**Predicting and Reducing Impulse Behavior**
Can biometric technology reduce impulse decisions, improve empathy, and reduce conflict?

May 3, 2023

Travis A. Tatman
Columbia University School of International and Public Affairs

**Predicting and Reducing Impulse Behavior**
Can biometric technology reduce impulse decisions, improve empathy, and reduce conflict?

# Predicting and Reducing Impulse Behavior
Can biometric technology reduce impulse decisions, improve empathy, and reduce conflict?

## Abstract

When couples enter a conflict, their emotions can become escalated, often lending to self-protection and aggression, and even good partners can end up in intense fights that damage the relationship. Understanding this impulse, and learning how to calm down, to shift out of fight or flight mode, and connect, can help couples develop awareness, empathy, and other mentalizing[1] skills that can encourage conflict resolution.


Biometric indicators have helped us maintain our physical health and fitness, but are they helping us alleviate—or are they in fact lending to—our hectic lifestyles and untimely work schedules? How are our lifestyles affecting our mental fitness? As wearable tech such as the Apple Watch becomes more common in society, we find rises in cases of anxiety disorders, depression, stress-induced psychosomatic disorders like hypertension, variations in blood sugar levels, migraines, peptic ulcers, heart diseases and stroke. The research is well defined in associating exposure to stressful environments over a long duration with feelings of stress, physical and emotional fatigue, and consequently, impulsive behavior (Simon, Jiryis, & Admon, 2021; Leppink, Odlaug, Lust, Christenson, & Grant, 2016; Raio, Konova, & Otto, 2020).

---

[1] The American Psychology Association defines mentalizing as "the ability to understand one's own and others' mental states, thereby comprehending one's own and others' intentions and affects" (American Psychological Association, 2023).

**Predicting and Reducing Impulse Behavior**
Can biometric technology reduce impulse decisions, improve empathy, and reduce conflict?

The proposed study seeks to replicate recent research[2] that a wearable device which monitors biometric indicators such as heart rate and body temperature can effectively predict impulse behavior. Next, based on research that shows a correlation between mindfulness and empathy[3], we look to test whether participants wearing a device which predicts and alerts the user to heightened emotional states leads to a reduction in response time (RT) in dialogue during therapy sessions. Last, to test the affective valence of the therapy sessions, we will conduct a statistical analysis of conflict language used during couples therapy sessions to learn whether being alerted to impulse states—and thus slowing RT—is associated with a reduction in conflict behavior.

Empathy, defined by *Psychology Today* as "the ability to recognize, understand, and share the thoughts and feelings of another person, animal, or fictional character", provides numerous benefits to people and is critical for building relationships and practicing compassion (Psychology Today, 2023). More generally, empathy provides a foundation for our social lives, shaping and encouraging prosocial and caregiving behaviors, reducing aggression, and promoting cooperation among members of similar and even divergent social groups (Decety, Bartal, Uzefovsky, & Knafo-Noam, 2016). In the proposed study, we focus on empathy during marital conflict in particular because how couples understand each other's emotions during

---

[2] Raychaudhuri et al. (2021) find that a deep learning algorithm along with a Bayesian probability module can predict the future mood fluctuations of the user with lower error than the other contemporary models. Predicted mood fluctuations matched with the actual mood changes of the experimental subject within ±10 min of the predicted time index in 93% of the cases and within ±5 min in 82% of the cases (Raychaudhuri, et al., 2021).

[3] Mindfulness programs that reduce stress also enhance empathy (Shapiro, Schwartz, & Bonner, 1998; Lamothe, Rondeau, Malboeuf-Hurtubise, Duval, & Sultan, 2016).

conflict may be critical for relationship satisfaction and longevity. With a divorce rate of 2.5 per 1,000 population, and a domestic violence event occurring on average for nearly 20 people each minute in the United States, the implications for the learnings and potential positive outcomes from this study are substantial (Center for Disease Control and Prevention, 2023; National Coalition Against Domestic Violence, 2023).

## Proposed Methods

### Participants

Participants will include 60 or more married couples of varying ages, socioeconomic statuses, and relationship lengths recruited from a popular couple's therapy agency in New York City. Consistent with prior studies using fMRI technology, all participants must meet the criteria for fMRI scanning (i.e., right-handed, no metal, no psychoactive medications, no psychiatric disorder). Participants will be provided a small monetary incentive via reduced hourly rate to encourage participation in the study.

### Procedure

**fMRI and Biometrics session**

Participants will each attend four sessions. In the first session, participants will wear a lightweight smart processing device mounted with sensors to capture biometrics (heart rate, body temperature) and enter an fMRI machine to calibrate the same to the mental state of the user on a scale of zero to hundred, similar to the procedure found in Raychaudhuri, et al. (2021). While under fMRI monitoring, participants will be asked to recall a difficult challenge in their relationship to stimulate clusters of activation in the fronto-limbic regions including the medial

frontal gyrus and dorsal ACC, areas known to modulate resolution of stimulus interference under stress (Sebastian, et al., 2014). Using a deep learning algorithm along with a Bayesian probability module, we will look to replicate the findings in Raychaudhuri, et al. (2021) that the mood fluctuations of the user can be predicted with lower error than other contemporary models.

**Behavioral assessment**

In the second, third, and fourth sessions, participants will attend three 60-minute couples therapy sessions. For each session, participants will be randomly assigned to one of three conditions. Condition A (alerts) participants will wear a wearable device with a sensor which monitors biometric indicators (heart rate, body temperature) and delivers an alert when the participants biometrics indicate a heightened emotional, or impulsive, state. Condition B (no alerts) participants will wear a wearable device with a sensor which monitors biometric indicators (heart rate, body temperature) but *does not* deliver an alert when the participants biometrics indicate a heightened emotional, or impulsive, state. This allows researchers to assess any study effects due to simply wearing the device. Condition C (control) participants will not wear a device and act as a control.

**Survey**

Following the fourth session, participants will complete a 14-item IRIC survey to assess cognitive and emotional empathic tendencies within the context of intimate relationships. Derived from Péloquin & Lafontaine (2010) the 14 items comprising the Perspective Taking and Empathic Concern scales are adapted to specifically measure empathy toward the partner.

**Planned Analyses and Hypothesized Results**

**Biometric Results**

As noted above, in the biometric session, participants will wear a lightweight smart processing device mounted with sensors to capture biometrics (heart rate, body temperature) and enter an fMRI machine to calibrate the same to the mental state of the user on a scale of zero to hundred, similar to the procedure found in Raychaudhuri, et al. (2021). We predict that when asked to recall a difficult challenge in their relationship, participants will show a significant increase in biometric activation (increased heart rate, increased body temperature) in addition to stimulation of the fronto-limbic regions including the medial frontal gyrus and dorsal ACC.

**Behavioral Results**

In all behavioral sessions, participants will be monitored for reaction time (RT) and frequency of conflict language[4] used. To assess whether participants who receive an alert of an impulsive bodily state leads to reductions in impulse behavior in real time, the response time (RT) to dialogue and frequency of conflict language will be compared across all four therapy sessions and all three conditions. Participants in Condition A (alerts), wearing a device with impulse alerts enabled, should show a significant reduction in biometric indicators associated with an impulsive emotional state, when compared to both Condition B and Condition C, based on our prediction that alerts will encourage reflection and slower response times. Additionally,

---

[4] Phrases that lead to conflict can include naïve realism such as "clearly," "obviously," or "beyond doubt"; exaggeration "you *always* …" or "you *never*…"; judgement "you should do X"; blaming "you make me so angry"; bad morals such as "wrong" or "unethical (Detert, 2021).

**Predicting and Reducing Impulse Behavior**

Can biometric technology reduce impulse decisions, improve empathy, and reduce conflict?

participants in Condition A should show a significant reduction in conflict language used. See

Figure 1 Condition A: wearing a device with impulse alerts. Participants in Condition B, wearing

a device with no impulse alerts enabled, should show no significant difference from the control

group in the biometric indicators associated with an impulsive emotional state during counseling

sessions, but we predict a reduction in the frequency of conflict language used, due largely to

study effects. See Figure 2 Condition B: wearing a device with no impulse alerts. Notably, we're

predicting a reduction in the frequency of conflict language used in Condition A (alerts) to be

significantly greater than the reduction found in condition B (no alerts), due to a heightened

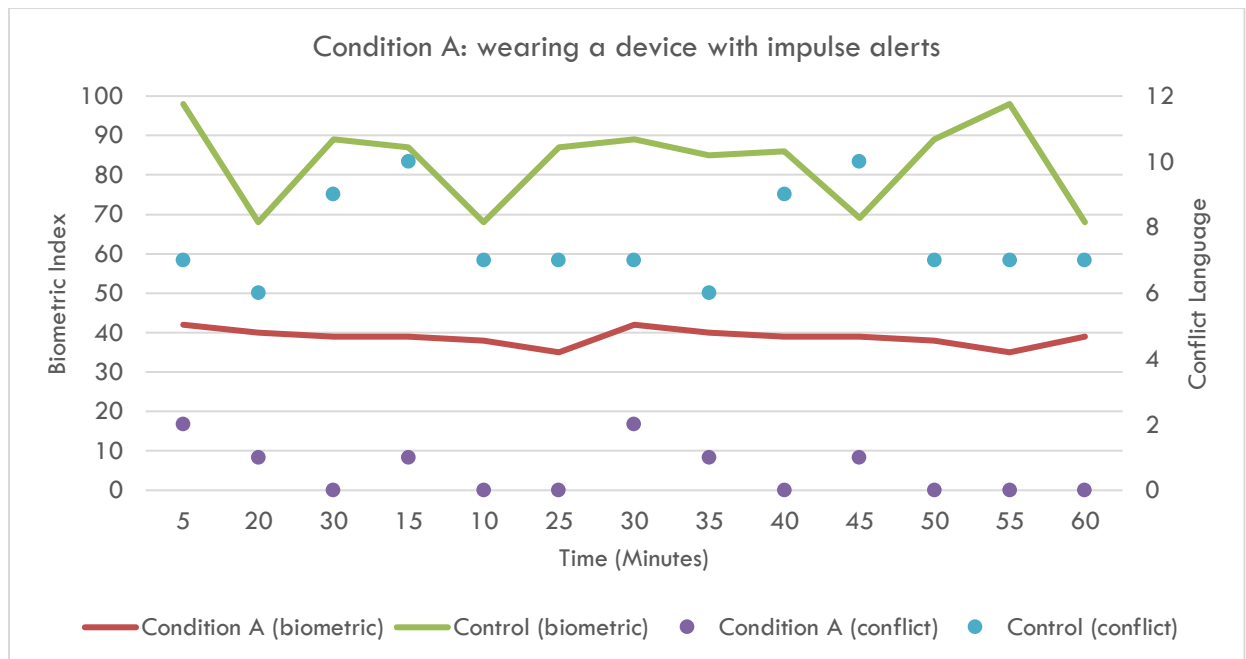awareness of emotional state and preventative measures to reduce negative dialogue.



*Figure 1 Condition A: wearing a device with impulse alerts*

Can biometric technology reduce impulse decisions, improve empathy, and reduce conflict?
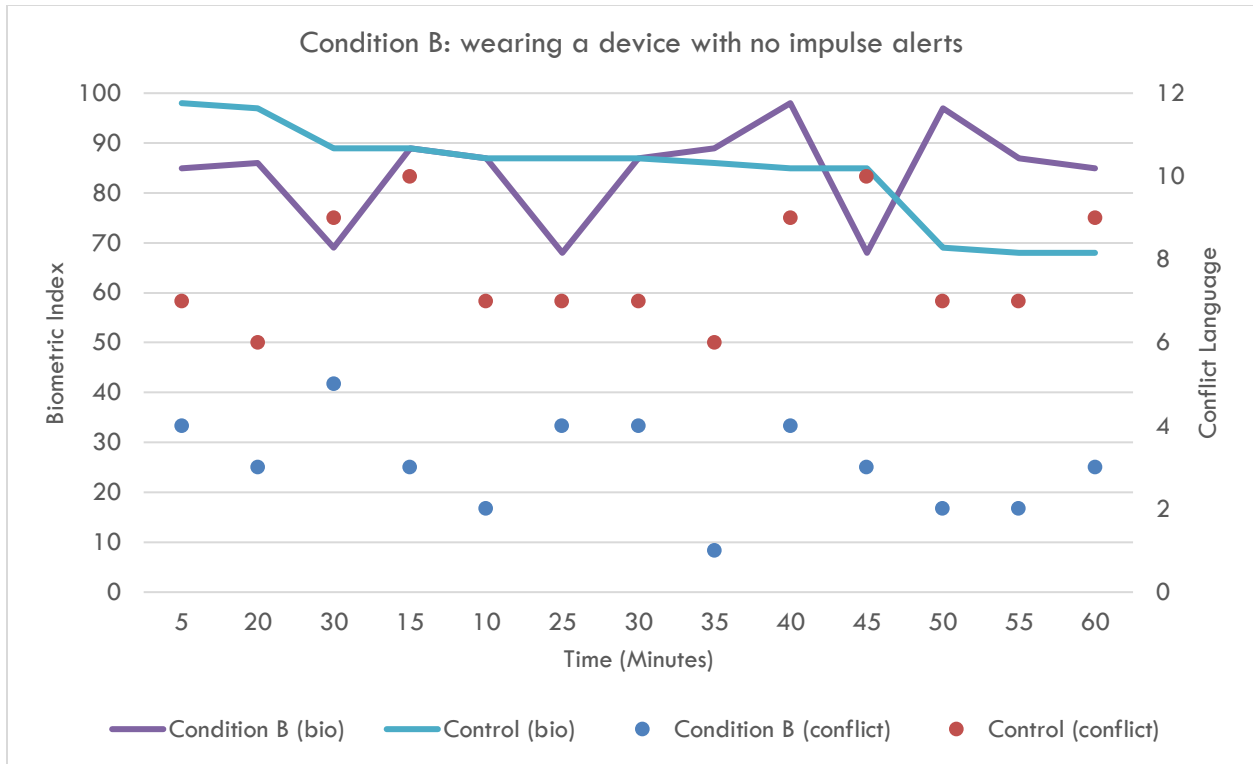


*Figure 2 Condition B: wearing a device with no impulse alerts*

## Behavioral post-analysis

To assess any changes in behavior or empathy throughout the experiment, we will conduct a longitudinal post-analysis regressing biometric scores, RT, and frequency of conflict language over time. Our prediction is that participants exposed to Condition A (alerts) will experience a stronger diminishing effect than Condition B (no alert) and Condition C (control) in both the physiological state and the behavior associated with impulse behavior over time.

**Predicting and Reducing Impulse Behavior**
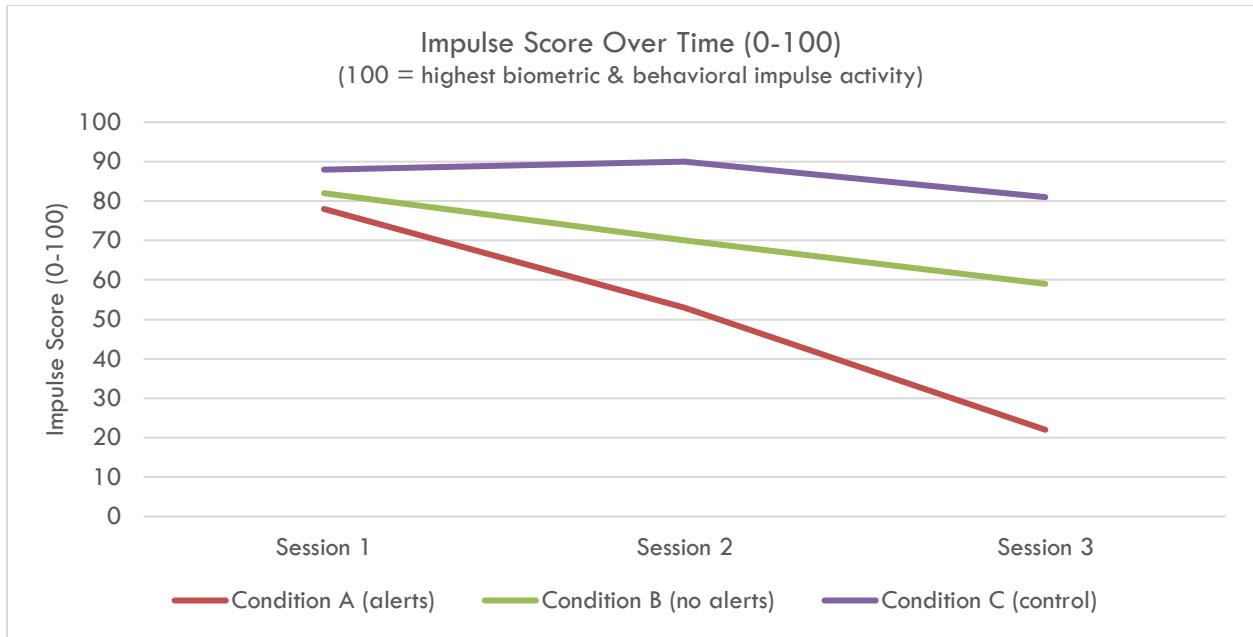Can biometric technology reduce impulse decisions, improve empathy, and reduce conflict?



*Figure 3 Impulse Score Over Time (0-100). A score of 100 indicates the highest level of biometric & behavioral impulse activity.*

## Survey results

We predict that participants exposed to Condition A (alerts) will respond more favorably to the IRIC survey, indicating that they perceive a greater sense of perspective taking and empathic concern toward their partner. We predict that participants exposed to Condition B (no alerts) will show no significant difference from the control in cognitive and emotional empathic response.

## Limitations

While the longitudinal analysis can provide us with an understanding of how the treatment condition affected participants over the course of the experiment—the predicted result is lower impulse-associated biometric response and behavior—there is currently no mechanism to attribute the treatment to changes in empathy specifically. We encourage researchers to

**Predicting and Reducing Impulse Behavior**

Can biometric technology reduce impulse decisions, improve empathy, and reduce conflict?

explore fMRI experiments which combine our impulse alert mechanism with fMRI scans which can measure changes in neural regions associated with empathy activation, generally understood to be the anterior insula region (Singer, Critchley, & Preuschoff, 2009; Morelli, Torre, & Eisenberger, 2014).

A limitation to any study of emotional activity and neural or behavioral response is interpretation and generalization. What exactly is empathy and how is it measured? Is it generalizable across regions, cultures, and ethnic groups? Any findings should be approached with care and understood that any learnings are highly context dependent.

While we predict that we'll find that impulse response to associated with conflict language in a relationship context, impulsive emotional states and behavior may *not always* be associated with conflict language. People may use conflict language while in a baseline emotional state.

There is a likelihood for study effects in the behavioral session. Individuals who know they are being monitored are likely to exhibit varying behaviors than in a natural condition.

## Conclusions and Broader Impacts

The proposed study seeks to determine if a wearable that alerts subjects to their heightened emotional state, a state associated with impulsive behavior, can lead to increases in response time during moments of heightened sensitivity (couples therapy sessions, in this case) thus leading to reductions in the use of language associated with conflict, and increases in perceived partner perspective-taking and empathetic response. While this experiment addresses how biometric indicators and alert mechanisms may prevent undesirable behavior, we encourage

Can biometric technology reduce impulse decisions, improve empathy, and reduce conflict?

future researchers to examine whether biometric indicators can improve favorable

characteristics, such as perseverance or focus.


We believe the broader impacts of our hypotheses and research, if proven true, are advancements

in a wearable technology that can lead to stronger mentalizing skills such as empathy, thus

leading to deeper relationships and more of them, greater compassion for others and thus

stronger social outcomes, reduced aggression and reductions in inter-group as well as outer-

group conflict, stronger cooperation among members of similar and divergent social groups,

reduced marital conflict, reductions in the rate of divorce, and reductions in domestic violence

and abuse.

**Predicting and Reducing Impulse Behavior**
Can biometric technology reduce impulse decisions, improve empathy, and reduce conflict?

**References**

American Psychological Association. (2023). Retrieved from American Psychological Association: https://dictionary.apa.org/mentalization

Center for Disease Control and Prevention. (2023, May 2). *Marriage and Divorce*. Retrieved from Center for Disease Control and Prevention: https://www.cdc.gov/nchs/fastats/marriage-divorce.htm

Decety, J., Bartal, I. B.-A., Uzefovsky, F., & Knafo-Noam, A. (2016). Empathy as a driver of prosocial behaviour: highly conserved neurobehavioural mechanisms across species . *Philosophical Transactions of the Royal Society B*, 371.

Detert, J. R. (2021, June 21). *Words and Phrases to Avoid in a Difficult Conversation.* Retrieved from Harvard Business Review: https://hbr.org/2021/06/words-and-phrases-to-avoid-in-a-difficult-conversation

Leppink, E. W., Odlaug, B. L., Lust, K., Christenson, G., & Grant, J. E. (2016). The Young and the Stressed: Stress, Impulse Control, and Health in College Students . *The Journal of Nervous and Mental Disease*, 931-938.

Morelli, S. A., Torre, J. B., & Eisenberger, N. I. (2014). The neural bases of feeling understood and not understood. *Social Cognitive and Affective Neuroscience*.

National Coalition Against Domestic Violence. (2023, May 2). *Statistics*. Retrieved from National Coalition Against Domestic Violence: https://ncadv.org/STATISTICS#:~:text=NATIONAL%20STATISTICS&text=On%20average%2C%20nearly%2020%20people,10%20million%20women%20and%20men.

Oyserman, D., & Destin, M. (2010). Identity-Based Motivation: Implications for Intervention. *The Counseling Psychologist*, 1001-1043.

Péloquin, K., & Lafontaine, M.-F. (2010). Measuring Empathy in Couples: Validity and Reliability of the Interpersonal Reactivity Index for Couples . *Journal of Personality Assessment*, 146-57.

Psychology Today. (2023). Retrieved from Psychology Today: https://www.psychologytoday.com/us/basics/empathy

Raio, C. M., Konova, A. B., & Otto, A. R. (2020). Trait impulsivity and acute stress interact to influence choice and decision speed during multi-stage decision-making. *Scientific Reports*.

Raychaudhuri, S. J., Manjunath, S., Srinivasan, C. P., Swathi, N., Sushma, S., Bhushan, K. N., & Babu, C. N. (2021). Prescriptive analytics for impulsive behaviour prevention using real-time biometrics. *Progress in Artificial Intelligence*, 99-112.

Sebastian, A., Jung, P., Krause-Utz, A., Lieb, K., Schmahl, C., & Tüscher, O. (2014). Frontal dysfunctions of impulse control – a systematic review in borderline personality disorder and attention-deficit/hyperactivity disorder. *Frontiers in Human Neuroscience*.

Simon, L., Jiryis, T., & Admon, R. (2021). Now or Later? Stress-Induced Increase and Decrease in Choice Impulsivity Are Both Associated with Elevated Affective and Endocrine Responses . *Brain Sciences*, 1148.

Singer, T., Critchley, H. D., & Preuschoff, K. (2009). A common role of insula in feelings, empathy and uncertainty. *Trends in Cognitive Sciences*, 334-340.