emissions released from different building products, under different fire scenarios. It will also discuss human tenability criteria for the concentrations of the individual toxic gas species generated by combustion.

1024 Exposure and Cancer Risks among Structural Firefighters

K. Fent. *NIOSH, Cincinnati, OH.* Sponsor: M. Gilmour.

This talk will summarize recent studies that have evaluated cancer incidence and mortality in structural firefighters. The speaker will further discuss the predominant exposure pathways among firefighters, and how these pathways contribute to biomarkers of exposure, with an emphasis on known or probable carcinogens. He will wrap up with a discussion about the wildland-urban interface (WUI) and how this may impact firefighters' exposures now and in the future.

1025 Investigating the Links between Chemical Exposures and Adverse Health Effects Associated with Camp Fire Smoke

Q. Zhang. *University of California Davis, Davis, CA.* Sponsor: L. Van Winkle.

We investigated the links between chemical exposures to wildfire smokes and adverse health outcomes through performing real-time measurements of ambient PM in Davis, CA during the Camp Fire period in November 2018. Specifically, we characterized the highly time-resolved temporal variations of PM concentration and composition using a high-resolution soot particle aerosol mass spectrometer (SP-AMS) and applied novel mass spectrometry analysis to estimate the total concentrations of phthalates in PM. Different sources of the PM were resolved as well. These results are combined with data on nonhuman primate pregnancies at various stages of development to investigate the adverse effects of wildfire smoke on pregnancy and fetus development.

1026 Mutagenicity and Toxicity of Combustion Products from Synthetic Materials and Comparisons to Biomass Emissions

Y. Kim. *University of North Carolina at Chapel Hill, Chapel Hill, NC.*

This presentation will discuss differences in the chemical components of wildfire smoke depending on fuel types and burning temperatures and how such differences can promote similar or distinct toxicity outcomes. This will introduce how we develop a lab-scale combustion system to simulate various wildfire smoke emissions and present how our computational approach can be used to identify individual chemicals that drive specific toxic outcomes. This will also provide potential beneficial effects of particle filtration in reducing health impacts from acute exposure to wildfire smoke. This presentation will help to better understand health effects of smoke exposures from burning homes, structures, and man-made materials in the wildland urban interface (WUI) areas during wildfires. *The views expressed do not necessarily represent the views or policies of the US EPA.*

1027 Health Risk Assessment on Fire's Front Line: Challenges for Characterization and Communication

A. Jarabek. *US EPA, Research Triangle Park, NC.*

The acute nature and chemical composition of exposures associated with structural fires pose a complex challenge to risk assessment approaches as well as to informing impacted populations of potential health effects. This presentation discusses specific components of current assessment approaches that require customization, including consideration of "C vs t" as determinants of toxicity; evaluation of chronic trajectories from acute measurements; specification of parameters for vulnerable populations; and mixtures methods with unknowns. Discussion of approaches for translation and communication of health risk, including visualization of data and public engagement, is also included. *The views expressed in this abstract are those of the authors and do not necessarily represent the views or policies of the US EPA.*

1028 Mechanistic Insights on Gene x Environment Interactions in Autism

L. Smirnova. *Johns Hopkins University, Baltimore, MD.*

Autism spectrum disorders (ASD) constitute a global public health concern. In the US, incidences of ASD have increased from 1 in 5,000 children in 1975 to 1 in 44 children in 2020. Similarly, these increases have been documented in other countries around the world. Until recently, research on the etiology of neurodevelopmental disorders has focused largely on genetic causes. However, this research has clearly shown that single genetic anomalies account for only a small proportion of cases, and even in genetic syndromes highly associated with ASD, a significant percentage of carriers do not have ASD. Overall, genetic factors seem to account for 40-50% of ASD cases. There is now credible evidence that ASD is the result of complex interactions between genes and environmental factors. In contrast to genetic risks, which are currently irreversible, environmental factors are modifiable risk factors. Therefore, identifying factors that increase risk for ASD may provide rational approaches for the primary prevention or mitigation of the severity of symptoms associated with these disorders. However, to date, the identities of environmental factors that influence ASD risk or severity and the mechanisms by which environmental factors interact with genetics to determine individual risk remain critical gaps. The phenotypic heterogeneity—the clinical hallmark of ASD—together with the complex multigenic etiologies, significantly increase the difficulty of identifying specific environmental factors increasing risk. The complexity of ASD heritable factors also creates a range of sensitivities of the developing brain to the adverse effects of environmental factors, which has made it challenging to establish clear associations between exposure to environmental factors and diagnosis of specific disorders. To address this, it is critical to integrate approaches and findings from diverse fields, which is the goal of this session. Presenters with expertise in epidemiology, genetics, and mechanistic toxicology will present these diverse findings. The session will open with an overview of the broad spectrum of research activities (epidemiological, genomics-based, and bioinformatics-based studies) in the field of gene x environment (GxE) in ASD supported by the National Institute of Environmental Health Sciences. This will be followed by a discussion of how molecular epidemiology and systems biology approaches can be leveraged to study GxE interactions in ASD prevalence. The next two talks will illustrate how *in vitro* models are used to investigate molecular mechanisms underlying potential synergy between environmental chemicals and ASD-linked genetic susceptibilities. The session will conclude with a presentation demonstrating how animal models are used to validate *in vitro* findings of putative GxE. In summary, attendees will gain knowledge regarding current state-of-the-art, interdisciplinary approaches for studying mechanisms of GxE interactions that influence ASD risk and will learn about emerging data and remaining gaps.

1029 Challenges and Opportunities for Gene-Environment Interaction Studies Supported by the Extramural Division of NIEHS

K. McAllister. *NIEHS, Research Triangle Park, NC.* Sponsor: L. Smirnova.

NIEHS has a strong interest in understanding the interaction of genetic and environmental risk factors for complex human diseases, and this Institute has a long history of exploring gene-environment interactions particularly relevant to many neurodevelopmental diseases. Genetic susceptibility is recognized as a significant component to the varying effects of toxicants on disease pathways. This underlying understanding of genetic susceptibility or resistance to environmental exposures is currently being examined in a variety of genetic epidemiology studies supported by NIEHS. NIEHS has also supported both solicited and unsolicited proposals related to other multi-faceted aspects of G x E research including the development of innovative statistical and bioinformatics methods, the use of sophisticated *in vitro* functional genomics approaches, and the use of novel population-based model organisms, such as the Collaborative Cross and Diversity Outbred mice. NIEHS also recognizes the importance of the ethical, legal, and social implications that may arise from individuals or communities being identified as at increased disease risk due to a combination of genetic and environmental factors and their interplay. The translational goal of this G x E research is to identify populations that are most sensitive to exposures to ultimately adopt prevention/intervention strategies to protect the most vulnerable subpopulations.

1030 Using Molecular Epidemiology to Better Understand the Interplay between Environment and Genes in the Causation of Autism Spectrum Disorder

A. Ponsonby. *The Florey Institute for Neuroscience and Mental Health, Melbourne, Australia.* Sponsor: L. Smirnova.

Molecular epidemiology involves working at the interface of epidemiology and system biology. For environmental determinants of autism spectrum disorder, our work uses these approaches to investigate how putative harmful environmental agents, such as phthalate chemicals, may have a differential impact on outcomes depending on genetic vulnerability. Gene x environment interaction using pathway and/or network approaches can provide greater statistical power and information than examining the differing effect of phthalates on neurodevelopment by individual genetic SNP (single nucleotide polymorphisms) variants alone. The developing brain is highly sensitive to environmental disturbances, and adverse exposures can act through oxidative stress. Here, we first generated a genetic pathway function score for oxidative stress (gPFSox) based on the transcriptional activity levels of the oxidative stress response pathway in brain and other tissue types. Then, in the Barwon Infant Study (BIS), a population-based birth cohort (n = 1074), we demonstrated that a high gPFSox, indicating reduced ability to counter oxidative stress, is linked to higher autism spectrum disorder risk and higher parent-reported autistic traits at age 4 years. Past work in BIS has reported higher prenatal phthalate exposure at 36 weeks of gestation associated with offspring autism spectrum disorder. In this study, we examine combined effects and show a consistent pattern of increased neurodevelopmental problems for individuals with both a high gPFSox and high prenatal phthalate exposure across a range of outcomes, including high

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