Discussion:

Each of the prior sections indicates that technology provides opportunities for improving the measurement of the domains of negative symptoms for clinical trials. However, these new methods are at different stages of development and vary in their readiness for inclusion in a new multimodal instrument. There are also substantial challenges in moving these newer methods from the laboratory to clinical settings. However, the authors agree that the current instruments for measuring the domains are flawed and there is a compelling need for new approaches. This discussion section will focus on measures that can be considered for inclusion in the very near future. It is understood that each of these proposed measures would require further before it would be included in a beta version of an instrument.

1. Diminished Verbal Communication

The goal of a measure of verbal communication would be to assess levels of alogia. There was a consensus that this could be measured from recordings of subjects who are asked open ended questions that are standardized. This is preferred over close ended questions that may not assess an individual's tendency to limit their speech. Unvoiced pause times? Other indices of diminished speech?

2. Diminished affect

There was a consensus that this could be measured by measuring facial expressions when subjects are shown both positive and negative stimuli. Methods such as computerized facial movement analysis could evaluate facial expressiveness and vocal analysis could be collected by wearable or smartphones. For example, a decrease in the variability of volume and pitch has been associated with negative symptoms.

3. Diminished Sociality

Two approaches were suggested. EMA could be a promising tool for assessing whether subjects have an interest in interacting with other people. It would be important to assess the individual's interests that extend beyond organized interactions with family members or caregivers. The use of an "avitar" as a tool for assessing social interest could be particularly helpful. Written questions provided with EMA is an alternative method. The subject's responses would need to be assessed by a rater. Geolocation using smartphones could assess the size of a subject's social network as well as movements. That is, subjects could be queried as to whether they are alone or with another person and geolocation could establish the effort that was used to interact with another person.

4. Diminished Hedonic Drives

Anhedonia in schizophrenia is characterized by a decrease in the individual's anticipation of reward. There was a consensus that EMA could be used to assess if a subject was anticipating that activities would be pleasurable. A challenge is that the queries would need to be individualized for subjects. It would also be important to be able to differentiate activities that require subjects to elicit effort from those that do not. For example, a subject may report that they enjoy watching movies. Seeing movies may require exerting effort to attend a film or passively watching television.

5. Diminished Goal-Directed Behavior

The goal would be to develop a measure of avolition. This could be assessed by EMA paging and inquiring whether the subject is alone or with another person. Characterizing the activity would be necessary for assessing the qualities of the activities. For example, was it productive and did it require effort. Trained raters may be necessary for this assessment. GPS and actigraphy could characterize both the amount of movement and could characterize the amount of effort exerted by the subject.