

# Behavioral and Psychological Mechanisms and Interventions to Understand and Address COVID-19 Vaccine Hesitancy Across the Lifespan

June 14-15, 2021

Virtual Meeting

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## Acronym Definitions

BBCSS	Board on Behavioral, Cognitive, and Social Sciences
CDC	Centers for Disease Control and Prevention
COVID-19	coronavirus disease 2019
HPV	human papillomavirus
NASEM	National Academies of Science, Engineering, and Medicine
NIA	National Institute on Aging
NIH	National Institutes of Health
PPE	personal protective equipment
SARS-CoV-2	Severe Acute Respiratory Syndrome Coronavirus 2
SNF	skilled nursing facility
WHO	World Health Organization

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## Executive Summary

The National Institute of Aging (NIA) and the National Academy of Sciences, Engineering, and Medicine (NASEM) Board on Behavioral, Cognitive, and Social Sciences (BBCSS) jointly hosted a seminar titled *Behavioral and Psychological Mechanisms and Interventions to Understand and Address COVID-19 Vaccine Hesitancy Across the Lifespan* on June 14-15, 2021, via videoconference. Meeting participants discussed the full spectrum of vaccine hesitancy, its intersection with aging, and ways that behavioral science can increase vaccine uptake in a variety of populations. While many people in the United States have received the COVID-19 vaccine, uptake is uneven across regions and populations and has not reached the level sufficient for herd immunity. Rogers' diffusion of innovation curve from communications science provides an approach to targeting individuals to expand the vaccinated population.

A recurring theme throughout the seminar was equity in vaccine distribution and vaccination campaign efforts. Some demographic groups continue to face obstacles to access to COVID-19 vaccines, which, combined with existing vaccine hesitancy, suppresses their vaccination rates. Many of these marginalized<sup>1</sup> populations have also experienced more severe health and economic impacts from COVID-19.

In addition, many minority groups have community history that drives a lack of trust in government and the health care system as a whole. This lack of trust can transitively affect trust in vaccines, especially a vaccine developed rapidly to combat a novel disease using a technology never before used in human vaccines. Other sources of mistrust can arise from political partisanship and (social) media mis/disinformation campaigns, as well as perceived or actual mistreatment and undervaluation either historically or at the onset of the pandemic in the United States. For example, skilled nursing facility workers harbor resentment over early mistreatment in the distribution of personal protective equipment, which impacted their opinions toward COVID-19 vaccines as they became available and heavily encouraged for these workers.

Emotion is central to decision-making processes, and vaccination campaign workers must shape narratives in which individuals can change their decision gracefully. To appeal to different population segments, researchers must identify common values among those segments; for example, valuing elders or family may be a motivator for vaccination, and emotional and social connection can encourage individuals to revise their decisions. Social connection becomes a stronger motivator over the lifespan, exemplified by older adults valuing immediate rewards more when making decisions involving social or health rewards as opposed to financial rewards.

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<sup>1</sup> "Marginalized communities are those excluded from mainstream social, economic, educational, and/or cultural life. Examples of marginalized populations include, but are not limited to, groups excluded due to race, gender identity, sexual orientation, age, physical ability, language, and/or immigration status. Marginalization occurs due to unequal power relationships between social groups" (Sevelius, J. M., et al. [2020]. Research with marginalized communities: Challenges to continuity during the COVID-19 pandemic. *AIDS and Behavior*, 24(7), 2009–2012. DOI: 10.1007/s10461-020-02920-3). The term "underrepresented" describes any subset of a population that holds a smaller percentage within a significant subgroup than it holds in the general population.

However, some personality traits, such as anti-social behavior and low empathy, that influence vaccine-related decisions remain constant over the lifespan.

Not all individuals who remain unvaccinated do so by conscious choice (i.e., presented with an opportunity and actively refusing the vaccine) but rather by a lack of choice or apathy. This population is considered the “laggards” or “late majority” in the diffusion of innovation model. Such individuals are especially susceptible to “nudges,” such as small personal benefits or reminders/cues to action such as text messages and direct appeals by trusted members of their community. Encouraging people to make a commitment—even if only to themselves—is especially helpful to increasing likelihood of behavioral follow-through on intentions.

Meeting participants discussed potential strategies to increase vaccination rates and necessary future research directions that may drive future campaigns for COVID-19 boosters or other new vaccines. In particular, participants discussed including former anti-vaccine activists in study design, examining the roots of pro-sociality and empathy, and studying the most effective nudges to increase vaccine uptake. How pro-sociality changes as people age was also specifically considered.

Throughout the meeting, participants addressed questions regarding how decision-making processes impact the timing of vaccine uptake, how age-related changes in decision-making processes alter assessment of vaccine benefits and harms, how contextual factors impacting vaccination decisions differ across individuals and groups, and which techniques might most effectively accelerate the pace of vaccination in different individuals or groups.

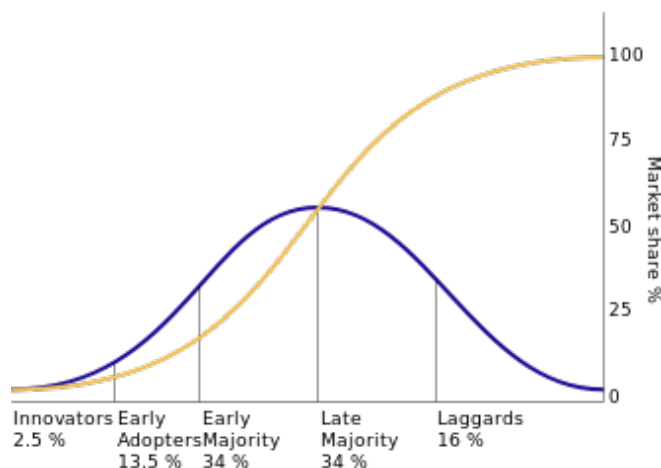
## Meeting Summary

### Introduction

*Terrie Moffitt, Ph.D., Duke University and Chair, BBCSS; Luke Stoeckel, Ph.D., Program Director, Mechanistic and Translational Decision Science*

Each year, the National Academies of Sciences, Engineering, and Medicine (NASEM) Board on Behavioral, Cognitive, and Social Sciences (BBCSS) and the National Institute on Aging (NIA) jointly host a seminar to explore an emerging area of behavioral and social sciences relevant to aging. On June 14-15, 2021, NASEM and NIA convened a group of experts in a seminar titled “Behavioral and Psychological Mechanisms and Interventions to Understand and Address COVID-19 Vaccine Hesitancy Across the Lifespan” to identify the best research approaches to improve understanding of the mechanisms behind vaccine-related behaviors, with COVID-19 as a salient and timely example.

The World Health Organization (WHO) defines vaccine hesitancy as the delay in acceptance or refusal of vaccines despite availability of vaccine services. Vaccine hesitancy is a term that describes a set of complex phenotypes around vaccine decisions and behaviors, covering the spectrum between people who demand vaccines immediately and people who refuse vaccines outright. The factors that influence vaccine hesitancy and deliberation are diverse and multi-



**Figure 1. Diffusion of innovation curve.**

factorial. Vaccine uptake can be associated with the classic diffusion of innovation curve (see Figure 1)<sup>2</sup>: those who acquire the new development first are termed “innovators” and those who acquire it later are termed the “late majority” or “laggards.” For COVID-19, the “wait-and-see” group may have been cautious to receive vaccines that were developed “at warp speed” in response to a novel virus. Emergency Use Authorization was granted by the U.S. Food and Drug Administration (FDA) in December 2020; initially, the vaccine was available only to priority groups (e.g., health care workers, adults

aged 65 and older, people with high-risk pre-existing conditions) and became available to all adults aged 18 and older in April 2021. The “wait-and-see” group shrank from 39 percent to 17 percent between December 2020 and March 2021, transitioning to either the “already-gotten” or “as-soon-as-possible” groups—depicted as the “early” groups on the diffusion of innovation

<sup>2</sup> Dearing, J. W., Cox, J.G. (2018). [Diffusions of innovations theory, principles, and practice](#). *Health Affairs*, 37(2). DOI: 10.1377/hlthaff.2017.1104.

curve. However, while self-predicted vaccine acceptance rates increased with patient age, these rates actually decreased as vaccine roll-out approached.

As of May 25, 2021, approximately 50 percent of U.S. adults who were eligible had been vaccinated. However, this vaccination rate varied considerably across the U.S. population. Early in the vaccine rollout, public health agencies prioritized geographic areas with high social vulnerability indices, as determined by the Centers for Disease Control and Prevention (CDC). However, as of May 22, 2021, the lowest vaccination rates remained in counties with both the highest hesitancy and the greatest vulnerability. While individuals who are deeply opposed to vaccination may not be influenced by many traditional behavioral interventions, groups that are open to vaccination but have real or perceived structural barriers to access show an increase in vaccination if these barriers are acknowledged and removed. In order to increase vaccine uptake, the adoption curve for vaccination must be accelerated and shifted by using interventions tailored to specific individuals and populations and informed by behavioral and social science research.

During this seminar, speakers leveraged findings from behavioral science research, information from past pandemics and related vaccination efforts, and existing data from the current COVID-19 pandemic to identify research gaps and opportunities and to determine future directions for behavioral and social research related to COVID-19 vaccine hesitancy across the lifespan. Specifically, the speakers were asked to consider the following topics:

- The vaccine uptake challenge is multi-dimensional (individual, interpersonal, community, global) in *heterogeneous* risk groups across the lifespan
- Role of decision-making in vaccination choices and behaviors
- Identification of *causal* factors that drive vaccine uptake and how might this inform tailored interventions that target these causal mechanisms
- Prioritization of risk groups for largest impact of vaccination in those with greatest need, for which behavioral strategies are likely to be effective

## Vaccine Uptake and Hesitancy

### The Big Picture

*Jennifer Cunningham-Erves, Ph.D., M.P.H., M.Ed., M.S., CHES, Meharry Medical College, Vanderbilt University Medical Center*

Dr. Cunningham-Erves studies COVID-19 vaccine hesitancy within the African American community and discussed the scope of hesitancy, strategies to address hesitancy, the role of health equity in vaccine distribution and hesitancy, and the importance of stakeholder engagement. She expanded on the concept of “hesitancy” to include indecision, uncertainty, reluctance, deliberation, and apathy, to reflect the complexity and context-specificity of vaccine hesitancy. The complexity in attitudes toward vaccines demand targeted approaches to increase likelihood of vaccine acceptance and are captured by different combinations of the WHO’s 3C model of complacency, convenience, and confidence. Complacency arises when

people believe vaccines are unnecessary or perceive a low risk of vaccine preventable diseases. Convenience exists when vaccines are affordable and physically available. Confidence describes an overall level of trust—not only in vaccines themselves, but also in the system that delivers them, the reliability of health care professionals, and the motivation of policy makers.

Disparities in vaccine hesitancy have emerged for all vaccines, especially the COVID-19 vaccines, in part because of differing levels of trust across demographic categories. Minority groups have exhibited reduced uptake of these vaccines as compared to white Americans, a disparity that may result from not only hesitancy dependent on structural racism, but also on inequity of vaccine distribution. In fact, Dr. Cunningham-Erves urged meeting participants to consider both equity and justice when determining approaches to vaccine hesitancy. With equity, every individual receives the needed support, whereas with justice, no supports are necessary because all barriers have been removed. Contextual individual and group influences as well as vaccine-specific concerns drive vaccine uptake and hesitancy overall and by race. Contextual influences include politics and policies that influence both vaccine confidence and vaccination campaigns, as well as historical research abuses, which have particularly strong impacts in minority communities. Risk/benefit analysis may be skewed by lack of confidence in the health care system. In addition, the rapid development and delivery of COVID-19 vaccines drives hesitancy in minority communities.

Social networks also drive vaccine hesitancy across groups. Some networks support the idea of “natural immunity,” and some influence people to perceive a disease as low risk or low severity. For example, young people may believe they are at no risk for the disease or will not have severe outcomes. Further, pregnancy can impact vaccine acceptance because of fears that vaccination may harm a growing fetus. Social networks can also impact vaccine uptake, because trusted individuals can answer questions which can promote misinformation. Social network influences on vaccine acceptance are particularly complex among health care workers. The general population tends to trust health care worker perspectives on given vaccines, but many health care workers have expressed hesitancy toward COVID-19 and other vaccines. One review of 35 published studies found reported rates of hesitancy toward COVID-19 vaccines among health care workers ranging from 4 to 72 percent. WHO working groups have studied interventions to convince individuals to become vaccinated and have found motivational interviewing and self-persuasion to be promising strategies.

Equitable vaccine distribution requires an understanding and acknowledgement of specific local histories and existing inequities across the social and health care environment, which is one of the first steps to building trust in the system generally. Existing inequities can be based in specific concerns about, for example, missing work to receive the vaccine and potential side effects, which could lead to lost pay or employment. To fully address vaccine hesitancy, psychological processes and structural barriers must be managed and, more importantly, communication must target specific communities and individuals. Researchers must study how to change *how* people think, in addition to *what* people think. Including community leaders and affected individuals in this effort can also shape vaccine confidence campaigns.

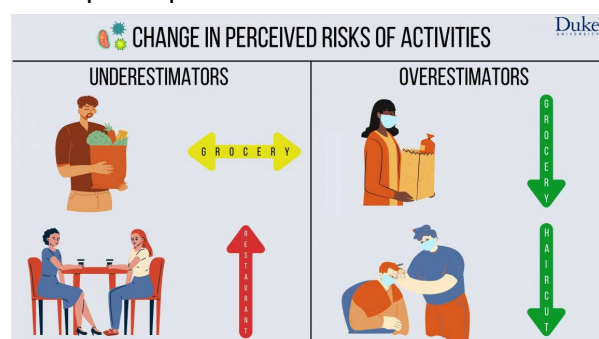


## Basic Behavioral Science to Inform Understanding about Vaccine Hesitancy

Gregory Samanez-Larkin, Ph.D., Duke University

Dr. Samanez-Larkin studies how decision-making processes change over the course of adulthood and how the inherent psychological processes have impacted COVID-19 vaccine hesitancy and pandemic-related behavior. Older individuals learn more slowly from feedback, and they are more anchored to their own knowledge. When presented with frameworks that resemble real life or enable them to draw on past-lived experiences, older adults will focus on past experience to the point of ignoring contingencies established in artificial environments. Some strategies, such as introduction of very novel tasks, can encourage older adults to focus on newer information. Dr. Samanez-Larkin's team uses a values-based decision-making framework that requires determination of the subjective utility of different options to learn how people maximize utility. Examples of decisions include whether to receive \$5 immediately or \$7 later, to receive a small dose of a novel and beneficial drug immediately or a larger dose later, or to spend 11 minutes with a known and beloved social contact immediately or 45 minutes with them later. Prior research suggests that older adults are more patient for monetary rewards and will wait for a larger reward at a later timepoint; however, Dr. Samanez-Larkin's research suggests that impatience for monetary rewards is not age-dependent. In contrast, impatience for health and social rewards is age dependent, with older adults showing greater impatience than younger adults. That age effect on near-term valuation of health and social rewards held steady across multiple years, including during the emergence of the COVID-19 pandemic in the United States during March-May 2020.

To apply this research to the COVID-19 vaccines, Dr. Samanez-Larkin's team first explored whether different age groups understood the risks posed by the SARS-CoV-2 virus. The researchers used a dashboard of COVID-19 risks developed by Georgia Tech to determine location-specific risks of COVID-19 exposure. Researchers first asked participants to estimate the riskiness of activities such as grocery shopping, eating in or outside of a restaurant, or attending a concert. After receiving the correct answers for those specific activities, participants guessed their risk of exposure based on the number of people at an event in their location. Most participants underestimated their risk of exposure, although a subset dramatically



**Figure 2. Representation of findings in risk assessment recalibration experiments**

overestimated their risk. Finally, participants were again provided with the correct information and then contextualized the options with personalized events—for example, participants might imagine hosting eight friends and family in their home and learning the next day that one visitor had tested positive for COVID-19—followed by another round of perceived risk assessment. The entire exercise was repeated 1 to 3 weeks later, and researchers found that risk assessment was better calibrated both among people who had

underestimated and people who had overestimated, reinforcing the idea that people can learn to reevaluate risks and to change their perspectives on managing the COVID-19 pandemic.<sup>3</sup>

Based on their findings, Dr. Samanez-Larkin's team plans to develop a dashboard with CDC to choose salient group sizes for future interventions to adjust perceptions of risk. This strategy might also be effective for non-COVID-19 purposes, such as a future influenza season.

## Discussion

### ***Demographic Influence on COVID-19-Response***

Research from the beginning of the pandemic suggested that older adults appeared more informed about the virus, tracked the pandemic more closely, displayed less anxiety about illness, and followed physical distancing guidance equally as well as younger adults. Age is not the sole demographic variable affecting perception of COVID-19 risk. Latinx and African American communities have a higher incidence of health conditions that increase risk of severe disease or death from COVID-19 and have culturally strong values of family protection—factors that influenced risk assessment and decisions around physical distancing, mask-wearing, and vaccine acquisition.

### ***Demographic Influence on Decision-Making Processes***

Dr. Samanez-Larkin's studies did not examine intersectional influences on decision-making processes, such as those across race and age. Although samples were representative of the United States, they were of insufficient power to detect those sorts of interactions. In addition, analysis of political party affiliation revealed little predictive value. Meeting participants noted that the personal contextualization of COVID-19 risk was a major strength of Dr. Samanez-Larkin's work.

### ***Combating Mis/Disinformation***

Mis/disinformation around the COVID-19 vaccines is widespread but not a unique phenomenon. To date, few evidence-based interventions to combat mis/disinformation campaigns exist. However, in the context of the human papillomavirus (HPV), researchers designed an interventional tool originally developed to increase HPV vaccine uptake that exploited the psychological aspects of self-persuasion and that may be translatable to COVID-19 vaccines. In this tool, hesitant parents generate their own reasons for vaccinating their child and summarize their main reasons; these activities assist with decision-making—if decide in favor, the tool helps parents make an action plan; if remaining concerns, the tools directs

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<sup>3</sup> Sinclair, A. H., Hakimi, S., Stanley, M., Adcock, R. A., & Samanez-Larkin, G. R. (2021). [Pairing facts with imagined consequences improves pandemic-related risk perception](#). *Proceedings of the National Academy of Sciences*, 118(32), e2100970118. DOI: 10.1073/pnas.2100970118; Sinclair, A., Stanley, M., Hakimi, S., Cabeza, R., Adcock, R. A., & Samanez-Larkin, G. (2021). [Imagining a personalized scenario selectively increases perceived risk of viral transmission for older adults](#). *Nature Aging*, 1, 677–683. DOI: 10.1038/s43587-021-00095-7; Bulley, A., & Schacter, D. L. (2021). [Risks, real and imagined](#). *Nature Aging*, 1, 628–630. DOI: <https://doi.org/10.1038/s43587-021-00097-5>; [Imagination exercise helps people get a grip on real pandemic risks](#). (2021, August 5). Duke Today.

parents to discuss concerns with provider.<sup>4</sup> Dr. Erves-Cunningham is developing interventions that identify patients' top three concerns regarding the HPV or COVID-19 vaccines and then direct users to reliable sources that can address those concerns.

## Considerations in Underrepresented Groups

### Underrepresented Minorities and Emphasis on Health Equity and Disparities

*Neil Lewis, Jr., Ph.D., Cornell University*

Dr. Lewis presented directions for future research and practice efforts to equitably vaccinate the population. After joining a team organized by the New York City Health Department in late 2020, Dr. Lewis learned that many concerns shaped individuals' hesitancy toward receiving a COVID-19 vaccine and that these concerns evolved over time.

- When COVID-19 vaccines first became available: the speed of vaccine development
- January: which vaccine "was better" to receive
- February: side effects
- March: vaccine access
- April: safety, especially after the pause on the Johnson & Johnson COVID-19 vaccine
- Most recently: vaccine access again

These examples highlight the infeasibility of a static top-down approach to increasing vaccine uptake; it is essential to have systems in place to dynamically respond to evolving concerns.

Long-standing patterns of health inequality and inequity shape current perceptions and actions toward vaccines. Health outcomes and health care access in the United States have been shaped by socioeconomic, racial, and geographic differences, which, in turn, shapes how people in each of those contexts consider newly arising health problems and behaviors. Recommended strategies may seem unreasonable for some populations based on their social contexts and identities. To change behaviors of each group, public health actors must understand how these determinants shape the backdrop against which individuals make their health decisions.

A team approach within the public health sphere can usher in improved vaccine uptake. Clinical workers who engage directly with patients can identify initial concerns and then share those concerns with behavioral scientists who can study messaging strategies and begin to develop scientific principles for addressing patient concerns, both in one-on-one interactions with clinicians and wider campaigns. Dr. Lewis's team partnered with three Colorado organizations—COVID-Check Colorado, InOn Health, and Mobile Impact Lab—which focus on COVID-19 testing, vaccination, and related inequities; health equity specializing in geo-targeted messages; and infrastructure partnering with community organizations, respectively. Along with these organizations, the team issued surveys designed to measure vaccine hesitancy, barriers,

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<sup>4</sup> Baldwin, A. S., Zhu, H., Rochefort, C., Marks, E., Fullington, H. M., Rodriguez, S. A., Kassa, S., Tiro, J. A. (2021). [Mechanisms of self-persuasion intervention for HPV vaccination: Testing memory and autonomous motivation](#). *Health Psychol*, Epub ahead of print. DOI: 10.1037/hea0001075.

facilitators, and concerns, as well as incentives to increase response rates. This approach has resulted in large and demographically representative samples that can be used to guide intervention strategies. For example, participants expressed preferences for easy registration and walk-up vaccination sites, and Spanish-speaking participants expressed preferences for bilingual options. Developing strategies specific to individuals aids researchers not only in affecting behavior now, but also in shaping future vaccination campaigns and addressing social science research challenges more broadly.

One group that unexpectedly displayed hesitance was staff at nursing homes and long-term care facilities, who questioned the sudden encouragement to receive quickly developed vaccine when they were the last recipients of personal protective equipment (PPE) earlier in the pandemic. The Centers for Medicare & Medicaid Services has improved uptake among that population by acknowledging and confronting this problem directly and apologizing for past wrongs. Engaging in those sometimes difficult conversations can go a long way to build trust and good will in the future.

### **Nursing Homes and Care-Providers, Including Persons Living with Dementia and Their Caregivers**

*Vincent Mor, Ph.D., Brown University; Sarah Berry, M.D., Hebrew SeniorLife*

Dr. Berry discussed research on COVID-19 vaccine barriers in skilled nursing facilities (SNFs) among both the workforce and residents and efforts to improve vaccine uptake in this setting. The COVID-19 pandemic has been the greatest challenge to U.S. SNFs: although comprising only 1 percent of the U.S. population, SNF staff and residents have comprised 6 percent of cases and nearly 40 percent of deaths from COVID-19. Despite the severity of the pandemic in this setting, staff expressed considerable vaccine hesitancy, with only 45 percent saying they would seek the vaccine as soon as it became available, 44 percent claimed they would consider it in the future, and 11 percent stated they would refuse the vaccine. Notably, the most hesitant SNF staff were disproportionately African American and younger. Forty-four percent of the SNF workforce reside in low-income housing, and 36 percent are uninsured or use Medicaid or Medicare. Many of the “moveable middle” in the SNF workforce, as described by Dr. Lewis, harbor resentment about the handling of PPE distribution early in the pandemic as well as about conflicting media reports that either hailed them as “health care heroes” or blamed them for the state of the pandemic in SNFs.

Early in the vaccine roll-out, practical issues such as getting the vaccine on site for congregate care residents and staff were primary concerns. To increase vaccine access, CDC partnered with CVS and Walgreens to form the Pharmacy Partnership Program for Long-Term Care in 49 states as well as the District of Columbia to deliver and administer COVID-19 vaccines on site. Vaccination timelines were aggressive and available dates were limited; for example, at one SNF, staff were notified on December 28, 2020, of their three clinic dates, January 1, January 25, and February 16, 2021. The rapidity of this roll-out produced challenges in terms of both anxiety and logistics; staff who were not scheduled to work those days had to reorganize their

schedules with little notice. Some staff, however, chose to receive the vaccine, motivated by keeping their children and SNF residents safe.

Drs. Berry and Mor carried out a cluster randomized controlled trial to study a multitargeted intervention to increase COVID-19 vaccine uptake among SNF staff and residents, with a primary outcome of the proportions of staff and residents who received a COVID-19 vaccine. The intervention consisted of six components. First, researchers employed electronic messaging and education, hosted a website with frequently asked questions and short videos with testimonials from SNF staff, and promoted that material through social media. Second, researchers invited staff across disciplines to attend a virtual town hall as “opinion leaders,” where they could express concerns and receive information to use in discussions with others. Community leaders were engaged in the third component by video messaging attempting to inspire vaccine confidence. Positive reinforcement for vaccinated staff and residents followed in the form of small merchandise (e.g., T-shirts) with pro-social messages. Finally, researchers provided consenting specialists to facilitate consent with proxies of SNF residents who were cognitively impaired, as well as funds for enhanced testing to distinguish staff and residents who were exhibiting side effects from the vaccine from those with COVID-19. Overall, the study was unsuccessful, showing marginal or no notable effects on the probability of vaccination among staff or residents. Dr. Berry suggested that this outcome was likely due in part to the compressed timeline. The study suggested that changing behavior requires time, as does building trust, which appeared to be the most important factor in vaccine uptake. An observational study suggested that effective strategies to increase COVID-19 vaccination included designating frontline champions, setting targets, and distributing rewards to vaccinated staff. The randomized trial, however, did not reflect those findings and suggests that these interventions alone may not be enough to increase vaccination coverage.

## Discussion

### ***Combating Discrepancies in Beliefs and Actions***

Meeting participants noted that if asked to report factors that would directly influence their behavior or likelihood of receiving a vaccine, study participants may report factors that do not align with findings after an intervention is implemented. One way to circumvent this problem is to directly ask study participants to choose between two scenarios (e.g., a mobile vaccination unit in their neighborhood or traveling to a vaccination center).

### ***Latinx-Specific Concerns***

Vaccine uptake by Latinx participants in Dr. Lewis’s studies was influenced more by language mismatch than by concerns about potential immigration reporting. However, documentation concerns were more common among New York Latinx populations than among Colorado Latinx populations, highlighting the need for public health officials to understand and address local contextual factors for given populations.

### ***Trust and Vaccine Uptake***

Meeting participants reiterated the importance of trust to vaccine uptake, particularly in an organized effort to rapidly vaccinate a large population. Mistrust of vaccines varies along not

only racial lines, but also partisan lines. Trust extends beyond social or governmental levels; for example, SNF staff were more likely to choose vaccination if they trusted and liked their managers and organizational leadership, who were encouraging vaccination. That correlation of trust with vaccine confidence was particularly strong among Black SNF staff. Trust in the messenger can increase vaccine acceptance and speaks to the need to think beyond public health officials, health care providers, and health care organizational leaders as sole messengers; for example, outreach programs that train barbers to combat vaccine myths and host vaccination sites have successfully increased vaccination rates in local communities. Similar effects were seen among SNF staff; a housekeeper was more likely to trust another housekeeper who expressed confidence in vaccines.

In addition, social pressures can increase or decrease vaccine uptake among a group; for example, condescension from nurses directed at care aides decreased willingness to vaccinate. Pluralistic ignorance—a mistaken belief regarding how many or few people in a peer group participate in a given activity—worked as a motivator only for small populations; people must believe not only that *people* obtain vaccines but also that *people like themselves* obtain vaccines.

The science of trust is related to science communication, but incredible heterogeneity exists in this interaction in part based on social group.

### ***Vaccine Development Speed***

The speed of vaccine development caused concern among some SNF staff, especially when compared to the initial lowering-of-expectations messaging used early in the pandemic. The name “Operation Warp Speed” may have also skewed perceptions of the vaccination process. Of greatest concern for SNF staff was the contrast between the speed of vaccine availability and the delays in PPE availability, a discrepancy that caused them to question the reasoning behind now prioritizing their access to this new technology.

## **Interventions to Address Vaccine Hesitancy**

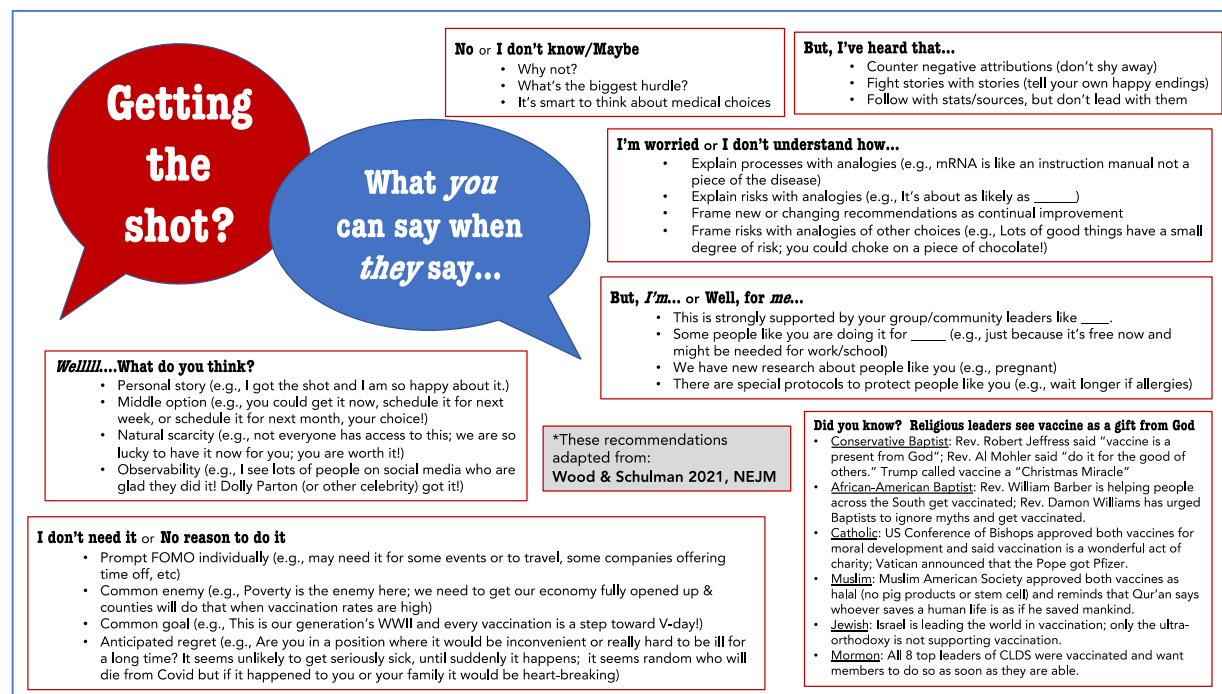
### **Addressing Attitudes, Mis/Disinformation, Trust, and Other Targets**

*Kevin Schulman M.D., M.B.A., Stanford University; Stacy Wood, Ph.D., North Carolina State University*

Previous presentations emphasized the challenge of addressing vaccine uptake across diverse populations using different approaches. Older populations are similarly diverse, especially when their networks are considered. Dr. Schulman claimed that the COVID-19 vaccine was the most important product launch of his lifetime and collaborated with Dr. Wood, a marketing scientist, to determine how to improve vaccine uptake. As with all new products, the COVID-19 vaccine uptake patterns reflect a combination of accessibility, awareness, and consumer attitudes. The diffusion of innovation curve, shared by Dr. Stoeckel in his introduction to the meeting, suggests that approximately 160 million adults would choose vaccination in the absence of new approaches to convincing people who are hesitant or deliberative. While current strategies have facilitated vaccine uptake by enthusiastic innovators and the moveable middle, the late



majority and laggards require new approaches by vaccine confidence campaigns. Marketing theory outlines many standard and effective communication tactics to address each type of product adopter. Importantly, these tactics can be communicated to frontline HCWs to help their face-to-face persuasion (see Figure 3).



**Figure 3. Persuasion tip-sheet for U.S. health care workers**

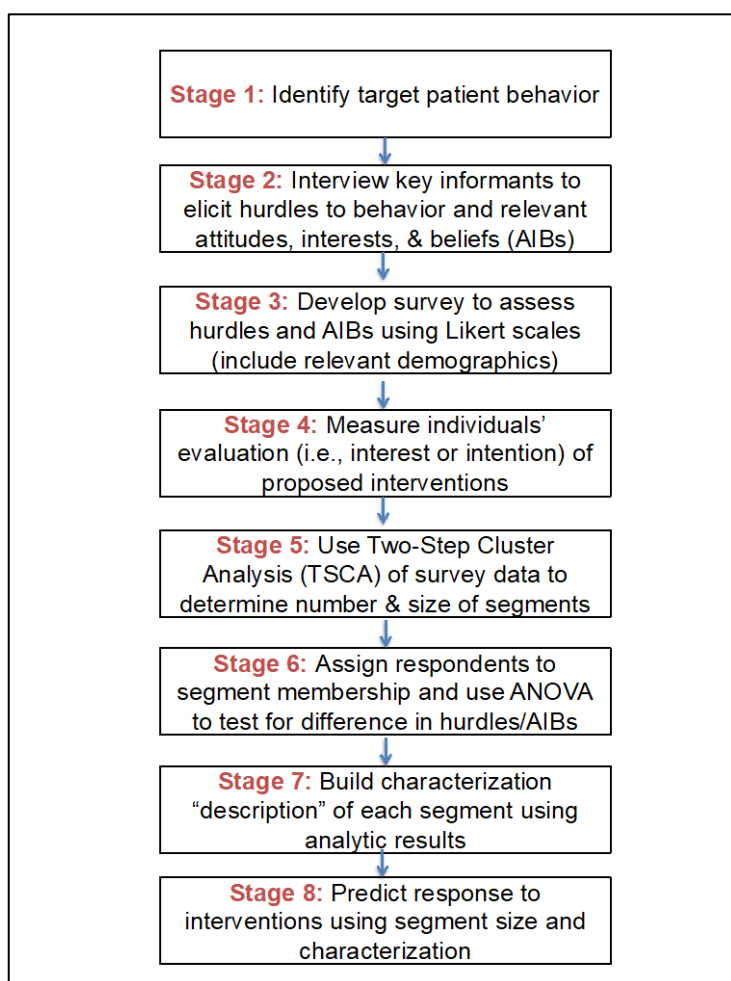
Early in the vaccine roll-out, accessibility and word of mouth reigned, encouraging people who wanted a vaccine but had yet to seek one. Observable choices—vaccine selfies, for example—were valuable additions. However, it has become clear that new narratives that allow people to change their minds with dignity and avoid judgment will be necessary for encouraging resistant parts of the population to receive the vaccine, and that niche opinion leaders will be more effective for promoting COVID-19 vaccination for those parts of the population. Three primary categories of behavioral intervention strategies focus on cognitive mechanisms (two) and social mechanisms (one). Of the two cognitive mechanisms, one uses learning and memory and the other uses nudges.

Importantly, these approaches convey information in digestible forms—for example, relating the statistical risk of dying after full vaccination to being struck by lightning rather than merely providing the number, or comparing the vaccine's mRNA to tissue paper or another ephemeral substance. Maintaining awareness of the base rate fallacy—the belief in anecdotes over statistics—is critical and demands sharing individual stories with people who are hesitant. As an alternative to sharing stories through the news media, which many late adopters do not trust, people who have changed their minds about receiving the vaccine could be sent on mini-speaking tours to share their stories face-to-face. One uncommon nudge is personalized or specialized messages. Rather than focusing on the fact that everyone should be vaccinated,

fulfilling individuals' uniqueness bias by publishing stories with titles such as "the four types of people who should be vaccinated" would be valuable. Incorporating strategies that counter uniqueness neglect into vaccine delivery can improve vaccine uptake—for example, a hesitant person could be allowed to wait at the vaccination site longer after injection or special appeals to pregnant women could offer unique statistics by pregnancy to avoid the appearance of a "one-size-fits-all" vaccination approach.

Identity segmentation, an extension of this uniqueness bias, can enable very specific targeting. For example, Drs. Wood and Schulman partnered with NASCAR driver Bobby Labonte and Facebook to develop a set of advertisements that connect receiving the vaccine to NASCAR values, such as honoring elders. That project encouraged 100,000 of 11 million previously resistant people to become vaccinated against COVID-19. Three versions of the Labonte spot were created and tested; interestingly, the version that worked best was the message to "honor our elders" citing the devotion of fans who built the sport in the 1950-60s and remain faithful fans today. This version was more effective than the calls to "protect your family" and to "race to beat COVID."

Social psychology suggests that the existing messaging strategies, which effectively drove vaccine uptake among early adopters, will not be effective with people who are hesitant or resistant. Many people are apathetic and have yet to cognitively engage with the decision; this behavior differs from that of anti-vaxxers, who are highly involved and have deliberately decided not to receive the vaccine. Providing apathetic individuals with additional facts can bias them against the vaccine because they do not want to spend additional time on making that decision. Driving personal benefits and costs (e.g., through vaccine lottery programs) can be beneficial strategies to target apathetic individuals. Future research directions include studying how identity drives decision-making and how social media—especially Facebook—drives populations toward different health choices, especially aging populations.



**Figure 4. Segmentation method from Wood, Schulman**



Studying questions about COVID-19 vaccine hesitancy during the initial roll-out will guide marketing and messaging around boosters when they become necessary. Methods to conduct this research are an effective combination of well-known protocols in ethnography, survey, and data analysis (e.g., cluster analysis; for example, see Figure 4).

### **Behavioral Economic Approaches and ‘Nudging’ Across the Lifespan**

*Katherine Milkman, Ph.D., University of Pennsylvania*

Dr. Milkman described experiments that offer insights into vaccination nudges, which she asserted should have begun in May 2021. This concept focuses in part on the intention-action gap, in which people have good intentions but do not follow through. The follow-through rate on influenza vaccines, for example, is about 80 percent. Dr. Milkman conducted a prior study that used nudging to address the intention gap during the H1N1 pandemic, which may translate to COVID-19 vaccination among the moveable middle. Her team sent one of three mailings to 3,000 employees of a large Midwestern utility company that routinely held on-site influenza vaccine clinics for its employees. Those mailings all listed dates and times for free flu shot acquisition, but some additionally asked employees to write the day of the week when they planned to receive the vaccine, and others asked employees to write the date and time when they planned to receive the vaccine. This intervention can narrow the intention-action gap by creating a sense of making a commitment, even though only to oneself. Simple prompts to write the date and time increased vaccination by about 4 percentage points and were particularly effective at sites with one-day-only clinics, which experienced an 8 percentage point increase in vaccination. Health insurance data suggested that people who were unlikely to have otherwise received a vaccine did so because of this intervention. This same strategy has been implemented by Get-Out-The-Vote organizers. An even more effective invention that assigned patients an appointment, which they could choose to change or cancel, led to an 11 percentage point increase in the flu vaccination rate. These findings suggest that a planning prompt could be useful, but that providing every person in the United States with an appointment for a COVID-19 vaccine would likely dramatically increase rates of vaccine or booster uptake.

Recently, Dr. Milkman conducted two megastudies that combined dozens of messaging interventions into large “tournaments.” Because the studies were conducted in late 2020, the research team used influenza vaccine uptake as a proxy for COVID-19 vaccine uptake. In the first megastudy, 50,000 patients in a trial at Penn Medicine and Geisinger Health were randomly assigned 1 of 20 conditions (19 treatments and 1 control), with an outcome of receiving a flu vaccine within the 3 days prior to or during their routine primary care appointment. The 19 treatments were designed to test different hypotheses. These ideas included the hypothesis that making a joke about the flu in a reminder to get a vaccine would increase the memorability and appeal of vaccination, that having the chance to dedicate a vaccine to a loved one would boost vaccination, and that learning that a vaccine had been “reserved” for a given patient would increase inoculation rates. Overall, the text reminders had a significant positive impact on vaccination rates. The best performing intervention was texting patients to say an influenza vaccine has been “reserved for you”. Humor was the worst

performer. The prosocial message that receiving an influenza vaccine would protect others was not among the most effective interventions. The top 3 interventions used language related to appointment reservations. Importantly, messages congruous with normal communications from physicians were more effective. An additional study at Walmart Pharmacies involving more than 650,000 pharmacy customers who received encouragement to receive a vaccine at a Walmart pharmacy found similar results. The best-performing Walmart messages described vaccines as “waiting for you” (“reserved for you” language was not tested in this tournament). Every text messaging reminder tested at Walmart significantly improved vaccination, providing more evidence that reminders are effective and that behavioral science can nudge vaccine adoption. Results did not vary across demographic groups.

While those nudges were effective for early vaccine patients, later adopters need greater motivation. Dr. Milkman established the Philly Vax Sweepstakes in partnership with the University of Pennsylvania. This strategy is a regret lottery; all residents of the city were automatically entered and were called if they won. However, if they had not received the vaccine, they could not receive their reward—up to \$50,000. The Sweepstakes also prioritized under-vaccinated areas; for example, a priority ZIP code might have 100 times the chances of winning a prize than a non-priority ZIP code. Using this design, Dr. Milkman’s team evaluated the impact of dispersed incentives and of the concentrated incentives on selected and priority ZIP codes. The results of the trial were equivocal. While the lottery may have boosted overall vaccination rates in Philadelphia somewhat, increasing the chances that residents of a given zip code would win by 50-100x did not have the hoped for positive impact on vaccination rates. This research points to the need for stronger policies than vaccine lotteries to encourage vaccination at this stage of the pandemic.

## Discussion

### ***Individual Versus Group Costs and Benefits and Institutional Policies***

Meeting participants discussed strategies that address benefits versus costs of obtaining a COVID-19 vaccine at both the individual and group levels. Personal costs (e.g., unvaccinated individuals will be subject to hourly temperature checks at the behest of an employer) were found to be equally effective as personal benefits (e.g., ability to attend a concert or enter a lottery). Individual costs are also employed with pediatric vaccines, where an opt-out structure rather than an opt-in structure has been implemented. At the institutional level, this structure is exemplified by school mandates that make remaining unvaccinated a larger hurdle than obtaining a vaccine, such as the imposition of additional paperwork on college students who do not obtain a COVID-19 vaccine. Per recently updated Occupational Safety and Health Administration guidelines, health care systems in the United States can now mandate the COVID-19 vaccine for their staff as a condition for employment; however, health care systems are reluctant to impose such mandates due to risk of lawsuits and loss of staff, and no health care system in the United States has yet achieved 100 percent vaccination.

### ***Additive Interventions***

Multiple nudges can potentially additively increase vaccination rates, but only if the “active ingredient” differs. For example, a nudge targeting forgetfulness could be paired with a nudge

targeting social normalization, but multiple nudges targeting forgetfulness would likely show little additive effect.

## Prioritizing Future Research Directions

*Moderator: Jasmin Tiro, Ph.D., University of Texas Southwestern Medical Center*

### Poll Results

At the beginning of the second day's session, meeting participants completed a poll that asked them to agree or disagree with three opinions: (1) CDC's lifting of mask mandates for vaccinated individuals was an effective means of encouraging vaccine uptake, (2) public trust in government regulatory authorities has increased over the course of the COVID-19 pandemic, and (3) health care organization should use vaccine mandates to increase vaccination rates among employees. Participants largely disagreed that lifting mask recommendations for vaccinated people functioned as an incentive. Half of participants disagreed that public trust in government regulation has increased. Participants largely agreed that mandating vaccines for health care workers was a useful strategy. Poll results highlight how opinions about public health communications and interventions have and continue to rapidly evolve during the pandemic.

### Proposed Strategies to Improve Uptake

At the time of the meeting, NIA had two open funding opportunities focused on mitigation strategies and communication strategies, particularly regarding local trust and social media disinformation, to address vaccine hesitancy. Meeting participants described the following research they might undertake if awarded \$500,000 in funding.

- Whether or not incentives to receive money, food and drinks, and fishing licenses, as examples, are effective strategies.
- The additive effects of different strategies, the intersection of pro-sociality (i.e., the proclivity to behave in ways benefitting others) and vaccine hesitancy, and aging's effects on those components; for example, prior research has shown an increase in pro-sociality over the lifespan.
- The cognitive mechanisms of empathy and how empathy might intersect with vaccine decisions and responses to the loss of life from COVID-19.
- How the fear response in the United States was redirected away from COVID-19 much more so than was observed in other countries.
- Strategies to overcome the versioning resistance (i.e., consumers' hesitancy to consume newly marketed versions of an existing product) expected when booster shots are introduced.
- Vaccine uptake intervention strategies for different population segments.

Participants also suggested specifically incorporating people from demographic groups with lower vaccine uptake into study design, because they are more likely to start from a position of understanding the communities studied.

### **Collaboration Between Biomedical and Behavioral Research**

Participants emphasized the existing disconnect between fundamental biomedical research and marketing and social sciences. That disconnect challenges health communications and the provision of advice; for example, confronting changing recommendations as knowledge grows may require asking for grace. However, the intersection between those questions is also critical to increasing vaccine uptake. For example, people concerned about the rapidity with which SARS-CoV-2 vaccines using mRNA technology were developed have often become reassured after learning about the history and biology of mRNA-based vaccine research.

### **Addressing Vaccine Denial**

Designing projects to meet the needs of the community rather than solely the needs of research or to align with funding opportunity announcements would reflect a fundamental change in the field, but is essential to determining how to engage and change the opinions of vaccine-hesitant demographics. As an extension of this point, meeting participants discussed recruiting former anti-vaccine activists to contribute to study design and to co-opt effective anti-vaccine messaging and strategies (e.g., efforts to remove barriers to remaining unvaccinated).

Motivating people in the moveable middle may be possible by exposing them to the realities of the virus (e.g., via virtual reality ICU visits), not unlike Dr. Samanez-Larkin's work around personalizing risk perceptions, and by emphasizing emotion such as Drs. Wood and Schulman's work around messaging and anticipated regret. Exploring and amplifying emotion in these vaccine hesitancy mitigation strategies may be critical to increasing vaccine uptake.

### **Longitudinal Studies**

Meeting participants discussed a longitudinal study of participants currently in their fifties from New Zealand, where COVID-19 vaccines were not available at the time of the meeting. Recently, the study included questions about vaccine intentions. Patterns in personality traits over the lifespan were consistent across approaches to the vaccine; for example, people in midlife who planned to refuse the vaccine displayed low empathy, hostility, difficulty managing stress, and antisocial behaviors beginning in adolescence. In contrast, people fearful of vaccine side effects tended to have anxiety disorders, low health literacy, and low health locus of control while young adolescents. These findings suggest that childhood education should cover the topic of infectious disease pandemics and should improve health literacy from younger ages. This type of research could aid the current pandemic response by pointing to longstanding attitudes, beliefs, and values that tend to characterize people who dislike vaccines, knowledge that could help to frame health messaging. It could provide valuable information for future disease outbreaks as well as day-to-day health decisions.

NIA supports many longitudinal cohort studies; such questions and analyses could be supported through supplements to these studies. Little is known about how vaccine hesitancy changes over the life course or is patterned by age. Meeting participants also discussed the challenges of recruiting middle-aged research subjects, who cannot be easily accessed through schools or universities. Studying structural elements that influence vaccine access and acceptance is also a

critical question, particularly given issues related to equity, health disparities, and impacts of COVID-19 on vulnerable populations.

## Final Reflections

*Luke Stoeckel, Ph.D., Program Director, Mechanistic and Translational Decision Science*

NIA BSR is interested in the behavioral, social, and psychological drivers of the spectrum of vaccine hesitancy across the lifespan. Future research should address the following questions: Might individual or group differences in present versus future valuation impact the timing of vaccine uptake? Might changes in decision-making processes with age or life-stage alter one's assessment of the risk or effort required to achieve the gain presented by vaccines? Social science research can shed light on questions related to attitudes and values, trust of institutions, and vulnerability to mis- and disinformation, as well as how these factors vary across individuals from different backgrounds and generations. Which differences across individuals and groups *causally* related to these important factors, and how might an answer to that question inform tailored interventions that target these causal mechanisms? For example, what specific techniques might best accelerate the pace of vaccination in the "wait-and-see" group? Given the limited impact of "nudging" and other incentive-based strategies (e.g., lotteries), are there other social and behavioral science-based techniques that researchers can test and deploy to encourage vaccination in adults of different age groups? As the pandemic evolves, are new vaccine-hesitant groups emerging that are driven by different mechanisms for vaccine hesitancy; if so, do those new mechanisms warrant thinking about different solutions (e.g., consent policies for vaccinating adolescents, booster shots)? How can messaging be effectively tailored to populations across different phases of adult lifespan, people living with dementia (PLWD), and/or caretakers of PLWD?

## Appendix 1: Agenda

### Day 1

**12:20 Welcome and Introductions**

*Terrie Moffitt, Duke University and Chair, BBCSS*

**12:25 Introductory Remarks from NIA**

*Luke Stoeckel, Program Director, Mechanistic and Translational Decision Science*

**12:35 Vaccine Uptake and Hesitancy**

The Big Picture

*Jennifer Cunningham-Erves, Meharry Medical College, Vanderbilt University Medical Center*

Basic Behavioral Science to Inform Understanding about Vaccine Hesitancy  
*Gregory Samanez-Larkin, Duke University*

**1:25 Break**

**1:35 Considerations in Underrepresented Groups**

Underrepresented Minorities and Emphasis on Health Equity and Disparities  
*Neil Lewis, Jr., Cornell University*

Nursing Homes and Caregivers, Including Persons Living with Dementia and Their Caregivers

*Vincent Mor, Brown University*  
*Sarah Berry, Hebrew SeniorLife*

**2:25 Reflections on Presentations and Discussions and Plan for Day Two**

*Luke Stoeckel, Program Director, Mechanistic and Translational Decision Science*  
*Terrie Moffitt, Duke University and Chair, BBCSS*

### Day 2

**11:00 Interventions to Address Vaccine Hesitancy**

Addressing Attitudes, Mis/Disinformation, Trust, or Other Targets

*Kevin Schulman, Stanford University*  
*Stacy Wood, NC State University*

Behavioral Economic Approaches and “Nudging” Across the Lifespan  
*Katherine Milkman, University of Pennsylvania*

**11:50**      **Break**

**12:00**      **Prioritizing Future Research Directions**

*Moderator: Jasmin Tiro, University of Texas Southwestern Medical Center*

**12:45**      **Final Reflections**

*Luke Stoeckel, Program Director, Mechanistic and Translational Decision Science*

## Appendix 2: Meeting Participants

### ***Expert Panel***

Sarah Berry, Hebrew SeniorLife  
Jennifer Cunningham-Erves, Meharry Medical College, Vanderbilt University Medical Center  
Neil Lewis, Jr., Cornell University  
Katherine Milkman, University of Pennsylvania  
Vincent Mor, Brown University  
Gregory Samanez-Larkin, Duke University  
Kevin Schulman, Stanford University  
Jasmin Tiro, University of Texas Southwestern Medical Center  
Stacy Wood, North Carolina State University

### ***Committee Members***

#### ***Board on Behavioral, Cognitive, and Sensory Sciences***

Richard Aslin, Distinguished Research Scientist, Haskins Laboratories  
Wilson S. Geisler, David Wechsler Regents Chair in Psychology and Director, Center for Perceptual Systems, University of Texas, Austin  
Michele Joy Gelfand, Distinguished University Professor of Psychology, University of Maryland, College Park  
Terrie Moffitt, Terrie Nannerl O. Keohane University Professor of Psychology, Duke University, and Professor of Social Development, King's College, London

#### ***Societal Experts Action Network (Advisory Group)***

David Yokum, Director, The Policy Lab, Brown University

### ***National Institute on Aging***

Frank Bandiera, Program Official, Division of Behavioral and Social Research (DBSR)  
Melissa Gerald, Program Official, DBSR  
Christeenna Irheta, Staff Assistant, DBSR  
Amelia Karraker, Program Official, DBSR  
Jonathon King, Senior Scientific Advisor to the Division Director, DBSR  
Isis Mikhail, Supervisory Health Scientist Administrator, Scientific Review Branch (SRB)  
Bita Nakhai, Supervisory Health Scientist Administrator, SRB  
Lisbeth Nielsen, Division Director, DBSR  
Lisa Onken, Director Behavior Change and Intervention Program, DBSR  
Dana Plude, Deputy Director, DBSR  
Mujaahida Shakur, Division of Extramural Activities (DEA)  
Ali Sharma, Division of Neuroscience (DN)  
Janine Simmons, Chief, Individual Behavioral Processes Branch, DBSR  
Luke Stoeckel, Program Director, Mechanistic and Translational Decision Science, DBSR



***Board on Behavioral, Cognitive, and Sensory Sciences Staff***

John Baugh  
Alexandra Beatty  
Ashton Bullock  
Adrienne Stith Butler  
Gretchen Chapman  
Molly Checksfield  
Jacqueline Cole  
Ivory Dean  
Bianca Markovich  
Ulrich Mayr  
Elizabeth Necka  
Elizabeth Phelps  
David Poeppel  
Dylan Rebstock  
Nicole Reeder  
Stacey Sinclair  
Timothy J. Strauman  
Tina Winters

***Other Participants***

Sylvia Chou, Director, National Cancer Institute  
K. Andrew DeSoto, American Psychological Society  
Anna Gaysynsky, Marketing Communications Analyst, ICF  
Christina Tricou, Rose Li & Associates, Contractor