# Utilizing Artificial Neural Networks to Further Understand Psychiatric Comorbidity

## Literature Review

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# Chapter 1

# Paper Analysis 1 - *Comorbidity: A network perspective* [1]

## 1.1 Why was the study conducted?

The goal of this study was to rethink the idea of causal relationships in psychiatry. The predominant psychiatric theory on cause of mental illness is the latent variable model. This model presumes that mental illness has a root cause even if we haven't discovered it yet. Cramer et. al. challenges this model using a robust dataset - the National Comorbidity Survey [2] - to argue for a network perspective that says "disorders are *networks* that consist of *symptoms* and *causal* relations between them." [1]

## 1.2 Was there any similar works discussed in the paper?

Cramer et. al. don't discuss many similar works because their theory is fairly revolutionary. It is a newly proposed model. They discuss a few papers about current diagnostic research and studies on comorbidity, but nothings specific to a network model [1]. Although, in 2014 the Oxford Journal that originally published *Comorbidity: A network perspective* re-published the article with multiple responses to the paper. [3].

A cornerstone of Cramer et. al.'s argument is an assumption that the latent variable model cannot include the cyclic networks which support the causal re-

lationships between symptoms (i.e. you're anxious and trying not to be which makes you more anxious) [1]. Danks et. al. disagreed with this assumption, arguing instead that we can define the latent variable model to do this and assuming inability to do so limits possibilities [4].

## 1.3 What were the procedures or methods used?

Cramer et. al. focused on the comorbid (or co-occuring) relationship between Major Depression Disorder (MDD) and Genral Anxiety Disorder (GAD). The began with the theory of complex networks "without assuming *a priori* that scuh relationships arise from a mental disorder as a common cause" [1]. Then, Cramer et. al. put symptoms into nodes and created paths to represent the relation between symptoms.

They used statistical parameterization and the Akaike Information Criteron to find the most accurate model. They found that a bridge model holds when there are no independent variables. A bridge model is a undirected graph where overlapping nodes (symptoms) indicate a comorbid relationship (see Figure 1.1) [1].

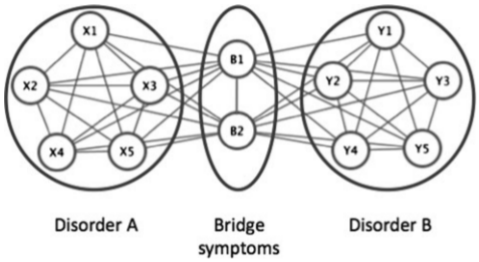


Figure 1.1: Example of a Bridged Network [1]

Using this bridge model, Cramer et. al. used edge thickness and color to further demonstrate relationships between symptoms. The edge thickness represented the co-occurrence of the two symptoms and the edge color represented the strength or association, or log odds ratio, between the two symptoms. The node size was used to exemplify frequency while the color is the node strength, or the sum of the weights of the connected edges [1]. The outcome of these additions can be seen in Figure 1.2.


Figure 1.2: Example of a Fully Realized Network using GAD and MDD [1]

## 1.4 What conclusions did the authors reach (what did they find)?

Cramer et. al. found that a network approach can be very useful. First, it can aid in hypothesis development on the cause of psychiatric disorders and specific symptoms. Secondly, the can identify ”pathways of comorbidity” that can help lead to identifying some root cause of symptoms (i.e. MDD turning into GAD or *vice versa*). They also found that symptoms were more strongly connected when there was at least one pair of overlapping symptoms [1].

Overall, Cramer et. al. found that a network approach to psychometric analysis is a potentially groundbreaking approach to the analysis of comorbidity and can lead to discovery about the causal relationship between symptoms [1].

## 1.5 What implications or applications can you see in this study for yourself or for computer society in general?

This study has implication across psychiatry and psychology and has potentialy to greatly impact diagnostic models. By identifying bridge symptoms, professionals can gain insight to comorbidity and potentially find effective methods of treating comorbid mental illnesses. For this research project, Cramer et. al.'s findings form the base of our hypothesis - that neural networks can further understanding of psychiatric comorbidity. If a network model was not feasible and the only model was a latent variable model then our ANN would be lacking information from the start. Overall, Cramer et. al. lay the groundwork that makes using ANN to understand comorbidity a plausible hypothesis [1].

## 1.6 How may this work be improved or how can you improve this work?

I agree with Danks et. al. that dismissing the latent variable model "overlooks a wealth of extant possibilities" [4]. The possibility of latent causal attributes exists. Cramer et. al.'s work could be improved by exploring this possibility. Cramer et. al. could also build on their models by using ANNs to identify mental illnesses and comorbid diseases from their network models.

# Bibliography


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