Firstly, what drew you to psychology?

I have always been interested in substance abuse behaviour – for example, why some adolescents can smoke a few cigarettes and never smoke again, whereas others quickly become addicted. It’s a complicated process, and so I became interested in exploring how novel or innovative statistical methods could be used to address more complex research questions related to the aetiology of substance use.

Can you summarise each of the key aims of ‘Integrative Data Analysis for Nicotine Dependence Symptoms in Novice Smokers’ and how you are seeking to address them?

The aims of the project are to evaluate the psychometric properties of nicotine dependence (ND) symptoms, and assess invariance in these properties across studies. Looking at whether ND-symptom properties differ as a function of level of smoking exposure (smoking frequency and quantity, number of years smoking, etc.), controlling for study and demographic difference. This is accomplished by pooling three separate datasets – 1999 and 2000 National Survey on Drug Use and Health (NSDUH) and Wave 1 National Epidemiological Survey on Alcohol and Related Conditions (NESARC) – and by using a newly developed statistical method called moderated nonlinear factor analysis (MNLFA).

Could you discuss the use of integrative data analysis (IDA), as well as MNLFA, in your research?

MNLFA produces an ND factor score that is invariant across studies, which allows us to test novel hypotheses in a dataset that combines data from different studies. We proposed a sensitivity analysis where the relation between nicotine and alcohol use, abuse and dependence is examined for individuals with similar levels of smoking exposure, using: the empirically derived ND factor score with study, demographic and smoking exposure moderators; an empirically derived ND score allowing only study-related differences in psychometric properties; and traditional ND scoring of presence/absence of nicotine dependence from the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV), and the proportion of endorsed symptoms.

IDA isn’t a new concept, but it has rarely been used to better understand measurement of substance abuse and dependence. MNLFA is a newly developed extension of factor analytic methods that has more flexibility in terms of the distribution of items, missing data and moderation of important parameters.

What are the potential benefits of the development of a novel, optimally valid and reliable measure of ND symptoms?

Many methods of assessing ND symptoms are available, and researchers tend to choose different measures. Some of the most commonly used techniques, such as DSM criteria for ND, were developed using adult heavy smokers rather than adolescents, who tend to smoke fewer cigarettes, less frequently. Therefore, we don’t know for sure whether the ND symptoms assessed by these measures adequately capture the symptoms experienced by adolescents who have just begun smoking, especially because adolescents tend to have much lower levels of smoking exposure in terms of frequency and quantity.

Identifying measures of ND that capture symptoms of dependence across the full range of smoking exposure, from infrequent light smoking to more chronic and heavier smoking, could allow us to identify symptoms that might be missed when assessing young, recent-onset smokers. In the long run, it is hoped that what we learn through measurement of adolescent ND symptoms using IDA will help develop a consensus on measurement that will make the design of future studies more amenable to IDA.

Why is consensus on how to best measure ND, specifically within your study population, important?

Although IDA holds considerable promise for addressing novel or more complex hypotheses, it might not always work. It is possible that the differences between studies in measurement of ND may result in researchers being unable to find items that are invariant across studies. Without at least a few invariant symptoms, we cannot be fully confident that the same construct is being measured on the same scale across studies, which creates problems for combining datasets from independent studies to create a single larger, more heterogeneous pooled dataset.

If we can achieve a consensus on measurement of ND for recent-onset smokers, new studies can be developed with more consistency in measurement of ND and with IDA as a future goal. It is likely that no single existing measure will emerge as superior, but rather an ideal ND measure is likely to draw items from multiple measures.
IN THE PAST, only chronic smokers were believed to experience symptoms of nicotine dependence (ND). This encouraged studies to set high thresholds for measuring ND, focusing on daily, heavy smokers and discounting participants with lower levels of nicotine use. However, the work of Dr Jennifer Rose, Research Professor of Psychology at Wesleyan University, USA, alongside that of other leading experts, is producing a growing body of evidence that suggests adolescents who are infrequent smokers are affected by ND symptoms, and that these early emerging symptoms are predictive of continued future smoking.

The belief that those who engage in, and progress beyond, smoking initiation and experimentation may have a propensity for heavy dependent use has propelled investigations into individual differences in patterns of early smoking behaviour and early dependence symptoms. In this context, the focus of Rose’s current project, ‘Integrative Data Analysis for Nicotine Dependence Symptoms in Novice Smokers’, is on people who have recently taken up smoking, with varying levels of current exposure. The overarching goal is to develop a novel measure of ND symptoms with maximum reliability and validity for this understudied population, through pooling and analysing existing data from multiple studies.

EARLY INTERVENTION

Rose seeks to ensure that adolescents with low dependence levels are not overlooked as they may be at risk for chronic, heavy smoking in later years. “It is important to identify adolescent smokers with low-level dependence as it presents the opportunity to intervene before dependence becomes more severe,” she explains. Ultimately, her team is working to help further understanding of ND; contribute to the development of a method to more precisely measure ND symptoms in young smokers; and enhance solidarity among researchers with regards to how ND symptoms are measured within this population.

Important differences in the number and type of ND symptoms reported by individuals have been identified. Additionally, some but not all early emerging symptoms have been linked to future smoking behaviour. This indicates that risk for heavy smoking is dependent on the particular symptoms that are endorsed, rather than just the number of symptoms – which is the exclusive focus of the majority of traditional ND measures. Rose recognises that a better understanding of ND through more careful measurement of symptom types is necessary to accelerate research in this area.

The fact that the percentage of adolescent smokers is low presents barriers to this research. As a result, relatively few smokers are available for analysis, making it difficult to test complex hypotheses and evaluate ND in traditionally underrepresented ethnic populations such as Hispanic youth. Furthermore, these adolescents tend to be infrequent, light smokers and therefore individual studies on this population offer a limited range of smoking exposure. These issues combined mean that careful examination of the psychometric properties of ND symptoms across the full range of smoking experiences is restricted.

THE DATA POOL

In order to overcome these limitations, Rose and her team are employing integrative data analysis (IDA) to pool individual studies that assess ND in recent-onset smokers. Such data consolidation
to facilitating this process: “It gives the advantage of multiple viewpoints, and allows you to achieve a consensus about your data harmonisation procedure prior to moving forward with MNLFA”.

SMOKING PATTERNS

Rose has observed that despite significant declines in smoking rates in recent decades, there is a group of smokers that appears to be more resistant to prevention efforts and cessation treatment. “We wonder whether these smokers are the ones who developed ND symptoms earlier, and at lower levels of use than most adolescent smokers,” she muses. In collaboration with her colleague Dr Lisa Dierker, Rose recently examined longitudinal data from the ‘Social- Emotional Contexts of Adolescent and Young Adult Smoking Patterns’ study, which is led by Dr Robin Mermelstein from the University of Illinois in Chicago, USA.

Dierker and her colleagues identified adolescents who indicated they experienced ND symptoms not long after starting smoking, despite smoking cigarettes only a few times a month. They found that these early emerging symptoms predicted persistent and more frequent smoking 24 months later. “We don’t know yet whether the early emerging symptoms continue to predict smoking persistence into adulthood,” Rose explains. “This is something Dierker and her colleagues are currently working on.”

A NOVEL METHOD

MNLFA facilitates IDA by testing for differences in symptom psychometric properties across studies and other key characteristics, and generating an ND score for each individual in the combined dataset. This method allows for differences in the psychometric properties of symptoms across studies. “It is the ND score that makes IDA feasible, because it has a common metric across studies and takes into account unwanted measurement bias due to differences in study design and measurement,” Rose explains. The results will be used to obtain optimal ND symptom scores and will be compared to those obtained using traditional ND scoring methods.

“One of our biggest challenges was in harmonising ND symptoms across the studies we were combining,” Rose reveals. Prior to conducting MNLFA, the researchers must identify the symptoms that are shared across studies and appropriately link them. This presents difficulties because methods for measuring a particular symptom may differ across studies. An additional obstacle is the fact that response options can vary. Therefore, the team must make decisions about how to make the response scales equivalent. Rose emphasises that collaboration is key to addressing these challenges.

REACHING A CONSENSUS

A sub-aim for Rose and her team will be to perform a more rigorous test of ND scoring methods by using a pooled dataset that also includes the 2008 NSDUH and combines symptoms from both DSM-IV and the Nicotine Dependence Syndrome Scale. Rose hopes that a consensus on how ND is best measured will be more rapidly reached by combining such measures and also utilising novel statistical methods – such as IDA and MNLFA – and that this will lead to the development of a significantly more powerful and sensitive technique for measuring ND.

INTELLIGENCE

INTEGRATIVE DATA ANALYSIS FOR NICOTINE DEPENDENCE SYMPTOMS IN NOVICE SMOKERS

OBJECTIVES

To combine integrative data analysis (IDA) and moderated nonlinear factor analysis (MNLFA) to evaluate nicotine dependence (ND) symptom properties in the understudied population of young smokers across a full range of current smoking exposure.

KEY COLLABORATORS

Professor Lisa Dierker, Department of Psychology, Wesleyan University • Arielle Selya, PhD, Department of Psychology, Wesleyan University • Professor Robin Mermelstein, Department of Psychology and Institute for Health Research and Policy, University of Illinois at Chicago • Professor Donald Hedeker, Department Of Biostatistics, University of Illinois, Chicago

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CONTACT

Professor Jennifer Rose
Research Professor
Department of Psychology & Quantitative Analysis Center
Wesleyan University, 207 High Street
Middletown, Connecticut 06459-0408
USA
T +1 860 685 2406
E jrose01@wesleyan.edu

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JENNIFER ROSE is a Research Professor in the Psychology Department and Quantitative Analysis Center at Wesleyan University with extensive training in statistical methods. At Indiana University, Rose received postdoctoral training in categorical data analysis, longitudinal data analysis and multilevel modelling. At Brown University, Rose gained extensive experience in the design, implementation and analysis of randomised controlled trials. She has experience with measurement scale development and psychometric evaluation using structural equation modelling techniques. In addition, she has successfully implemented and published numerous analyses including MNLFA, mixed linear regression modelling, growth curve modelling of both continuous and categorical outcomes, multilevel modelling, latent class analysis and pattern mixture modelling of missing data. Rose has similarly strong teaching credentials at the undergraduate level having offered courses at Wesleyan University, Indiana University and Rhode Island College.