participants felt connected to the confederate, but wanted nothing to do with her in the future. This raises questions about the mechanism of shared emotions and their social implications.

From a mechanistic standpoint, participants in study 5 separated their inclination to interact with the participants from their feelings toward her. One explanation is that the effect of the shared emotion on people's attitudes split so that the shared emotion only had an impact on more specific attitudes toward the confederate. Another possibility that is more consistent with the previous studies is that this disconnect reflects a process further downstream in social decision-making. Participants felt closer and more similar to the confederate, but when asked questions about actually affiliating with her they questioned those feelings through a higher-level reflective process.

Study 5 was also interesting because of its potential social implications. Given the increasingly divisive political climate in which we live today, any means to getting people to reach across social or political divides is worth examining. But, the currency for social change is action, not just positive feelings. One must therefore ask about the extent to which the positive feelings, evoked by shared emotional experiences, translate into social interactions. Across all dependent measures in study 4, the effects of shared emotional experiences were attenuated to various degrees. Therefore, one explanation for the lack of change in people's inclinations toward interacting with a conservative confederate is that a greater quantity of shared emotional

experiences or more potent ones would still lead to social interaction. Future studies can look at the effects of multiple shared emotional experiences as well as compare more and less relevant instances of shared emotional experiences. It's also possible that differences as potent as ideological dissimilarity must be overcome with deeper social interactions.

### **Study 6: What happens when contextual information contradicts a shared emotional experience?**

Earlier, we described a hypothetical scenario where a man and a woman experience very different reactions to a controversial film to highlight the different processes that might shape people's perceptions of one another during a shared emotional experience. Specifically, any shared emotional experience can change people's evaluations of one another through at least 3 different processes: 1) an automatic process based on similarity in emotional reactions (Affective Wavelengths), whether or not someone appears to agree with an individual's reaction (agreement), or more effortful inferences about an individual is like (inference). Studies 1-5 were designed as empirical tests of Affective Wavelengths. To control for the effect of agreement, participants shared emotional experiences with a recorded individual rather than a live person who would seem difficult or disagreeable when not sharing their emotional reaction. To limit the effects of inferences, we selected experiences with relatively low diagnosticity, where participants could glean very little information about the confederate.

Despite the selection of relatively nondiagnostic stimuli, participants reliably felt more connected and less averse to a confederate when sharing an emotional experience (studies 1-4). The potency of these relatively nondiagnostic shared experiences was especially evident in study 5 where a mundane shared experience, vicarious embarrassment for a bad singer, made participants feel closer and more similar to a confederate despite ideological differences. A tenuous relationship between the diagnosticity of a shared experience and the socially adhesive effects of shared experiences is precisely what one would expect from an adaptive social cognitive mechanism for effortlessly and automatically fine-tuning perceptions of people in one's social environment. But, studies 1-5 raises an interesting question about the boundary conditions of shared emotions: would people continue to evaluate others based on shared emotions when inferences based on context suggest that emotional overlap is irrelevant or even misleading?

Study 6 addresses this question by pitting Affective Wavelengths against inference. In studies 1-5 participants report their emotional reaction to an event and then explain their reaction in a sentence or two. Study 6 manipulates the explanations the confederate provides for her feelings to create a clash between shared emotional experiences and what a participant infers from the confederate's explanation.

This experiment also provides a unique lens into the mechanism underpinning shared emotional experiences. While earlier studies tried to minimize the information gleaned from

inference, one could still argue that all the previous findings can be explained via a single inference-based mechanism. For example, participants may have inferred a high capacity for empathy when the confederate felt vicarious embarrassment for the singer. Study 6's inclusion of situations where shared emotions and inferences provide contradictory information about a participant's compatibility with the confederate also provides a stronger test for comparing the dual process account of shared emotions, which includes affective and inferential mechanisms, to an entirely inference-based account. A cognitive load manipulation that should interfere with inference-based, but not automatic affect-based, mechanisms was also included in study 6.

## **Study 6 Method**

### **Participants.**

370 liberal-identifying women participated in study 6 for course credit.

### **Procedure.**

Study 6 was a 2 x 2 x 2 Emotion (Shared, Unshared) x Inference (Liberal, Conservative) x Cognitive Load (Timed, Untimed) between-subjects design.

#### ***Inducing anger with a video of a politically divisive event.***

Participants saw a video where two women, who were victims of sexual assault, pleaded with Senator Jeff Flake not to support the nomination of Kavanaugh (who had been accused of sexual assault) for the Supreme Court. Jeff Flake remains silent and avoids interacting with the two women. When asked whether they felt more angry or pleased, all participants in study 6 reported feeling angered, rather than pleased, by the video and briefly explained their reaction in a sentence or two.

#### ***Inducing shared or unshared emotions through the confederate's emotion.***

Participants saw a video recording of the confederate's emotional reaction. The confederate said she was angry in the shared emotion condition and pleased in the unshared emotion condition.

#### ***Manipulating information available for inference through confederate explanations.***

Inferences were pitted against shared emotional experiences through the explanations the confederate gave for her emotion. The confederate's explanation for her emotional reaction implied that she was liberal in the Liberal Explanation condition or conservative in the Conservative Explanation condition.

By crossing emotion (Shared Emotion, Unshared Emotion) with Inference (Liberal Explanation, Conservative Explanation), we get two conditions where shared emotions and



inferences provide consistent information about the confederate's compatibility with the participant and two conditions where the confederate's explanation contradicts the shared emotion so as to completely undermine it. For example, the confederate might share the participant's anger, which suggests compatibility based on Affective Wavelengths, but explain that she was angered by the inappropriate behavior of the women, which would lead the participant to infer that the confederate has a conservative perspective. Alternatively, a confederate might say that she was pleased, resulting in an unshared emotion, and then claim that she was pleased that the women were raising awareness about the prominence of sexual assault, which implies a more liberal perspective. In the other two conditions, explanations and sharing (or not sharing) emotions point in the same direction like in studies 1-5. Bearing in mind that all participants reported feeling angry at the Senator, the following were the confederate's responses in each condition:

- Shared Emotion, Liberal Explanation: "The senator wouldn't even look them in the eyes. He should have stood up for himself and explained his opinion...even if he did do something horrible, I wish he had the guts to say something to them."
- Shared Emotion, Conservative Explanation: "I think that those women were being crazy and that they harassing him. They should have just let him leave...he didn't need to defend himself...he didn't do anything wrong, so I didn't see why they were doing that..."
- Unshared Emotion, Conservative Explanation: "The senator handled himself really well in a really tense situation and he acted really professionally given that he was just doing his job...and Kavanaugh didn't do anything wrong so I don't think that he needed to engage those women in any way"
- Unshared Emotion, Liberal Explanation: "...I'm glad they had a platform to talk about the issues and he had to listen to them, so I thought that was good."

### ***Inducing cognitive load by timing responses to dependent measures.***

We also included a cognitive load manipulation designed to interfere with inference-based mechanisms. Cognitive load was induced by timing participants while they rated the confederate on a 5 point likert scale. To hide that the timer was meant to influence evaluations of the confederate, participants were instructed to respond to all dependent measure *and* all the subsequent manipulation checks and demographic questions as quickly as possible. To remind participants to respond quickly and increase pressure, participants in the timed condition saw a timer counting upward from 0 seconds in milliseconds.

## **Results**

We followed the same analysis strategy as in the previous 5 studies.

### **Composite variables based on exploratory factor analysis.**

Based on the scree plot below, two factors were extracted.

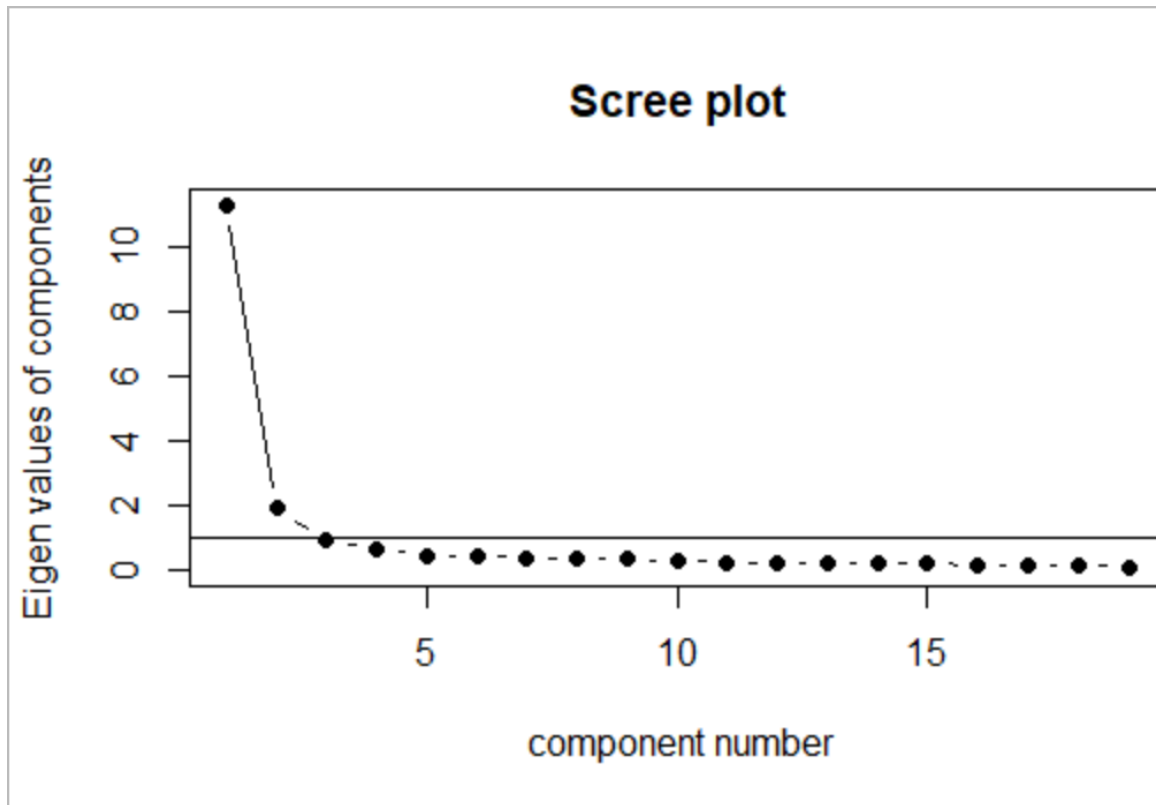


Figure 17. A Scree plot of the dependent variables from study 6.

We extracted 2 factors using a Promax, an oblique rotation. Table 7 contains the loadings, uniqueness, and complexity of the factors from study 6.

Dependent variable	Connection	Aversion	h2	u2	complexity
Connect outside of experiment	0.84	0.02	0.68	0.32	1.0
Enjoy spending time	0.84	-0.04	0.75	0.25	1.0
Can imagine overlapping interests	0.83	0.04	0.65	0.35	1.0
Imagine as friend	0.82	-0.04	0.71	0.29	1.0
Would enjoy chatting	0.80	0.01	0.62	0.38	1.0
Feel some connection	0.77	-0.06	0.66	0.34	1.0
Closer after study than would feel otherwise	0.76	-0.07	0.65	0.35	1.0
Interested in Getting to Know	0.76	0.24	0.38	0.62	1.2
Feel Similar to partner	0.76	-0.14	0.73	0.27	1.1
Would have things in common	0.73	-0.10	0.64	0.36	1.0
Would get along	0.65	-0.26	0.71	0.29	1.3
Feel close to partner	0.61	-0.21	0.59	0.41	1.2
Prefer same partner Partner	0.48	-0.37	0.61	0.39	1.9
Feel distant	0.04	0.90	0.77	0.23	1.0
Would not get along	-0.02	0.88	0.79	0.21	1.0
Would get along better with stranger	0.17	0.87	0.59	0.41	1.1
Prefer a different partner	-0.11	0.78	0.74	0.26	1.0
Feel different from partner	-0.12	0.78	0.74	0.26	1.0

Would not be friends	0.01	0.73	0.52	0.48	1.0
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*Table 7.* Loadings from study 6 connection and aversion factors.

Based on the loadings, “Connection” and “Aversion” composite variables were created by averaging responses to likert scale items.

### **Predicted Results.**

Study 6 pits shared emotions to see 1) whether or not shared emotions can shape social evaluation when they offer no diagnostic information and 2) whether evidence supports a dual process or single process model. Because shared emotions were robust when cues were removed (study 3) and could not be interrupted with perceptual fluency (study 4), we will make predictions for both the dual process and single process model assuming the timing manipulation works and assuming the timing manipulation fails.

#### ***Single process (Inference-only).***

If the cognitive load manipulation successfully interferes with inferences, then there should be a 2 way interaction between Timing and Inference. The shared emotion condition provides no useful information for evaluating the confederate, so the shared emotion condition should not be related to the composite Connection and Aversion variables. In the Untimed conditions, participants in the Liberal Explanation condition will feel more connected and less averse to the confederate compared to participants in the Conservative Explanation condition. The timed condition should eliminate this difference.

If the cognitive load manipulation fails, then single process model only predicts a main effect for Inference because the Emotion conditions offer no information beyond the confederate’s explanation.

#### ***Dual Process (Affective Wavelengths and Inference).***

If the cognitive load manipulation succeeds, then there should be a 2 way interaction between Inference and Cognitive Load. There should also be a main effect for Emotion, which should not be affected by Inference or Cognitive Load. Otherwise, there should be two main effects, one for Inference and one for Emotion.

### **The relationship between sharing emotions and social evaluation was affected by inferences.**

We ran between subjects three-way ANOVAs on a 370 participant sample to see the effect of Emotion (Shared, Unshared), Inference (Consistency, Contradiction), and Cognitive load (Timed, Untimed) on social evaluation. The three-way interactions for connection ( $F(1,359) = 1.16, p = .282$ ) and aversion ( $F(1,359) = .21, p = .644$ ) were non-significant.

However, there were significant two-way Emotion x Inference interactions for both Connection ( $F(1,359) = 32.65, p = <.001$ ) and Aversion ( $F(1,359) = 19.42, p < .001$ ). The bar and line graphs below show that the relationship between shared emotions and social evaluation flips when inferences contradict information provided by shared emotions.

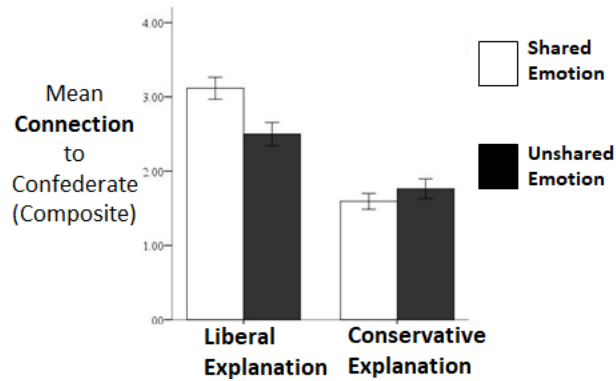


Figure 18. The effects of a contradiction between shared emotions and inference on connection.

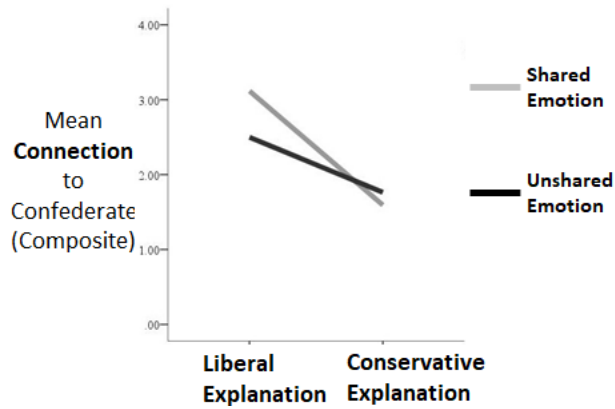


Figure 19. A closer look at the Emotion x Inference interaction for the connection variable.

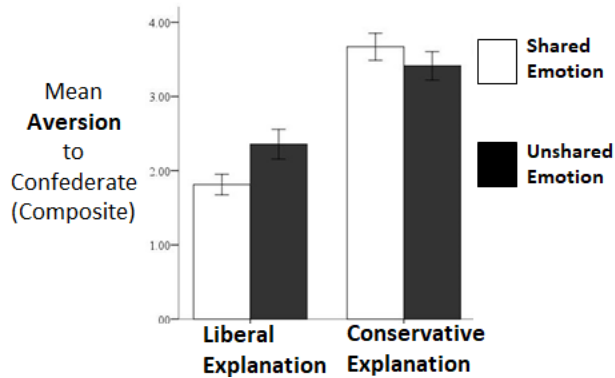


Figure 20. The effects of a contradiction between Emotion and Inference on Aversion.

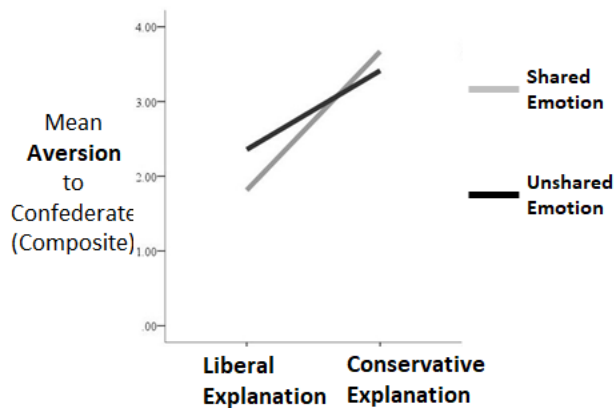


Figure 21. A plot of the Emotion by Inference interaction for the Aversion variable.

## Study 6 Discussion

The findings from study 6 suggest boundary conditions for the socially binding effects of shared emotional experiences: shared emotional experiences do not connect individuals when their meaning is undermined by contradictory contextual information.

Unfortunately, the Interaction between Emotion and Inference does not clearly favor a single process or dual process theory of shared emotions. Looking closely at the data, participants felt most connected and least averse when inferences and shared emotions suggested that the confederate would make a good social partner. Interestingly, the liberal confederate is evaluated less positively after an irrelevant unshared emotional experience. But, this finding has at least 3 plausible, non-mutually exclusive explanations. 1) To create contradictory situations where shared emotional experiences and inferences point in opposite direction, we had to change the object of the confederate's emotion and her explanation. When angry, the liberal confederate was angered by Kavanaugh's behavior toward the 2 women. A pleased liberal confederate was

glad that the women were increasing awareness about an important social issue. Differences between the Shared Emotion, Liberal explanation and Unshared Emotional, Liberal explanation conditions may have simply been due to a preference for the content in the video of the former. 2) If the dual process account is correct, another possibility is that the shared emotional experiences enhanced liberal participants' evaluations of liberal confederates. 3) A final possibility, which is consistent with the single process, inference-based account, is that participants evaluated the confederate based on inferential mechanisms, but that the inferential process was influenced by affect that arose as a by-product of the study design. Shared emotional experiences create expectations regarding the confederate. Participants in the shared emotional experiences conditions anticipated a liberal explanation, which facilitated processing this kind of explanation. This expedited processing, or fluency, could strengthen the inference a participant makes. Conversely, participants in the unshared emotion condition would have their expectations violated when they learned that the confederate was still liberal. This unpleasant experience could similarly influence inference. Within this explanation, the affective-byproducts act as moderators influencing the relationship between inference and social evaluation. While plausible, accepting this explanation in the absence of a dual process account of shared emotional experiences would suggest that feelings can influence inferences, but not evaluations of others more directly. If affect (feelings) from meta-cognitive experiences like processing ease and violations of expectations can shape inferences, then there is no obvious reason why Affective Wavelengths (which suggests that the meta-cognitive experiences arising from shared and unshared emotions change our feelings toward people) would be incorrect.

Future studies could improve upon study 6 by including an additional control condition where confederates provide the explanations in study 6 without a shared or unshared emotional experience. The result would be an Emotion (Shared, Unshared, No Emotional Reaction from confederate) X (Liberal explanation, Conservative Explanation) so that differences in stimuli cannot explain differences between conditions.

## **Discussion**

### **From Mechanism to Minimalism**

By showing that a child's exposure to language could not account for adult language competence, Chomsky ushered in the re-emergence of the scientific study of the mind. The field of linguistics grew with the discovery of new syntactic rules governing the formation of sentences in human language. But recognizing that each of these rules and representations would have to be instantiated in every human mind, Linguists found themselves facing a combinatorial explosion problem - every rule exponentially increased the complexity of what a person would have to know to speak a language. This led to the minimalist program, an effort to simplify linguists' discoveries into a smaller set of rules that could conceivably fit within the mind of every language speaker on the planet.

If we assume psychological theories are represented within the human mind, then psychology faces similar difficulties to those faced by the field of Linguistics when the Minimalist program was proposed. From an evolutionary standpoint, there is an additional

consideration in favor of minimalist, lightweight theories: they would be more likely to have evolved, due to the simpler cognitive architecture needed to scaffold them. This means natural selection would have had to take fewer steps for these kinds of mechanisms to evolve.

In the sections that remain, we will flesh out Affective Wavelengths as a minimalistic, mechanistic theory, demonstrate how the theory can organize and simplify some existing psychological theories, suggest additional empirical directions for expanding on the six studies described above, and close by briefly discussing additional applications for Affective Wavelengths in Artificial Intelligence and bridging the socio-political divide.

### **Affective Wavelengths Theory, a Mechanistic Account**

We began with the claim that people rely on shared emotional experiences to evaluate and prioritize social relationships in the service of navigating the social world. This claim was subsequently tested in 6 experiments. We will now propose a mechanistic account of Affective wavelengths. Rather than positing a completely independent mechanism, we will couch Affective Wavelengths in existing ideas about attention and emotion. Affective Wavelengths thus represents a step in the right direction toward a more minimalist, biologically plausible field of psychology.

We suggest that people make social decisions based on their feelings, which provides a route through which social evaluative mechanisms can guide individuals toward particular social partners. Because emotions provide diagnostic information for identifying social partners, people use a match or mismatch between their own emotions and those of others to adjust their feelings about others, which subsequently shapes future social decisions and interactions.

#### **Affect steers social decision-making.**

When people encounter someone and need to decide whether or not to interact with that person, how do they reach a decision? The most straightforward and reliable predictor of positive future interactions is prior knowledge of an individual including past interactions, direct observations, and information from others, e.g. gossip (Dunbar, 1998). An effective social decision-making mechanism should allow people to make quick decisions based on prior knowledge any time they encounter someone. We will argue that people look to their feelings about others to make social decisions because relying on the totality of their relevant knowledge is often computationally and therefore metabolically infeasible.

#### ***We cannot make social decisions based on raw, content-based representations.***

There are a priori reasons why relying on content-based representations would be ineffective. To start, people's memories are reconstructions rather than accurate representations of the past. When retrieving information from memory, people often rely on scripts known as "schemas" (Alba & Hasher, 1983; Schacter, 1999). As memories fade with time, people

increasingly fill in the blanks based on what they would have expected to happen in a particular social situation. People are even capable of forming false memories (Loftus & Pickrell, 1995). Additional issues stem from the need to aggregate divergent sources of information. For example, suppose a neighbor brought over a basket of fruit while one was sick and offers to look after one's pets during a business trip, but posts signs in support of a political party that disagrees with one's values. To make an informed social decision about the amount of time and energy that should be invested in a relationship with that neighbor, these incommensurate sources of information would have to be converted to a common representational format that would inform one's decisions. If one continues to interact with the neighbor, an additional problem arises: information overload. As people learn more about individuals in their social environment, the computational demands for determining the extent to which they should prioritize interacting with an individual based on all the available information rapidly increases.

*Affect as social information.*

People need to make fast, efficient social decisions that are resilient in the face of the challenges presented by limitations in memory, information overload, limited time and the need for a single representational format. Affect, the mind's embodied evaluative currency, neatly fits with the demands of rapid social decision-making. Affect represents whether an object should be approached or avoided through a valence component, and how urgently an object should be approached through degrees of physiological arousal (Clore, Gasper, & Garvin, 2001). Because all of one's social experiences with an individual can be expressed in terms of goodness/badness and urgency, affect can act as the mind's universal language for combining experiences. Affect is also a universal currency in another sense, namely that it is accessible to a range of cognitive systems including ones for memory, motivation, approach/avoid behaviors, physiological arousal, etc. An affective representation of the social world would therefore simultaneously guide an individual's attention toward important people and events, and prepare him/her for action. Because affect also represents non-social activities and objects, social decisions can even be weighed against non-social options such as choosing to write a paper instead of going out and socializing during a conference. Finally, affect can operate without the burden of conscious thought so people can quickly reap social rewards or avoid threats, or later, in conjunction with additional cognitive processes for further flexibility and sophistication.

We have suggested that there are a priori reasons for hypothesizing that affect represents multiple aspects of the social world, including people and experiences. Neurological evidence and phenomenological experience corroborate this claim. Phenomenologically, taking a moment to consider our history of social interactions with the relevant individual rarely precedes our day-to-day social interactions with others. There are also more neurologically grounded reasons for thinking that feelings, in the form of intuitions or gut reactions, are crucial for making sense of our relationships with others. When the visual system is severed from regions of the brain necessary for evaluating others, a condition known as Capgras syndrome results where people try to explain away their lack of gut reactions to others by convincing themselves that people



they know, including their loved ones, have been replaced by robots or aliens (Hirstein & Ramachandran, 1997). In other words, people need to feel something when they encounter others in order to accept what their visual system and memories are plainly telling them.

***People have an affective map of the social world***

People have intuitions, or gut reactions, associated with every person they have met corresponding to that individual's value as a cooperative partner (Shaked & Clore, 2016). When an individual values someone else as a cooperative partner, he/she will feel closer, more similar, and more inclined to interact with that person. Affective representations of the value of an object are known as attitudes, so we will refer to the feelings we associate with an individual as attitudes toward that person. We will refer to the set these attitudes in a single individual as that person's Social Affective Map. As a map of one's opportunities for social interaction, the Social Affective Map can also be understood as a map of social affordances.

Whenever a person encounters or thinks about someone, he/she will automatically access a representation that includes attitudes toward that person. The resulting feeling can range from an imperceptible intuition, e.g. a hunch that a salesman should be distrusted, to strong conscious reactions such as the disgust people sometimes feel when they see individuals with severe deformities. As people acquire new information about that person, feelings about the newly acquired knowledge are incorporated into the existing attitude. This follows from an existing idea known as the affect immediacy principle (Clore et al, 2001). According to the affect immediacy principle, affect is attributed to the object of one's attention. In other words, minds infer that the feelings a person is experiencing are caused by the focus of one's attention. When people interact with one another, they attend to each other, which allows their attitudes toward their partner to be adjusted to incorporate newly acquired information about them. Because the arousal component of a feeling reflects importance, the current event should lead to a greater adjustment of one's attitude toward a person to the extent that the event produces a high degree of arousal. The weight of new information should also be inversely proportional to the extent that other information about that person is available. If no prior information is available, people still form a judgment based on an individual's facial structure and facial expression (Willis & Todorov, 2006).

***Summary***

People have an affective social map consisting of the value of individuals in their environment as social partners. These maps are adjusted as individuals interact with others. We will now argue that shared emotional reactions shape attitudes toward others through adjustments to one's Social Affective Map.

**The binding effect of shared emotional experiences.**

According to Affective Wavelengths Theory elaborated here, people adjust their attitudes toward others in their Social Affective Map by gleaning information from others' emotional reactions during shared experiences. We will begin by briefly describing the Psychological Construction view about the nature of emotions (e.g. Barrett, 2013). Psychological Construction approaches can account for individual differences in emotion (Barrett, 2009), which will allow us to explain how every emotion reflects a subset of an individual's assumptions about the world. The resulting affective signature shapes an observer's attitude toward an individual experiencing an emotion based on the ease with which the observer can make sense of the experiencer's emotion.

***Emotions as emergent models of the world at a particular moment.***

Emotions are mental models of psychological situations situated between perception and action (Scherer, 1984). The situations represented by emotions are psychological because they are defined by their consequences for an individual rather than by observable features. For example, a friend not answering one's calls and being directly rejected by a friend have similar psychological implications and are therefore psychologically similar despite the friend being present in one situation and absent in the other. Theories differ in their conceptualization of the relationship between psychological situations and emotions. Some theories, sometimes known as Basic Emotions Theories, posit a rigid relationship between emotions and situations (e.g. Ekman, 1992). Emotions are seen as reified, rigid mechanisms instantiated within the brain that are triggered when a particular kind of psychological situation takes place. For example the loss felt after being rejected by a friend would activate a sadness mechanism that includes frowning, seeking comfort from others, and slumped posture. But, failure to find a rigid pattern of behavior in response to psychologically similar situations (e.g. Russell & Barrett, 1999) and to localize the mechanism that would give rise to these mechanisms (Lindquist et al, 2012), lead some researchers to question these kinds of theories. In contrast Constructivist approaches (e.g. Coan, 2010; Shaked & Clore, 2016) embrace the diverse range of human emotional reactions. Rather than positing that an emotion is a causally significant, latent entity, constructivists conceptualize emotions as emergent phenomena that occur when a psychological situation, e.g. the loss of a friend, is represented in multiple disparate modalities. For example, the loss might independently trigger crying and motivation to reconnect, and the simultaneous activation of these systems in response to the loss would be experienced as sadness. Thinking of components of an individual's response to a situation as causing the emotion rather than as being caused by the emotion allows researchers to account for individual differences in response to the same situation as well as differences within a single individual's responses to psychologically similar situations.

According to Affective Wavelengths Theory elaborated here, shared emotional experiences allow people to use an individual's unique emotional responses to evaluate them as social partners. We will first discuss what emotions convey about the people experiencing them and then explain how this information is used to tune one's Social Affective Map.

***Affective signatures as indicators of social compatibility.***

The function of social evaluation is to identify good social partners, meaning ones with whom behavior is easily coordinated to provide the most benefits at the least cost. As mental representations of psychological situations, others' emotions provide observers with a window into the experiencer's view of the world. While emotions are inherently situated and subject to transient internal factors such as a person's mood, aggregating across many instances of the same individual's emotions can shed light on an individual's emotional tendencies, or Affective Signature (also known as Affective Styles in Shaked & Clore, 2016).

According to Shaked & Clore, immersion in a social and cultural environment that reinforces particular patterns of behavior in similar kinds of situations can lead to increasingly coherent patterns of responses (2016). For example, a child whose parents avoid all displays of intimacy and conversations about sex may become reserved about his sexuality, which could lead to embarrassment in response to dirty jokes and sexual situations in movies as an adult. The totality of these tendencies to have certain kinds of emotions during psychologically similar situations is an individual's Affective Signature (Shaked & Clore, 2016). While observing that any one emotional reaction will have limited predictive value, observing many of an individual's emotions can provide an increasingly accurate approximation of that individual's Affective Signature. Before explaining how people represent others' Affective Signatures, we would like to address an additional factor that lends further coherence, and therefore predictability, to people's Affective Signature: dichotomization.

***The convenience of living in a dichotomized world.***

Too much variability within an individual's emotional reactions could obscure his/her potential compatibility as a social partner. Luckily, people's tendency to dichotomize the social world further structures their Affective Signature. The tribalism of human beings, including a need to be distinct from out-groups (Brewer, 2003), and group processes such as polarization (Myers & Lamm, 1976), give members of a group a worldview that is increasingly coherent and differentiated from other groups, which makes the emotional reactions of group members more stereotyped and similar than they would be otherwise. Individuals who share one's worldviews consequently become all the more identifiable. One possibility is that cultural and genetic evolution gave rise to these tendencies to increase group coherence and coordination, and to make it easier for members of a group to identify one another. The result is that individual differences in responding to a particular situation are often so divergent that they naturally fall into dichotomies. For example:

	One person's...	Is another person's...
Dirty Jokes	Funny	Gross
Revealing Clothing	Sexy	Slutty
Sarcasm	Funny	Mean-spirited
Extravagant Courting Behaviors	Romantic	Cheesy
Extreme sports	Exhilarating	Terrifying
Media Violence	Entertaining	Grotesque
Self-Improvement Speech	Inspirational	Lame

Figure 22. Dichotomies in responses to shared situations.

### **Affective Wavelengths: social connection through emotional fluency.**

As emergent phenomena tuned by recurrent situations over the course of people's lives, every emotional reaction reflects an individual's history and consequently has predictive value for perceivers. While observing a single emotional reaction provides limited insight into an individual's world, more observations give rise to increasingly clear impressions of that individual's Affective Signature. But, how can a mind combine multiple observed emotions to encode and represent something as complex and multi-dimensional as an Affective Signature? And how can the complexity of an Affective Signature be translated into attitudes in a Social Affective map that can drive behavior quickly and efficiently?

The challenge of representing and utilizing an Affective Signature may sound familiar from our discussions of the challenges facing social decision-making. Computing an Affective Signature after observing many different instances of the same individual's emotions would lead to a problem with information overload. Constructing a single Affective Signature from qualitatively different emotional categories raises a problem with incommensurability. And the limitations of human memory raise doubt as to the integrity of our memories of others' emotions. We believe that others' emotions are integrated into our Social Affective map through the same route as other kinds of social information that people acquire about a person: they adjust their attitudes toward that person based on how they feel about that person's behavior, which, in the context of Affective Wavelengths, happens to be an emotional response.

When positing new theories, there is always a temptation to reify them, to imagine one's own ideas as biological mechanisms with causal power. But, biology has to be fast and cheap to improve an organism's likelihood of surviving and reproducing. We will claim that minds save resources by directly reacting to others' emotions rather than representing them, encoding these reactions based on mental effort, and estimating Affective Signatures through repeated adjustments of one's attitude toward others. In other words, minds generally do not waste precious resources representing others' emotions, let alone their Affective Signatures.

***Others' emotions as their own best models.***

We have suggested that the similarity between one's own emotions and those of others is indicative of their value as social partners. But how is this comparison made? The most powerful and conservative approach is to construct multiple models of the other person's internal state, each corresponding to a possible version of his/her world, and then to compute the difference between those models and one's own emotional state. Because emotions are emergent phenomena, this would involve a comparison in multiple modalities including between facial expressions, actions, and inferences about that individual's motivational state. Historically, similar brute force strategies were deployed by Artificial intelligence researchers. To build a robot that plays chess, programmers would create a giant machine table consisting of all the possible moves given different states of the board. The computer would compare many different outcomes to determine the best one. Rodney Brooks challenged this approach by suggesting that artificial intelligence researchers should instead focus on the relationship between sensory inputs and actions rather than focusing on rules and representations (Brooks, 1995). According to Brooks, often "the world is its own best model". When others respond to a situation, they are already interpreting it. So a more efficient strategy for social evaluation is to determine whether or not their perceptible outputs, or actions, fit with one's own view of the world.

As highly social beings, people are natural observers of others. When something interesting happens, people quickly look at others to see how they are responding. When others' reactions, e.g. a frown, fit with one's own interpretation of the situation, e.g. as a loss, no additional processing is needed. This absence, or relative absence, of additional processing, is experienced as mental ease or fluency (Oppenheimer, 2008). Minds reward fluency both because it saves resources and because fluency indicates that the mind is successfully navigating its environment. Rewarding behavior that leads to appropriate courses of action limits resource use and prevents course corrections that can interfere with future rewards. Other activities that limit high level processing, like exercise and meditation, can be pleasurable for similar reasons. When others' emotional reactions are inconsistent with our own interpretation of the world, the violations to their expectations are jarring. Conflict, or inconsistency, monitoring identifies situations where minds' predictions fail, which is so important that there appear to be brain regions, namely the anterior singulate cortex (ACC), that are dedicated to it. Even infants are sensitive to violations of expectations. Many experimental paradigms for studying infants' knowledge of the world track violations of expectations through indicators such as turns of the infant's head or changes in sucking rate (e.g. Wang, Baillargeon, & Brueckner, 2004). Fluency and surprise by one's violated expectations reflect one's own internal state and are not accompanied by an object. As such, fluency should be attributable to a range of mental phenomena and processes, including our perception of people (Shaked & Clore, 2016). Indeed, research shows that fluency, like positive mood, can shape evaluations. (Wienkielman 2003).

When we observe others' emotional reactions, we naturally focus on them. According to the Affect Immediacy Principle, affect is experienced as a reaction to the object of one's attention (Clore et al, 2001). The fluency or surprise corresponding to the ease with which one

reacts to someone else's emotion, is therefore experienced as a reaction to that individual and consequently alters our attitudes toward them. According to Affective Wavelengths Theory, fluency and surprise are the vehicles through which shared emotions change the way we see and consequently behave toward others.

***Why we rely on metacognitive feelings, like fluency, rather than actual emotions?***

Relying on fluency also allows minds to dodge another bullet: minds cannot be “distracted” by the valence of an emotional reaction. If people were to simply associate others with the emotion they just experienced, then just being around others in negative situations would be sufficient for negatively evaluating them. Others would effectively be blamed for a situation that may have had nothing to do with them. Perhaps more importantly, negative emotions arguably hold more diagnostic utility than positive emotions. Negative emotions represent the situations where people are most likely to depend on others, whether it is for help, which may require coordinated action, or just for social support. So if one person is estimating another person's Affective Signature, weighing negative reactions is especially important. We will now turn to how individuals arrive at someone's Affective Signature from a series of shared emotional situations.

***Capturing an Affective Signature without representing it.***

An Affective Signature is a set of tendencies to interpret and interact with the world in a particular way. We use the word tendencies to reflect the fact that people can still behave in other ways based on more careful deliberations. When people adjust their attitudes toward others based on fluency or surprise during a shared experience, they are marking situations where they and prospective partners either did or did not see the world the same way. As adjustments are made with repeated interactions, the attitude someone has toward a particular individual will increasingly reflect their tendency to arrive at the same emotion. This means that attitudes toward others will become an increasingly good estimate of the overlap between the Affective Signatures of these individuals. So instead of building a veridical representation of another person's world, people have feelings of closeness roughly corresponding to the probability that they'll interpret the world in the same way.

***Affective Wavelengths in a nutshell.***

Other minds are, in effect, black boxes. People have no way to know how others actually interpret the social world. As models of the world at a particular moment, emotions reflect the subjective reality that an individual constructs when reacting to an event. So to identify individuals whose behavior is driven by similar beliefs and assumptions about the social world, minds determine whether or not the focal individual and a second individual arrive at a shared reality given the same situational cause. People's minds initially assume that others will react like they do. When others' reactions make sense, meaning that they are consistent with this

assumption, a feeling of fluency results and people feel closer, more similar, and more inclined to interact with each other. When others' reactions are baffling because expectations are violated, disfluency and surprise increase social distance. The closeness or distance from others that people feel is represented as attitudes toward that person corresponding to his/her value as a social partner. This feeling shapes social decisions.

### **Future Directions I: Theoretical Directions and Contributions**

We introduced a novel, mechanistic account of the binding effects of shared emotional experiences called "Affective Wavelengths." Returning to psychological minimalism, we will now argue that Affective Wavelengths clarifies existing descriptive psychological theories and highlights novel connections between otherwise disparate ideas, simplifying and unifying the psychological landscape. Below we show that: 1) Affective Wavelengths can mechanistically account for, and highlight, a relationship between two psychological phenomena that grew out of separate lines of research: social tuning and consensual validation. 2) We then demonstrate that as a mechanistic theory, Affective Wavelengths can flesh out existing theories pitched at the descriptive level, e.g. by providing a causal link for the well-known relationship between empathy and altruism. 3) After highlighting Affective Wavelengths' strength as a mechanistic theory, we turn to an additional strength of the theory: Affective Wavelengths is not committed to shared experiences occurring in the present, physical world. More specifically, we discuss how Affective Wavelengths can bind people together during story-telling and the recollection of past experiences. 4) We suggest that this specific usage accounts for a key function of communication, namely its value in bringing people together.

#### **Accounting for social tuning and consensual validation.**

According to Affective Wavelengths, shared emotions alter attitudes through the affect immediacy principle, according to which affect, or feelings, are about whatever is in mind at the time. People experience positive or negative feelings based on the ease with which they can interpret others' emotional reactions in the context of their own firsthand emotional experiences. These positive or negative feelings are then attributed to the individual they are observing, which leads to a change in their attitude toward the observed individual.

But, an individual does not have to be the object of someone's attention following an experience of fluency or violated expectations. If an individual attends to an object other than a person, e.g. the cause of one's own emotion, feelings of fluency would be attributed to that event. This would lead to a change in the individual's evaluation of a particular class of situations. Affective Wavelengths then becomes a vehicle for emotional learning from one's social environment. During long-term and/or valuable relationships, aligning perspectives toward the world can be advantageous for increasing coordination and fostering additional opportunities for social connection. The value of Affective Wavelengths extends beyond situations where people adjust their views to connect with others. People frequently find themselves in

ambiguous situations. Such situations can be disambiguated through others' reactions. Fluency suggests people's intuitions about an ambiguous situation are appropriate, whereas disfluency or violated of expectations would suggest that a situation should be re-evaluated.

Within the psychology literature, these two uses of Affective Wavelengths are understood at a descriptive level as two unrelated psychological phenomena. Adjusting one's attitude toward those of a stranger is known as social tuning (Sinclair et al, 2005), whereas using others' reactions to evaluate the accuracy of one's own views is known as consensual validation (Schachter, 1959). Affective Wavelengths highlights the similarity between these phenomena, while providing a mechanistic account for at least a subset of the instances in which they occur. Explaining these two seemingly disparate phenomena with the same process further suggests that these two processes might exploit overlapping aspects of our cognitive (and neural) architecture.

### **Empathy.**

In addition to unifying existing ideas, Affective Wavelengths can also shed light on known psychological phenomena, e.g. by providing the mechanism behind the well-known relationship between empathy and altruism (Batson & Oleson, 1991). Research on the empathy-altruism hypothesis, historically takes the relationship between empathy and altruism for granted without concern for how feelings of empathy are translated into altruistic behavior. Empathy is fundamentally a shared emotional experience. When experiencing empathy, an individual takes another individual's perspective to feel what he/she is feeling. Therefore, the individual is experiencing an emotion in response to the imagined situation. If the person with whom one is empathizing is present or imagined, overlap between the empathizer's emotion and the other individual's reaction would allow feelings of fluency to be attributed to the individual with whom one is empathizing. This would lead to positive feelings about and an inclination toward interacting with that individual.

### **Affective Wavelengths in past and possible worlds.**

Discussing the role of Affective Wavelengths in empathy raises another strength of Affective Wavelengths: people can share emotional experience when the shared experience is imagined rather than occurring out in the physical world. These imagined situations can be real past experiences or hypothetical. When recounting past experiences in detail, people are brought together or pulled apart by the newly created shared experience. In this way, people can double dip into their experiences gaining further social benefits. These memories do not have to be about social situations shared with the current partner. The individual could have experienced them alone or with different individuals.

Perhaps more importantly, the situations can even be hypothetical. A defining characteristic of stories is emotional content. When people tell one another stories, they collectively encounter a series of shared emotional experiences. They will be brought together to



the degree that they arrive at the same emotional destinations and distanced to the extent that their emotional reactions fail to align.

### **Communicating to connect.**

Extending Affective Wavelengths beyond experiences shared in the present also provides a means for understanding an important role of communication in building, maintaining, and navigating social relationships. While communication is typically defined in terms of the transmission of information, people just as frequently communicate with one another in order to connect. For example, people often discuss events, e.g. sports games, about which both parties are already fully informed. One view of this common process is that discussing shared knowledge serves as an exercise in generating feelings of fluency. To the extent that people compete for social partners, people would benefit from creating additional opportunities to strengthen their relationships by such means. Affective Wavelengths may be the mechanism behind communicating in order to connect: People talk about emotional content and make adjustments to their attitudes toward their conversation partners based on fluency and violations of expectations. One may notice that this situation resembles an aspect of groupthink (Janis, 1982), where individuals prioritize group harmony over making good decisions. During groupthink, individuals frequently discuss shared information rather than information unique to a particular individual in order to foster feelings of closeness.

More generally, Affective Wavelengths may explain our evolved appetite for frequent communication: to test, maintain, and build relationships. Whether its social media networks, phone calls, or texts, when technological advances present new opportunities for communication people increasingly use them and they rapidly become ubiquitous. Perhaps this occurs because people quickly latch onto new ways to affirm and confirm relationships.

### **Future Directions II: Bolstering Existing Empirical Evidence**

While Studies 1-6 provided substantial evidential support for Affective Wavelengths and its capacity to generate testable predictions, they leave ample space for future research. We recommend future studies that avoid samples of convenience, use behavioral dependent variables to directly measure the output of shared emotions, manipulate shared emotions in new ways including combining multiple shared experiences, look into the mechanism underpinning Affective Wavelengths, and investigate shared emotions in existing relationships.

### **Do findings here replicate in other samples?**

We believe that Affective Wavelengths is a universal aspect of the human mind. While we have no reason to believe that our findings would not replicate elsewhere, future studies should directly address this claim by examining shared emotional experiences among individuals of other ages, genders, countries, and socioeconomic status.

### **Can the effects of Affective Wavelengths be observed in behavior?**

For Affective Wavelengths to have real consequences, in both ongoing relationships and evolutionarily, attitude changes and increased preferences for interaction reported by participants should manifest in actual behavior. Future studies could capture changes in behavior by looking at shifts in partner choices, participants' willingness to invest tangible resources in partners after sharing an emotional experience, and frequency of communication.

#### ***Partner choice.***

As suggested earlier, investing resources in one social partner often comes at the expense of another. Shared emotional experiences may help individuals determine in which partner to invest their limited resources. This social prioritization can be studied by including partner choice as a dependent measure. Participants should prefer social partners with whom they shared an emotion to those with whom they have not.

#### ***Degree of investment.***

In addition to shaping preferences between partners, shared emotional experiences should increase investment in particular partners, whereas unshared emotional reactions should reduce investment in a social partner. Economic games, including the Trust game, Ultimatum Game, and Dictator Game that give individuals opportunities to invest different degrees of a desirable resource, usually money, in a social partner provide an opportunity to measure the connection between social partners in a quantifiable and tangible way.

#### ***Frequency of communication.***

In our studies, a subset of our dependent measures tapped into the participant's desire to interact with the confederate in the future. A more direct behavioral approach for measuring this construct is to actually measure frequency of communication, more specifically how often and for how long individuals communicate. Frequency of communication is a promising avenue for investigating the effects of shared emotional experiences in technologically mediated communication where one can count the number of messages individuals send to each other within a window of time. We will propose one such study design when we discuss empirical approaches to studying existing relationships.

#### ***How do multiple shared experiences combine?***

In the real world, people often encounter the same individual on multiple occasions, providing a window for multiple shared emotional experiences. For Affective Wavelengths to be more significant, multiple shared or unshared emotional experiences should have a cumulative effect. There is currently no data to this effect. As people share more emotions, does the effect of every additional shared emotional experience weigh less heavily on their relationship? What happens when individuals have both positive and negative shared emotions

with the same individual? Do they pull in opposite directions, or does one kind of shared emotion influence the effects of another? Does the order in which shared emotional experiences unfold matter?

***Does the intensity of the emotion that is shared matter?***

There are also open questions concerning the weight of individual shared emotional experiences. Simple studies that manipulate the length or degree of an unpleasant stimulus, such as electric shock, could shed light on this question without conflating stimulus intensity and the amount of information a stimulus provides about a social partner.

**Can we find additional evidence for mechanism?**

We hypothesized that shared emotional experiences adjust social evaluations through fluency, but the distortions, intended to disrupt fluency, did not seem to impact participants' ability to interpret the confederate's emotion. Future research should examine the mechanism behind Affective Wavelengths.

*Examining Fluency More Closely.*

One possible explanation for study 4's failure is that the fluency manipulation was too weak. This can be addressed through more drastic distortions that can occasionally interfere with participants' ability to accurately interpret their partner's reaction.

Alternatively, the fluency manipulation may be of the wrong kind. Studies of fluency typically manipulate fluency at a perceptual level, e.g. through fonts that are difficult to read or low contrast between a stimulus and its background. But in the context of Affective Wavelengths, fluency refers to the ease or difficulty with which participants can interpret their partner's emotion. A manipulation where the confederate's actual emotional reaction is more or less ambiguous would be a more direct and relevant test of the hypotheses proposed here.

*One mechanism or two?*

If future studies find that fluency is the mechanism behind Affective Wavelengths, then the additional studies should investigate whether fluency is a unitary or a more complex construct. When we introduced Affective Wavelengths, we suggested that fluency might be instantiated by the ease or difficulty with which a social partner's emotion can be interpreted in the context of one's own emotions. But, we have also suggested that disfluency might stem from a violation of expectations. More specifically, a surprised reaction to another individual's unexpected emotional reaction and/or a difficulty interpreting that individual's reaction might increase social distance. This raises the possibility that shared and unshared emotional reactions shape social evaluations and priorities through different (surprise versus ease) pathways. Exploratory factor analyses of dependent measures from studies 1-4 and study 6 extracted

separate factors for positive and negative dependent variables, which is consistent with the possibility of two disparate mechanisms for social connection and distance.

Fluency may also not be the correct mechanistic explanation for Affective Wavelengths. For example, a higher-level, more inferential process might be responsible for our findings. But, a higher-level process would presumably be more susceptible to, meaning less robust in the face of, our manipulations, e.g. whether or not individuals are members of the same moral group and whether or not the shared emotion was induced by two individuals having the same experience. A simpler, automatic inferential process is within the realm of possibility, but the means through which such a process would be instantiated in the human mind is unclear.

### **Can we examine Affective Wavelengths in existing relationships?**

In the real world, socializing frequently involves repeated interactions with closer others including friends and co-workers. While inducing close relationships in the lab is difficult and experimentally manipulating them is ethically questionable, existing relationships can be studied through self-report or passively through data collected from communication service providers (e.g. Facebook Messenger or WhatsApp). Both kinds of studies should ideally include close relationships, e.g. close friendships and romantic partners, as well as less intimate relationships.

***Looking at shared emotions through self-report.***

If shared emotional experiences bind people together, then there should be a correlation between the strength of a relationship and the extent to which emotional experiences are shared. A future study could have participants report the strength of specific relationships in their lives. Then, the participants would describe various experiences they shared with the individual in the described relationship along with the extent to which the participant felt the same emotion as their partner. The order in which participants rate their relationship and shared emotional experiences would have to be counter-balanced. All else being equal, there should be a positive correlation between the extent to which emotions are shared and relationship strength.

***Examining emotions shared through technology.***

Frequency of personal communication is a measure of time and effort invested in a relationship. If researchers obtain significant portions of participants' conversation history (e.g. from text messages, Facebook Messenger, Google Hangouts, email, etc.) with participant permission, then sentiment analysis could be used to investigate the relationship between shared emotions and frequency of communication. Sentiment analysis technology, such as Google's Natural Language API, can be used to evaluate the emotional content of specific messages. To the extent that messages exchanged closely in time between two individuals contain similar emotional content, as measured through sentiment analysis, participants should also be more frequently exchanging messages.

**Future Directions III: Applications**

The explanatory power of theories stems not just from their capacity to organize and explain other theories, but from their potential contributions in the real-world. This section briefly focuses on applications of Affective Wavelengths in politics and technology.

**Politics**

In study 5, participants felt closer and more similar, but not more inclined to interact with an ideologically dissimilar individual. But, positive correlations between composite variables tapping into liking, similarity, and willingness to interact (see *Table 6*) suggest that the lack of statistical significance in inclination to interact with the confederate might have more to do with effect size and sample size than participants refusing to meet with a moral out-group member.

The robustness and potency of shared emotions in studies 1-5 suggest that shared emotions might be an effective vehicle through which to bridge the increasing cultural divide between liberals and conservatives to encourage communication and cooperation. While past research suggested that contact between groups and common goals can unite people, shared emotional experiences could provide a means through which to create deeper connections that facilitate more positive and productive contact.

## Artificial Intelligence

Affective Wavelengths may also have applications in the world of technology. Results from study 3, where visual and auditory information is stripped from the confederate's emotional reaction, suggest that connection through shared emotions requires little information beyond knowing how someone feels about a shared situation. This means an intelligent agent would not need to fake full-spectrum emotion for a human being to connect with the intelligent agent through a shared experience. Since people are predisposed toward anthropomorphizing objects, e.g. speaking of their computers as though they prefer one kind of software to another, it might be possible to capitalize on this tendency to increase the connection people feel toward artificial agents, e.g. Amazon's Alexa or Google Assistant.

Beyond simulating shared emotions to build connections between people and artificial agents, Affective Wavelengths could also be used to model emotional worlds, e.g. to model a particular individual's Affective Signature (meaning all of a person's emotional predispositions) or to give artificial agents an Affective Signature of their own. As a cumulative, iterative process that adjusts feelings about people or objects based on the difference between people's own models and others' models of a shared experience (which can be understood as a kind of error score), Affective Wavelengths could be modeled using Neural Networks. Once the cumulative effects of shared emotions are better understood, deep learning models of Affective Wavelengths could potentially be used to:

- Improve computer interaction with humans by giving software an increasingly nuanced emotional "personality", that learns and becomes ever better suited for the person with whom it is interacting.
- Build computerized models of specific peoples' emotional predispositions.
- Simulate and predict how humans will
  - o Get along with another human given each person's emotional tendencies.
  - o Behave/adapt to certain situations.
- Based on knowledge from above, one could potentially glean new ideas for research to improve our understanding of social evaluation and perhaps other mental processes.

## Concluding Remarks

One of the oldest problems in Philosophy of Mind is the other Minds problem: people cannot know firsthand what another person is thinking or feeling. While there is no way to know exactly how others are interpreting a situation, others offer us many hints through their emotional reactions including facial expressions, body language, and verbal communication. When these clues align or misalign with one's own interpretation of the same events, the ease or difficulty with which one can interpret their reaction alters an attitude corresponding to that person's value as a social partner. These adjustments in our attitudes toward others shape our perceptions of our social landscape allowing us to expend our time, resources and energy in the kinds of relationships that provide us with comfort, meaning, and support.

Continuing to expand our understanding of shared emotions offers us an increasingly clear window into the forces that bring us together and pull us apart. We hope that applying this

research will one day aid in the construction of social bridges across religious and political fault lines in these trying and divisive times.

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