Semantic Network Model of

Cold & Flu Medications

by

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ABSTRACT

The cold and the flu are two of the most prevalent diseases in the world. Many over the counter (OTC) medications have been created to combat the symptoms of these illnesses. Some medications take a holistic approach by claiming to alleviate a wide range of symptoms, while others target a specific symptom. As these medications become more ubiquitous within the United State of America (USA), consumers form associations and mental models about the cold/flu field. The goal of Study 1 was to build a Pathfinder network based on the associations consumers make between cold/flu symptoms and medications. 100 participants, 18 years or older, fluent in English, and residing in the USA, completed a survey about the relatedness of cold/flu symptoms to OTC medications. They rated the relatedness on a scale of 1 (highly unrelated) to 7 (highly related) and those rankings were used to build a Pathfinder network that represented the average of those associations. Study 2 was conducted to validate the Pathfinder network. A different set of 90 participants with the same restrictions as those in Study 1 completed a matching associations test. They were prompted to match symptoms and medications they associated closely with each other. Results showered a significant negative correlation between the geodetic distance (the number of links between objects in the Pathfinder network) separating symptoms and medications and frequency of pairing symptoms with medication. This provides evidence of the validity of the Pathfinder network. It was also seen that, higher the relatedness rating between symptoms and medications in Study 1, higher the frequency of pairing symptom to medication in Study 2, and the more directly linked those symptoms and medications were in the Pathfinder network. This network can inform pharmaceutical companies about which symptoms

they most closely associate with, who their competitors are, what symptoms they can dominate, and how to market their medications more effectively.

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Introduction

The Center of Disease Control (CDC) estimates that "influenza causes between 9.3 million and – 49.0 million illnesses, between 140,000 – 960,000 hospitalizations between 12,000 – 79,000 deaths annually" (CDC, 2019). Most adults experience two to three colds a year (CDC, 2019). With cold and flu being so ubiquitous, an abundance of medications has been developed to combat these illnesses. The sales of over the counter (OTC) medication depend largely on whether the medication relieves the symptoms of the illness it claims. Since OTC medications do not require prescriptions, their purchase depends mainly on the judgement of the sick user.

Consequently, an OTC pharmaceutical company would likely find value in knowing what brands come to mind when thinking about each symptom. It would also be helpful to know if any symptoms are not associated with specific brands, or if specific brands fail to relate to any specific symptom. Other factors that may play a role in building associations in the minds of consumers is experience and reliability. Reliability means consistently arriving at the same result or conclusion multiple times. If a consumer has a consistently good experience with a certain OTC medication, they may form a strong positive association with that OTC medication and their symptoms in the future. Further, it would be useful to visualize these relationships in a way that sheds light on the relationships among medicines and symptoms. A few limitations of the visualization include a lack of information about how well a company is doing in terms of sales or stock. The visualization is also not something that can be automatically updated every year without having to go through the research and validation process again. But, visualizing this data will help pharmaceutical companies understand their consumers

better in terms of how their consumers view them in association with the Cold and Flu illnesses. It can also help companies take up new marketing strategies or get rid of any misconceptions about their products.

Empirically derived, semantic networks of a concept domain can be constructed by asking research participants to judge the relatedness of concepts in that domain (in this case symptoms and medicine brands), and then using these judgments to construct a network representation (Borge – Holthoefer $ Arenas, 2010). In such a network, concepts that are highly related to each other tend to be directly linked, whereas items that are unrelated tend to have several intervening links between them.

Understanding the relationships among OTC medications and symptoms could provide useful information about which medication brands most associated with various symptoms. This study investigatds 9 cold and flu symptoms (chills, headaches, cough, sore throat, aches, fever, runny nose, congestion, and fatigue) and 11 medications (Vicks, Robitussin, DayQuil, NyQuil, Theraflu, Sudafed, Mucinex, Delsym, Zicam, Tylenol, and Advil) to determine how these medications relate to each symptom, and to each other in the minds of the consumers.

It was expected, that symptoms and medications that are associated with each other in peoples' minds will be represented closer together in an empirically derived semantic network than symptoms and medications that are less associated, or not associated with each other at all. This could show the accuracy of the Pathfinder network and potentially help the pharmaceutical industry build on their products and advertising. It could also help educate consumers on which medications to take for specific symptoms.

Literature Review

Cold/Flu Symptoms and Medication

In the past year, the CDC estimated that around 45,000,000 people would suffer from the flu. Symptoms include fever, cough, sore throat, runny or stuffy nose, muscle or body aches, headaches, fatigue, and vomiting. Since the flu is so common, there are many preventative measures and treatments available. For preventative measures, there are vaccinations released every year to combat and prevent one from the getting the flu. The CDC also has methods to help people stop the spread of germs such as covering one's mouth, washing one's hands and more. As for treatments, there are OTC medications, and for severe cases, there are antibiotic prescriptions that can help treat the flu.

Like the flu, the cold is also a common illness, hence the name the common cold. Adults in the USA average about 2 to 3 colds per year and children experience the cold even more than that according to the CDC. The symptoms for a cold overlap with those pertaining to the flu. These symptoms include sore throat, runny nose, coughing, sneezing, headaches, and body aches. The cold affects so many people that the CDC has even created a handwashing regimen for people to follow in order to prevent germs from spreading. As for the treatment, it is the same as the flu. All one has to do is rest and take cold medication to relieve symptoms.

Mental Models/ Associations

There are many medications that could help alleviate the symptoms of the cold and the flu. The problem lies in how consumers and manufacturers think. Consumers tend to think about which medication will alleviate most of their symptoms when they have a cold or the flu. Manufacturers on the other hand may think about making sure that

they can effectively target their marketing in order to draw people to their products. Consumers and manufactures might operate under different mental models. According to P.N. Johnson-Laird, mental models represent the meaning an individual applies to objects in the physical world in order to build a mental layout of how the world works (Johnson-Laird, 1980). They can be applied to specific topics like consumer choice. An understanding of consumers' mental models would help manufacturers with marketing strategies, branding, naming, advertising, packaging, and numerous other initiatives. It could even be broken down to more specific concepts like consumerism. Consumerism is the protection or promotion of the interests of consumers. For example, if consumers start purchasing more and more of a manufacture's product, that manufacture may put more effort into the packaging and in the product itself to make it even better for the consumer. Mental models are built through associations. Maya Toteva defined the idea of brand association as "the ideas, preferences, and emotions connected to a brand" (Toteva, 2017). For example, one can look at the logo of a brand or its tagline and immediately associate it with the brand and its goal, quality, intention, etc. It is for this reason that one may think of using aspirin to alleviate a headache. This association creates a mental model in which the consumer sees a clear connection between their headache and the aspirin. These types of associations comprise part of the consumers' sematic memory for colds/flu. Michael N Jones and colleagues define sematic memory as the mind's process of giving meaning to words and objects in order to interact with the world in a knowledge-based manner. (Jones, Willits & Dennis, 2015). There are three primary ways of depicting mental models presented below: Cluster analysis, Correspondence analysis, and multidirectional scaling.

Visualizations

Associations and mental models are usually easier to understand when they can be clearly visualized. Many networks are based off of semantic memory, or memory created for meaning. Semantic memory usually takes into account associating different concepts with each other. These memories are often used to build mental models and create semantic networks. According to Teixeira and colleagues (2010), semantic networks are used to build graphic representations of participants' mental models and is a way to support automated systems about knowledge from different network structures. A lot of these networks are based off of associations, but sometimes associations that are not very significant are included in the construction of different visualized networks (Teixerira, Aguiar, Carvalho, Dantas et al., 2010). Empirically derived sematic networks are usually built through asking participants about the relatedness between concepts in certain domains. These usually take into account their beliefs, sematic memory, previously built associations, and mental models.

Thankfully there are multiple ways to visualize this data, such as cluster analysis (Phipps, 1971), correspondence analysis (Abdi & Bera, 2014), and multidimensional scaling (Hout, Papesh & Goldinger, 2013). Toteva (2017) discusses cluster analyses and how it can take something like relationships between objects and sort those associations in to different groups of relatedness. Cluster analyses are used to form homogeneous groups for complex data sets. Cluster algorithms are used for these analyses to separate objects into groups. Humans usually have the need to form classifications that represent different patterns in data, which is why the cluster analysis is

so helpful. The cluster analysis results are often represented as dendrograms, which is a diagram with branches resulting in items that are categorized and related in a hierarchical order. (Figure 1)

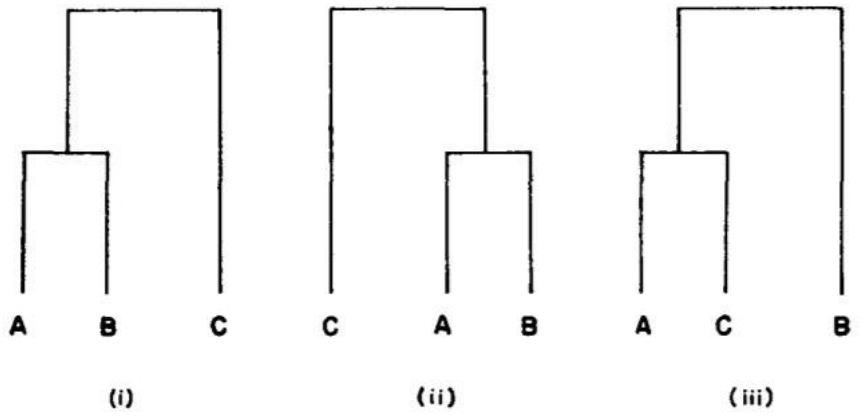


Figure 1: Dendrogram Example

Correspondence Analysis (CA) is usually used to analyze contingency tables but can be used with data matrices that do not involve any negative numbers (Abdi & Bera, 2014). It helps describe patterns seen in associations between elements within rows and columns in a data table. CAs can also turn into multiple correspondence analysis where multiple nominal variables can be compared.

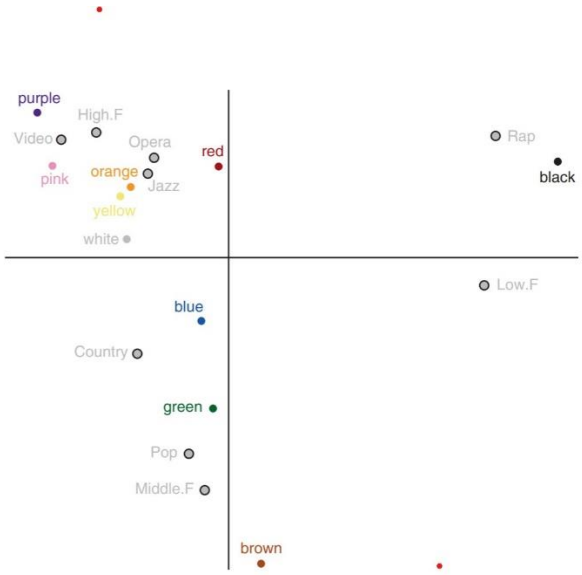


Figure 2: Example of Correspondence Analysis

Another way of visualizing data is through multidimensional scaling (MDS). Mead (1992) described MDS as spatially representing how objects are related or how similar they are by mapping them in pairs. MDS can be broken down into metric scaling and non-metric scaling. Metric scaling, also known as classical scaling, can give exact numerical solutions to finding a configuration of points. This type of scaling could even be done using judgements of similarity and dissimilarity in stimulus space. Non-metric scaling, also known as ordinal scaling, is used to find the distances between points that are in close agreement, or proximity, with each other. It is based on the rank order of distances between points rather than numerical values.

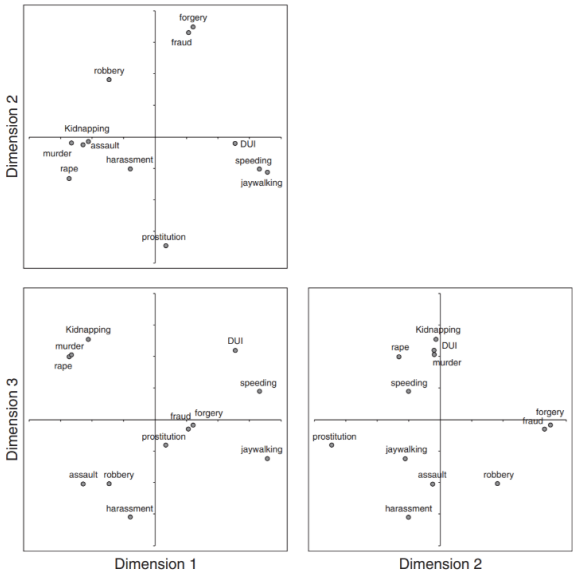


Figure 3: Multidimensional Scaling Example

The method used to construct the semantic network for this study is Pathfinder.

Pathfinder Networks

A Pathfinder network is a way to visualize associations among concepts. In this case, a Pathfinder network can provide a visual representation of how, in the minds of consumers, symptoms and medications are related to each other and amongst themselves. In this study, if most participants think of a particular medication when presented with a certain symptom, that symptom-medication pair is likely to be directly linked. If the medication does not come to mind at all when a symptom is presented, then several links will intervene between them. Pathfinder was also used by Celmer (2018) in her study on Brand Trust in Autonomous Vehicles. Celmer studied how the trustworthiness of a vehicle or vehicle brand played into the perceived safety of the vehicle. Her findings showed that perceiving a vehicle as trustworthy impacted how safe consumers thought that vehicle was and how trustworthy the brand was. Celmer used trust-based attributes

like confidence, secure, integrity, rugged to see which attributes would signify that a brand would produce the safest cars. This study also supported the notion that both brands and automation might have an impactful relation that, if understood, could help create safer systems that strengthen consumer trust. Pathfinder networks are used to represent the proximity of one variable to another. For example, the number of links between two objects shows how related they are. The fewer number of links between concepts (closer proximity) the more related; the more links (farther proximity) the less related. Schvaneveldt, Durso, and Dearholt (1989) discussed proximity data and network structures. They suggested that "networks entail the assumptions that concepts and their relations can be represented by a structure consisting of nodes (concepts) and links (relations)" (Schvaneveldt et al., 1989). The nodes represent entities or in this case it represents the symptoms and medications whereas the links represent the relations between the nodes (Figure 3).

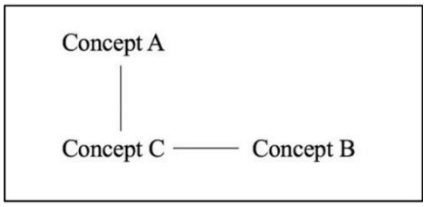


Figure 4- Pathfinder Network Example

Study 1 – Ratings Collection and Network Development

The purpose of the first study was to determine how closely users of cold/flu medications relate their symptoms to certain medications within their mental model. It is known that people suffer from multiple symptoms when they catch the common cold and flu. This could lead to consumers building meaning in their sematic memory around medications that take a more holistic approach or medication that focus on one specific

symptoms. This was measured through a short survey in which participants rated the relatedness of cold/flu medications to symptoms on a scale from 1 to 7 (1 = highly unrelated and 7 = highly rated). The goal of this survey was to build a Pathfinder network displaying how related and unrelated medications and symptoms are to each other. It was hypothesized that medications and symptoms that are closely related in the mental model of the participant will be ranked closer to 7 in the relatedness survey and will also have a smaller geodetic distance between them in the Pathfinder network.

Study 1 Methods

Participants

There were 100 participants in this study due to a similar number of participants being used in a past study (Celmer, Branaghan, & Chiou, 2018). All the data from each participant was taken into consideration when forming the Pathfinder network and was integral in the validation process of the Pathfinder network. The participants were all 18 years of age and older as people younger than 18 are considered minors and therefore would have needed parental consent to participate in any research study. Only those who are 18 years or older can sign up to be a worker on Amazon Mechanical Turk, which was the forum used along with Qualtrics to administer the test. The age restriction was also due to the fact that most cold/flu medications can only be bought by someone who is 18 years or older. The participants also needed to be fluent in English as the surveys were all in English. Participants were restricted to the residents of the USA as the medications that were used were American brands that are not typically found outside of the USA. The

reason that the participant pool was so broad for this study was because OTC cold/flu medications are available for the general public to purchase without the need for a prescription from a licensed medical professional.

Materials

Participants completed a consent form (Appendix A). A list of cold/flu symptoms and OTC medications were created for this study by researching the symptoms of both cold andfFlu according to the CDC. Since the symptoms and treatment options for the flu and cold overlap to such an extent, only the overlapping symptoms were used to create the list needed for the relatedness. The symptom list will cover the following: chills, headaches, cough, sore throat, body/muscle aches, fever, runny nose, congestion, and fatigue/tiredness.

As for medication, literature in determining the most well-known medications was sparse. However, some articles discussed ways to relieve symptoms and prevent the spread of cold and flu. According to Kim Gould, the treatment for cold and flu coincide with symptoms. For example, both flu and colds share the symptoms of body aches. To remedy those, the article says that one needs to take ibuprofen which is found in the medication Advil (Gould, 2009). After searching through these different treatments and looking up different medications that pertain to all the symptoms that were compiled before, there were 11 relevant medications; Vicks, Robitussin, DayQuil, NyQuil, Theraflu, Sudafed, Mucinex, Delsym, Zycam, Tylenol, and Advil (CDC, 2019).
This study also involved two separate surveys: the Relatedness Survey and Demographics Survey. All of these tests were administered through Qualtrics and

Amazon Mechanical Turk as this is the most effective way of collecting a wide range of participants within the United States of America. MATLAB was also used in order to treat the data and input it into the Pathfinder program, JPathfinder, to create a network. To generate this network, participants ranked the relations between different nodes in the Relatedness Survey. This study used a 7 point Likert Scale (a rating scale that measures someone's opinion on a specific topic directly); in this case how much a medication relates to a symptom when it comes to the cold and flu. The points 1 to 7 ranged from highly unrelated (1) to highly related (7). Ratings from individuals were then averaged (using a mean calculation) and submitted to the Pathfinder network scaling algorithm using the program JPathfinder (Schvaneveldt). The Pathfinder network can be examined visually to show the strongest relations and the weakest relations by the number of links seen between each node. It also illustrates which medication is being likely used for which symptoms.

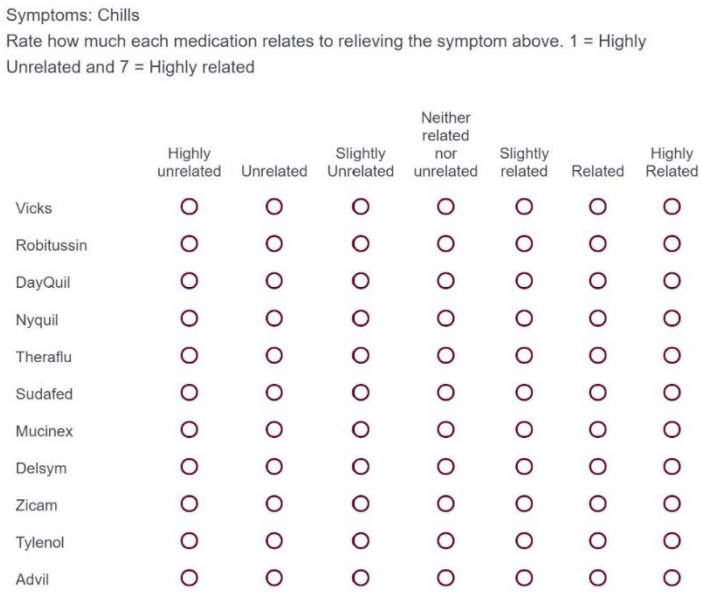
A one-dollar compensation was needed for each participant. Since, participants were collected in batches of 10, each batch had a 40% tax rate totaling to 14 dollars a batch ($140). All funds for this study came from the researchers personal accounts.

Procedure

Before administering the survey, it had to be linked through Amazon Mechanical Turk after designing it on Qualtrics. Designing the survey on Qualtrics was simple. After writing out all the questions and implementing the rating system, a 1 minute timer was placed on each page before the "next button" appeared to insure that participants properly read through and completed the survey. There was also a customized end of survey message put in place that gave a unique Amazon Mechanical Turn Code for participants

to enter in Amazon Mechanical Turk in order to be considered for compensation. In order to link the survey from Qualtrics to Amazon Mechanical Turk, the anonymous link for the survey was imputed into amazon mechanical turk. The restrictions for the participants were set and after paying the fee for the compensation and tax, the survey was posted for a total of 2 hours (the amount of time it took to get 10 participants). The posting of the survey was repeated 10 times (resulting in 100 participants).

Relatedness ratings were collected using Qualtrics and Amazon Mechanical Turk account. The data was collected in batches of 10 throughout the day in order to accommodate for different time zones around the USA. Splitting the participants in batches of 10 also made tracking and compensating them easier. Then, they completed a survey, rating the relatedness of cold/flu symptoms to medications which took approximately 7 minutes. They were also asked about their age, ethnicity, and where in America they were located.


Symptoms: Chills
Rate how much each medication relates to relieving the symptom above. 1 = Highly Unrelated and 7 = Highly related

	Highly unrelated	Unrelated	Slightly Unrelated	Neither related nor unrelated	Slightly related	Related	Highly Related
Vicks	○	○	○	○	○	○	○
Robitussin	○	○	○	○	○	○	○
DayQuil	○	○	○	○	○	○	○
Nyquil	○	○	○	○	○	○	○
Theraflu	○	○	○	○	○	○	○
Sudafed	○	○	○	○	○	○	○
Mucinex	○	○	○	○	○	○	○
Delsym	○	○	○	○	○	○	○
Zicam	○	○	○	○	○	○	○
Tylenol	○	○	○	○	○	○	○
Advil	○	○	○	○	○	○	○

Figure 5: Relatedness Survey Example

After entering their Human Intelligence Task (HIT: their submission code for completing the test) on Amazon Mechanical Turk, the answers were analyzed and the one dollar compensation was transferred to the participant through the money deposited in the Amazon Mechanical Turk account of the researcher.

Study 1 Results

Ratings data were imported into MATLAB and converted into matrices of psychological distances (Appendix C). In these matrices, the smaller the distance value, the more related the concepts. Pearson Product Moment Correlations were calculated among all participants' data to investigate inter-participant agreement. Correlation analysis showed a small positive correlation ($r = 0.25$). A p-value for this correlation is not reported here, since this number represents the mean of 4,950[(100 x 99)/2)] pairwise correlations. The average correlation is, however, a measure of mean effect size and suggests a weak effect.

The ratings data from all the participants were then averaged (mean; Appendix C) and submitted to the Pathfinder Network Scaling algorithm (JPathfinder). The symptoms/ medication network is shown in Figure 6 (below). The medications and the symptoms are nodes in this figure and the lines between these nodes, representing relatedness, are links. Fewer links between objects signify a higher level of relatedness. More links between objects signify a lower level of relatedness. As can be seen, this network uses only a fraction of the number of potential links to represent the original ratings data. In order to calculate the network density, the actual number of the links in the network was divided by the total number of possible links. In this case, there were 19 links in the network and the total number of possible links was 190, a network density of 0.1.

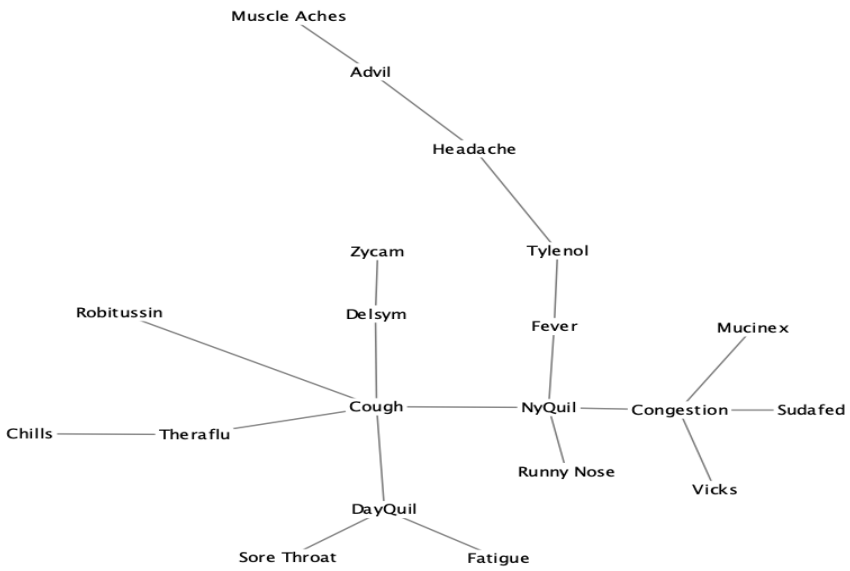


*Figure 6***:** *Pathfinder network depicting the relationship between different cold/flu symptoms and cold/flu medications. The line between each word, or object. is called a link, or path. The more links/paths there are between object, the further related they are and the less links/paths there are between objects, the closer related they are.*

Nodes	Links	Max Degree	Eccentricity	Center
Chills	1		8	
Headache	2		6	
Cough	5	Cough	6	
Sore Throat	1		8	
Muscle Aches	1		8	
Fever	2		4	Fever
Runny Nose	1		6	
Congestion	4		6	
Fatigue	1		8	
Vicks	1		7	
Robitussin	1		7	
DayQuil	3		7	
NyQuil	4		5	
Theraflu	2		7	
Sudafed	1		7	
Mucinex	1		7	
Delsym	2		7	
Zycam	1		8	
Tylenol	2		5	
Advil	2		7	

Table 1: Pathfinder Centrality Chart

Node centrality measures how close to the center of a network a node is compared to other nodes. One type of node centrality is degree centrality. Centrality based on

degree is the measure of how many links originate from a single object in the Pathfinder. Cough had the highest degree of centrality with 5 links followed by Nyquil (4 links) and Congestion (4 links). Degree can be an indicator of a level of strength and involvement of a node. It shows the objects that are associated the most with a large amount of objects in the same network. Another type of centrality measured was eccentricity. Another name for eccentricity is betweenness centrality. This takes an object in a network and measures how far it is from all the other objects in the network (Batool & Niazi, 2014). It helps identify the length of the shortest path between nodes. Betweeness depends on the identification of the shortest path and how many times one has to pass through them to get to another node. Fever presented with the lowest value of eccentricity (4). Fever is more centralized (Figure 4) and so has a lower value of eccentricity whereas muscle aches is more far removed and presents with an eccentricity value of 8.

Study 1 Discussion

The goal of this study was to build visual model of how people associate cold/flu symptoms with cold/flu medications. Inter-rater, evidenced by a weak positive correlation, showed some but by no means strong, consistency.

Although visualizing the data in a Pathfinder network helps build an understanding of the beliefs consumers hold about different medications, there are a few caveats to the method itself. The network itself is a static snap of the data itself. It does not provide information on the associations consumers hold about medication and symptoms pertaining to the future or even in the past. This network is solely based on what consumers were thinking at the time they took the study. Another fallback of this method is that it does not link this information to how well a company is doing in terms

of sales or stocks. All companies can see from this network are the beliefs and associations consumers have about their medication. However there is still a lot of information that can be learned from this network.

The Pathfinder network represents the structure of semantic memory as it relates to cold/flu symptoms and OTC medications. “Cough: had the highest degree centrality (i.e the number of links directly attached to a node) suggesting that it is an important component of this graph. As seen in Figure 4, there are many OTC medications like Delsym, Dayquil, Nyquil, and Theraflu that are directly linked and associated with Cough. Similarly, Nyquil has a high-level of degree centrality, too. NyQuil was highly associated with many symptoms like cough, fever, runny nose, etc. It is interesting to note that NyQuil’s tagline is “The nighttime, sniffling, sneezing, coughing, aching, fever, best sleep with a cold medicine” and it looks like that branding is working well. There were also clusters of concepts. For example, Mucinex, Sudafed, and Vicks all connected directly to congestion but nothing else. Highly related concepts were separated by just one link. It was not surprising that Advil was directly linked to muscle aches and headaches as Advil is primarily marketed as a pain-relief medication.

Study 2: Validation of the Pathfinder Network

The purpose of this study was to validate the Pathfinder network derived in the previous study. Validation refers to determine whether the Pathfinder network accurately represents how people think about cold/flu symptoms and medications. It was hypothesized that people would pair together medications and symptoms that were directly linked in the Pathfinder network. This was tested through a matching associations task in which participants were asked to pair symptoms to medications based

on how closely they associate them. It was compared against the Pathfinder network to see if the highly related pairs were actually grouped together more than highly unrelated pairs.

Study 2 Methods

Participants

A new set of participants were recruited in this study. They were recruited from the same pool on Amazon Mechanical Turk as the first study. The selection criteria for the second study were the same as the first study, only this time 90 participants were collected for this study instead of 100. Although the inclusion criteria for the participants remained the same the reason for a difference in number of participants had to do with the evolution of the research. Initially, a different test involving three conditions was going to be used to validate the Pathfinder network. 10 participants were going to be randomly assigned to each condition thus resulting in having 90 participants. The matching associations test seemed to be a more efficient way of validating the Pathfinder network as it got rid of the conditions. The number of participants however remained 90 as that is what it originally was.

Materials

This study consisted of a consent form, a matching association test, and a demographic survey. Accounts for both Amazon Mechanical Turk and Qualtrics were used to administer the test. The matching association test consisted of the same list of symptoms and medications used for the relatedness survey in the first study.

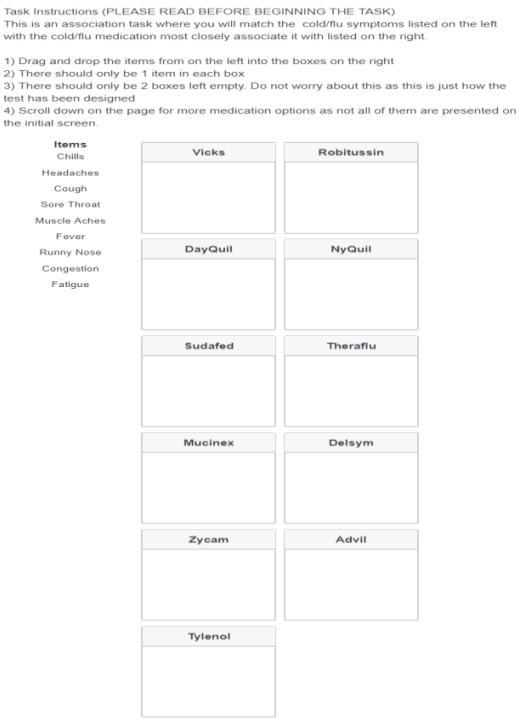


Figure 7: Matching Associations Test Example

The demographics survey inquired about the participant's age, gender, ethnicity, and location within the USA. The whole study lasted approximately 5 minutes. A one-dollar compensation was required for each participant. As for the data analysis, Excel was used to input the data and calculate values to create matrices (Appendix F) for analysis. MATLAB and SPSS were used to run correlations, partial correlations, and stepwise regressions on the data.

Procedure

As in Study 1, the matching associations test was designed in Qualtrics and linked to Amazon Mechanical Turk. Participants were collected in batches of 10 in order to accommodate for different time zones and to make administering compensation easier. Participants were redirected from Amazon Mechanical Turk to Qualtrics where they

signed a consent form to proceed with the rest of the study. The matching task, found in Appendix E, displayed a list of symptoms on the left side of the screen and a list of medications on the right side of the screen. The order of both lists was randomized for each participant. Participants were instructed to match the cold/flu symptom with the most associated cold/flu medication by dragging the symptoms on the left side of the screen into medication boxes on the right side of the screen (Figure 6). After completing the matching task, participants were asked about their age, ethnicity, sex, and location within the USA to see how representative the population was of the USA and if it accurately matched the demographics of the participants from Study 1. The whole study took approximately 5 minutes to complete for each participant. Participants were then paid a one-dollar compensation through Amazon Mechanical Turk

Study 2 Results

The data was organized in an Excel spreadsheet, where two matrices (Appendix F) were created. The first matrix, the mean ratings, provided the mean psychological distance ratings for all concept pairs (from Study 1). The second matrix, the geodetic distance matrix (from Study 1), displayed how many links separated medications and symptoms within the Pathfinder network. The third matrix, the frequency matrix, was passed on how often participants paired a specific symptom with a specific OTC medication.

Pearson Product Moment Correlations among the three measures (Psychological distance ratings, geodetic distances, and association frequency) were calculated. Results are shown in Table 2 below.

Pearson Product Moment Correlation

	Mean Ratings	Geodetic Distance	Frequencies
Mean Ratings	1.000	-0.588	0.537
Geodetic Distance	-0.588	1.000	-0.502
Frequencies	0.537	-0.502	1.000

Table 2: Pearson Product Moment Correlations

As can be seen there was a significant and strong negative correlation between psychological mean ratings and geodetic distance ($r(98) = -0.59$, $p < 0.001$). There was a significant and strong positive correlation between mean ratings and frequencies ($r(98) = 0.54$, $p < 0.001$). Finally, there was also significant and strong negative correlation between geodetic distance and association frequency ($r(98) = -0.50$, $p < 0.001$).

With this degree of inter-relationship, what if one measure, for example, geodetic distance, provided predictive validity above and beyond that provided by the other (e.g., the initial relatedness ratings). To do this, partial correlations were calculated, with frequencies as the dependent variable and relatedness ratings and geodetic distance as the predictor variables. The analysis revealed a significant and moderate negative

correlation between number of links and the mean ratings without the effect of the frequencies ($r(98) = -0.44$, $p < 0.001$). There was a significant and moderate positive correlation between the mean ratings and frequencies without the effect of number of links ($r(98) = 0.35$, $p = 0.005$). There was a significant and low negative correlation between number of links and frequencies without the effects of the mean ratings ($r(98) = -0.27$, $p = 0.006$).

Stepwise Regression: Coefficients

Model	Unstandardized Coefficients		Standardized Coefficients		
	B	Std. Error	Beta	t	Sig.
Constant	-18.665	7.468	-	-2.499	0.014
Mean Ratings	7.026	1.508	0.855	4.660	0.000
Geodetic Distance	4.140	1.791	0.917	2.311	0.023
Mean Rating x Geodetic Distance	-1.283	0.410	-1.028	-3.127	0.002

Table 3: Stepwise Regression

Last, a stepwise regression analysis performed on frequencies indicated that there were three predictors that explained 40.3% of the variance ($R^2 = 0.40$, $F(3,95) = 21.41$, $p < 0.001$). The significant predictors were the mean ratings ($\beta = 7.03$, $p < 0.001$), the number of links between objects in the Pathfinder network ($\beta = 4.14$, $p = 0.02$), and the interaction between the mean ratings and the number of links ($\beta = -1.28$, $p = 0.002$).

Study 2 Discussion

For a measure to be valid, it should be truly measuring what it was intended to measure and gives a sense of reinforcement to the visual model that was created (Golafshani, 2003). Analyses were run on the matching associations test to validate the Pathfinder network. The first set of correlations that occurred measured how different measures (mean ratings, number of links between objects, and frequencies of symptoms matched with medications) were related to each other. The first correlation was between the mean ratings and the number of links between objects in the Pathfinder network. Participants rated the relatedness between symptoms and medications on a scale from 1

to 7, where 1 meant highly unrelated and 7 meant highly related. As for the links, less number of links signified a higher level of relation between objects in the Pathfinder network. Seeing as there was a strong, significant and negative correlation, it confirmed that the closer the rating was to 7 in the relatedness survey, the smaller number of links were seen between those symptoms and medications in the Pathfinder network.

The next correlation was between mean ratings and the frequencies. The purpose of the matching associations test was to determine whether symptoms and medications that participants associate closely would match up with each other. The higher number of times a symptom is paired with a medication by participants, the stronger those symptoms are associated with those medications. That is what the frequency measures. The strong, significant, and positive correlation between the mean ratings and frequencies shows that with a higher rating of symptom relatedness to medication, there is also a higher frequency of that symptom being paired with the medication by the second set of participants. They validate each other as both show that participants closely associated the same symptoms and medications.

The last correlation was between the number of links and frequencies. The significant, negative, and strong correlation between the two indicates that the higher the frequencies, fewer links there were between symptoms and medications in the Pathfinder network. This correlation is integral to validating the Pathfinder network as it shows that the associations matching test truly is in agreement
with the Pathfinder network built off the relatedness survey. Since the batch of participants for the relatedness survey were a completely different batch than that of the

matching associations test, it also shows that the mental model translated across all 190 participants, further strengthening the Pathfinder network.

Partial correlations test the correlation between two variables without the effects of any other variables to see the amount of correlation or significance they have with each other. The correlations remained more or less the same but were weaker than the normal correlations done in the beginning. This breakdown shows us that the correlation between mean ratings and frequencies are stronger than the correlation between geodetic distance and frequencies. Nevertheless, all the correlations seem to be significant which means that those relations still have meaning when it comes to how people associate symptoms and medications together.

The stepwise regression was used to check how well mean ratings and number of links predicted the number of times a symptom was paired with a medication (frequencies). Mean ratings were seen to be the best predictor of the frequencies. But the geodetic distance and the interaction between the geodetic distance and mean ratings were also seen as significant predictors of frequency. This shows that both mean ratings and geodetic distance are an integral part to predicting associations between medications and symptoms through the number of times they are paired together by the general public. We know that if the geodetic distance is small and the mean ratings are high, there is a high chance that people associate these symptoms and medications to each other.

General Discussion

The goal of this research was to build a Pathfinder network that accurately represented the mental model of how consumers associate cold/flu medications and symptoms and validate the network. These tests were successful in validating the

Pathfinder network. The question now points to what can be done with this network. It can be very beneficial to the pharmaceutical companies that make and sell these medications. The network can show them the symptoms they have a monopoly over, who their competitors are, and which other symptom markets they can break into. It can help with marketing products and targeting their sales more effectively as well as helping them educate their consumers on the roles of different OTC medications. More research can also be done on this topic, like introducing levels of trust people have for specific brands based on how the brands market themselves and how successful brands' medications are in alleviating cold/flu symptoms. We can also compare sales between drugs that are more holistic in treating symptoms, like NyQuil, compared to medications that target specific symptoms, like Robitussin or Delsym.

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APPENDIX A

CONSENT FORM: EFFECTS OF THE RELATEDNESS BETWEEN COLD/FLU MEDICATIONS AND SYMPTOMS ON HOW USERS DECIDE WHICH MEDICATION TO USE TO RELIVE COLD/FLU SYMPTOMS

Consent Form

I am a graduate student under the direction of Dr. Russell Branaghan in the Human Systems Engineering Department at Arizona State University. I am conducting a research study to see how cold/flu symptoms relate to over the counter cold/flu medication and how that affects a person's decision on which medication to use to relieve their symptoms I am inviting your participation, which will involve signing this consent form, filling out a 25 minute survey about different cold/flu medications and cold/flu symptoms in order to create a Pathfinder network to visually show how closely related medications and symptoms are in the eyes of the user. Pathfinder network will be formed using all the data from all the participants within the main survey and to make sure that the network is proper and represents what the majority of the participants said. The data collected will then be used for another survey in order to validate the Pathfinder network created from the previous survey. You have the right not to answer any or all questions, and to stop participation at any time though this may result in a reduced to no compensation.

Your participation in this study is voluntary. If you choose not to participate or to withdraw from the study at any time, there will be no penalty expect for a potential reduction or cancellation of monetary compensation. You must be 18 years and older to give consent and participate in this study. You must also be fluent in the English language.

The information collected during this study may not benefit you directly, but the information learned in this study should provide more general benefits to make cold/flu medications potentially more effective. You will also be compensated $1 for participating in the study.

This survey is anonymous. Do not write your name on the survey. Since this is a web-based survey, you will not be asked for your direct name although you will be asked for age, gender, ethnicity, and residency. In order to preserve anonymity, each participant will be assigned a participant ID number (e.g. Participant 1, Participant 2, participant 3 etc.) Since this is a survey that is done online, complete anonymity cannot be absolutely guaranteed but I as the researcher will make sure that all data is stored securely in locked cabinets and encrypted computers. No one will be able to identify you or your answers, and no one will know whether or not you participated in the study. Tanvi Tendolkar, her thesis committee and the Institutional Review Board may inspect these records. The results of this study may be used in reports, presentations, or publications but your name will not be used.

If you have any questions concerning the research study, please contact the research team at: Russell.Branaghan@asu.edu. If you have any questions about your rights as a subject/participant in this research, or if you feel you have been placed at risk, you can contact the Chair of the Human Subjects Institutional Review Board, through the ASU Office of Research Integrity and Assurance, at (480) 965-6788. Please let me know if you wish to be part of the study.

APPENDIX B

RELATEDNESS SURVEY

Symptom: Chills
Rate how much each medication relates to relieving the symptom above. 1 = Highly unrelated and 7 = Highly related

	Highly Unrelated	Unrelated	Slightly Unrelated	Neither Related nor Unrelated	Slightly Related	Related	Highly Related
Vicks	1	2	3	4	5	6	7
Robitussin	1	2	3	4	5	6	7
DayQuil	1	2	3	4	5	6	7
NyQuil	1	2	3	4	5	6	7
Theraflu	1	2	3	4	5	6	7
Sudafed	1	2	3	4	5	6	7
Mucinex	1	2	3	4	5	6	7
Delsym	1	2	3	4	5	6	7
Zicam	1	2	3	4	5	6	7
Tylenol	1	2	3	4	5	6	7
Advil	1	2	3	4	5	6	7

Symptom: Headaches
Rate how much each medication relates to relieving the symptom above. 1 = Highly unrelated and 7 = Highly related

	Highly Unrelated	Unrelated	Slightly Unrelated	Neither Related nor Unrelated	Slightly Related	Related	Highly Related
Vicks	1	2	3	4	5	6	7
Robitussin	1	2	3	4	5	6	7
DayQuil	1	2	3	4	5	6	7
NyQuil	1	2	3	4	5	6	7
Theraflu	1	2	3	4	5	6	7
Sudafed	1	2	3	4	5	6	7
Mucinex	1	2	3	4	5	6	7
Delsym	1	2	3	4	5	6	7
Zicam	1	2	3	4	5	6	7
Tylenol	1	2	3	4	5	6	7
Advil	1	2	3	4	5	6	7

Symptom: Cough
Rate how much each medication relates to relieving the symptom above. 1 = Highly unrelated and 7 = Highly related

	Highly Unrelated	Unrelated	Slightly Unrelated	Neither Related nor Unrelated	Slightly Related	Related	Highly Related
Vicks	1	2	3	4	5	6	7
Robitussin	1	2	3	4	5	6	7
DayQuil	1	2	3	4	5	6	7
NyQuil	1	2	3	4	5	6	7
Theraflu	1	2	3	4	5	6	7
Sudafed	1	2	3	4	5	6	7
Mucinex	1	2	3	4	5	6	7
Delsym	1	2	3	4	5	6	7
Zicam	1	2	3	4	5	6	7
Tylenol	1	2	3	4	5	6	7
Advil	1	2	3	4	5	6	7

Symptom: Sore Throat
Rate how much each medication relates to relieving the symptom above. 1 = Highly unrelated and 7 = Highly related

	Highly Unrelated	Unrelated	Slightly Unrelated	Neither Related nor Unrelated	Slightly Related	Related	Highly Related
Vicks	1	2	3	4	5	6	7
Robitussin	1	2	3	4	5	6	7
DayQuil	1	2	3	4	5	6	7
NyQuil	1	2	3	4	5	6	7
Theraflu	1	2	3	4	5	6	7
Sudafed	1	2	3	4	5	6	7
Mucinex	1	2	3	4	5	6	7
Delsym	1	2	3	4	5	6	7
Zicam	1	2	3	4	5	6	7
Tylenol	1	2	3	4	5	6	7
Advil	1	2	3	4	5	6	7

Symptom: Body/Muscle Aches
Rate how much each medication relates to relieving the symptom above. 1 = Highly unrelated and 7 = Highly related

	Highly Unrelated	Unrelated	Slightly Unrelated	Neither Related nor Unrelated	Slightly Related	Related	Highly Related
Vicks	1	2	3	4	5	6	7
Robitussin	1	2	3	4	5	6	7
DayQuil	1	2	3	4	5	6	7
NyQuil	1	2	3	4	5	6	7
Theraflu	1	2	3	4	5	6	7
Sudafed	1	2	3	4	5	6	7
Mucinex	1	2	3	4	5	6	7
Delsym	1	2	3	4	5	6	7
Zicam	1	2	3	4	5	6	7
Tylenol	1	2	3	4	5	6	7
Advil	1	2	3	4	5	6	7

Symptom: Fever
Rate how much each medication relates to relieving the symptom above. 1 = Highly unrelated and 7 = Highly related

	Highly Unrelated	Unrelated	Slightly Unrelated	Neither Related nor Unrelated	Slightly Related	Related	Highly Related
Vicks	1	2	3	4	5	6	7
Robitussin	1	2	3	4	5	6	7
DayQuil	1	2	3	4	5	6	7
NyQuil	1	2	3	4	5	6	7
Theraflu	1	2	3	4	5	6	7
Sudafed	1	2	3	4	5	6	7
Mucinex	1	2	3	4	5	6	7
Delsym	1	2	3	4	5	6	7
Zicam	1	2	3	4	5	6	7
Tylenol	1	2	3	4	5	6	7
Advil	1	2	3	4	5	6	7

Symptom: Runny Nose
Rate how much each medication relates to relieving the symptom above. 1 = Highly unrelated and 7 = Highly related

	Highly Unrelated	Unrelated	Slightly Unrelated	Neither Related nor Unrelated	Slightly Related	Related	Highly Related
Vicks	1	2	3	4	5	6	7
Robitussin	1	2	3	4	5	6	7
DayQuil	1	2	3	4	5	6	7
NyQuil	1	2	3	4	5	6	7
Theraflu	1	2	3	4	5	6	7
Sudafed	1	2	3	4	5	6	7
Mucinex	1	2	3	4	5	6	7
Delsym	1	2	3	4	5	6	7
Zicam	1	2	3	4	5	6	7
Tylenol	1	2	3	4	5	6	7
Advil	1	2	3	4	5	6	7

Symptom: Congestion
Rate how much each medication relates to relieving the symptom above. 1 = Highly unrelated and 7 = Highly related

	Highly Unrelated	Unrelated	Slightly Unrelated	Neither Related nor Unrelated	Slightly Related	Related	Highly Related
Vicks	1	2	3	4	5	6	7
Robitussin	1	2	3	4	5	6	7
DayQuil	1	2	3	4	5	6	7
NyQuil	1	2	3	4	5	6	7
Theraflu	1	2	3	4	5	6	7
Sudafed	1	2	3	4	5	6	7
Mucinex	1	2	3	4	5	6	7
Delsym	1	2	3	4	5	6	7
Zicam	1	2	3	4	5	6	7
Tylenol	1	2	3	4	5	6	7
Advil	1	2	3	4	5	6	7

Symptom: Fatigue/Tiredness
Rate how much each medication relates to relieving the symptom above. 1 = Highly unrelated and 7 = Highly related

	Highly Unrelated	Unrelated	Slightly Unrelated	Neither Related nor Unrelated	Slightly Related	Related	Highly Related
Vicks	1	2	3	4	5	6	7
Robitussin	1	2	3	4	5	6	7
DayQuil	1	2	3	4	5	6	7
NyQuil	1	2	3	4	5	6	7
Theraflu	1	2	3	4	5	6	7
Sudafed	1	2	3	4	5	6	7
Mucinex	1	2	3	4	5	6	7
Delsym	1	2	3	4	5	6	7
Zicam	1	2	3	4	5	6	7
Tylenol	1	2	3	4	5	6	7
Advil	1	2	3	4	5	6	7

Demographics
Age: _____
Gender: F M Other
What state/Province and Country do you live in? (State/Province, Country)
Ethnicity

- American Indian or Alaska Native
- Asian
- Black or African American
- Native Hawaiian or Other Pacific Islander
- Hispanic or Latino or Spanish Origin
- White

APPENDIX C

DISTANCE MATRIX

Num	Term	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
0	Chills	0	0.606	0.589	0.546	0.595	0.524	0.596	0.656	0.634	0.609	0.425	0.348	0.308	0.288	0.535	0.612	0.597	0.587	0.456	0.478
1	Headache	0.606	0	0.795	0.677	0.504	0.56	0.768	0.815	0.666	0.717	0.673	0.503	0.483	0.563	0.552	0.672	0.698	0.688	0.132	0.12
2	Cough	0.589	0.795	0	0.504	0.755	0.682	0.516	0.5	0.714	0.308	0.191	0.196	0.189	0.275	0.482	0.364	0.395	0.523	0.722	0.739
3	Sore Throa	0.546	0.677	0.504	0	0.62	0.563	0.553	0.577	0.653	0.436	0.31	0.268	0.294	0.285	0.517	0.517	0.486	0.555	0.546	0.527
4	Muscle Acl	0.595	0.504	0.755	0.62	0	0.478	0.73	0.762	0.652	0.533	0.606	0.439	0.433	0.442	0.636	0.707	0.662	0.688	0.17	0.166
5	Fever	0.524	0.56	0.682	0.563	0.478	0	0.667	0.705	0.652	0.646	0.555	0.313	0.295	0.306	0.555	0.653	0.582	0.64	0.22	0.256
6	Runny Nos	0.596	0.768	0.516	0.553	0.73	0.667	0	0.43	0.685	0.367	0.411	0.262	0.259	0.281	0.287	0.31	0.486	0.456	0.724	0.74
7	Congestior	0.656	0.815	0.5	0.577	0.762	0.705	0.43	0	0.71	0.204	0.308	0.286	0.246	0.285	0.244	0.24	0.397	0.508	0.735	0.737
8	Fatigue	0.634	0.666	0.714	0.653	0.652	0.652	0.685	0.71	0	0.671	0.643	0.485	0.584	0.559	0.6	0.725	0.654	0.675	0.679	0.664
9	Vicks	0.609	0.717	0.308	0.436	0.533	0.646	0.367	0.204	0.671	0	0.517	0.6	0.616	0.616	0.572	0.553	0.558	0.564	0.82	0.814
10	Robitussin	0.425	0.673	0.191	0.31	0.606	0.555	0.411	0.308	0.643	0.517	0	0.502	0.484	0.524	0.557	0.534	0.488	0.549	0.823	0.806
11	DayQuil	0.348	0.503	0.196	0.268	0.439	0.313	0.262	0.286	0.485	0.6	0.502	0	0.309	0.422	0.58	0.601	0.589	0.641	0.78	0.77
12	NyQuil	0.308	0.483	0.189	0.294	0.433	0.295	0.259	0.246	0.584	0.616	0.484	0.309	0	0.398	0.586	0.604	0.587	0.64	0.768	0.757
13	Theraflu	0.288	0.563	0.275	0.285	0.442	0.306	0.281	0.285	0.559	0.616	0.524	0.422	0.398	0	0.574	0.601	0.59	0.599	0.776	0.756
14	Sudafed	0.535	0.552	0.482	0.517	0.636	0.555	0.287	0.244	0.6	0.572	0.557	0.58	0.586	0.574	0	0.487	0.521	0.513	0.778	0.771
15	Mucinex	0.612	0.672	0.364	0.517	0.707	0.653	0.31	0.24	0.725	0.553	0.534	0.601	0.604	0.601	0.487	0	0.441	0.468	0.834	0.812
16	Delsym	0.597	0.698	0.395	0.486	0.662	0.582	0.486	0.397	0.654	0.558	0.488	0.589	0.587	0.59	0.521	0.441	0	0.376	0.762	0.738
17	Zycam	0.587	0.688	0.523	0.555	0.688	0.64	0.456	0.508	0.675	0.564	0.549	0.641	0.64	0.599	0.513	0.468	0.376	0	0.737	0.714
18	Tylenol	0.456	0.132	0.722	0.546	0.17	0.22	0.724	0.735	0.679	0.82	0.823	0.78	0.768	0.776	0.778	0.834	0.762	0.737	0	0.235
19	Advil	0.478	0.12	0.739	0.527	0.166	0.256	0.74	0.737	0.664	0.814	0.806	0.77	0.757	0.756	0.771	0.812	0.738	0.714	0.235	0

APPENDIX D

CONSENT FORM: EFFECTS OF THE RELATEDNESS BETWEEN COLD/FLU MEDICATIONS AND SYMPTOMS ON HOW USERS DECIDE WHICH MEDICATION TO USE TO RELIEVE COLD/FLU SYMPTOMS – ASSOCIATIONS MATCHING TASK.

Consent Form

I am a graduate student under the direction of Dr. Russell Branaghan in the Human Systems Engineering Department at Arizona State University. I am conducting a research study to see how cold/flu symptoms relate to over the counter cold/flu medication and how that affects a person's decision on which medication to use to relieve their symptoms

I am inviting your participation, which will involve signing this consent form, participating in a short matching activity regarding the associations between cold/flu medications and symptoms. The data collected will then be used for another survey in order to validate the Pathfinder network created from the previous survey. You have the right to stop participation at any time though this may result in a reduced compensation to no compensation.

Your participation in this study is voluntary. If you choose not to participate or to withdraw from the study at any time, there will be no penalty except for a potential reduction or cancellation of monetary compensation. You must be 18 years and older to give consent and participate in this study. You must also be fluent in the English language as well as have residency or currently live within in the United States of America.

The information collected during this study may not benefit you directly, but the information learned in this study should provide more general benefits to make cold/flu medications potentially more effective. You will also be compensated $1 for participating in the study.

This survey is anonymous. Do not write your name on the survey. Since this is a web-based survey, you will not be asked for your direct name although you will be asked for age, gender, ethnicity, and residency. In order to preserve anonymity, each participant will be assigned a participant ID number (e.g. Participant 1, Participant 2, participant 3 etc.) Since this is a survey that is done online, complete anonymity cannot be absolutely guaranteed but I as the researcher will make sure that all data is stored securely in locked cabinets and encrypted computers. No one will be able to identify you or your answers, and no one will know whether or not you participated in the study. The researcher, their thesis committee and the Institutional Review Board may inspect these records. The results of this study may be used in reports, presentations, or publications but your name will not be used.

If you have any questions concerning the research study, please contact the research team at: Russell.Branaghan@asu.edu. If you have any questions about your rights as a subject/participant in this research, or if you feel you have been placed at risk, you can contact the Chair of the Human Subjects Institutional Review Board, through the ASU Office of Research Integrity and Assurance, at (480) 965-6788. Please let me know if you wish to be part of the study.

Thank you.

APPENDIX E

ASSOCIATIONS MATCHING TASK

Task Instructions (PLEASE READ BEFORE BEGINNING THE TASK)
This is an association task where you will match the cold/flu symptoms listed on the left with the cold/flu medication most closely associate it with listed on the right.

1. Drag and drop the items from on the left into the boxes on the right
2. There should only be 1 item in each box
3. There should only be 2 boxes left empty. Do not worry about this as this is just how the test has been designed
4. Scroll down on the page for more medication options as not all of them are presented on the initial screen.

Symptoms	Medication
Chills	Vicks
Headaches	Robitussin
Cough	DayQuil
Sore Throat	NyQuil
Muscle Aches	Sudafed
Fever	Theraflu
Runny Nose	Mucinex
Congestion	Delsym
Fatigue	Zycam
	Advil
	Tylenol

APPENDIX F

FREQUENCY MATRIX AND GEODETIC DISTANCE MATRIX

Frequency (number of times a symptom was paired with a medication) Matrix:

FREQUENCY MATRIX		Vicks	Robitussin	DayQuil	NyQuil	Sudafed	Theraflu	Muxinex	Delsym	Zycam	Advil	Tylenol
Chills		8	7	11	12	9	28	3	4	3	2	1
Headaches		4	4	2	0	7	2	1	4	1	33	31
Cough		6	38	7	7	2	1	9	15	3	1	0
Sore Throat		20	17	10	8	4	14	6	5	3	0	0
Muscle Aches		11	2	7	6	2	10	2	4	8	25	13
Fever		0	2	7	13	6	14	5	6	2	10	25
Runny Nose		9	7	9	10	24	7	6	7	9	0	0
Congestion		15	5	3	6	12	2	37	3	4	0	0
Fatigue		1	2	25	17	13	6	2	11	6	3	3

Geodetic Distance (between symptoms and medications) Matrix:

# of LINKS MATRIX		Vicks	Robitussin	DayQuil	NyQuil	Sudafed	Theraflu	Muxinex	Delsym	Zycam	Advil	Tylenol
Chills		5	3	3	3	5	1	5	3	4	7	5
Headaches		5	5	5	4	5	5	5	5	6	1	1
Cough		3	1	1	1	3	1	3	1	2	5	3
Sore Throat		5	3	1	3	5	3	5	3	4	6	5
Muscle Aches		7	7	7	6	7	7	7	7	8	1	3
Fever		3	3	3	1	3	3	3	3	4	3	1
Runny Nose		3	3	3	1	3	3	3	3	4	5	3
Congestion		1	3	3	1	1	3	1	3	4	5	3
Fatigue		5	3	1	3	5	3	5	3	4	8	5

APPENDIX G

ARIZONA STATE UNIVERSITY INSTITUTIONAL REVIEW BOARD FORM

1 Protocol Title

Effects of Symptoms on Decision-making within Cold/Flu Medications

2 Background and Objectives

Provide the scientific or scholarly background for, rationale for, and significance of the research based on the existing literature and how will it add to existing knowledge.

- Describe the purpose of the study.
- Describe any relevant preliminary data or case studies.
- Describe any past studies that are in conjunction to this study.

https://repository.asu.edu/attachments/211477/content/Celmer_asu_0010N_18494.pdf

This paper discussed brand Identities with different Car Brands. Natalie Celmer was a former student of Arizona State University who studied how people view different car brands. She used the Brand Personality Aaker Mode Framework to survey people on which characteristics they pair with which car brands. She then used that data to create a pathfinder network between the characteristics and the different brands that are attached to those characteristics. Through this she was able to see which car companies are trusted more/ seen in a better light by the users and which car brands are not as trusted/ perceived negatively by the users. The 15 characteristics that she used from the Aaker model are the same characteristics I will be using when it comes to medical devices and I too will e making a pathfinder network in order to see how trust flows between medical device companies in regards to its Brand characteristics.

3 Data Use

Describe how the data will be used.

Examples include:

- Dissertation, Thesis, Undergraduate honors project
- Publication/journal article, conferences/presentations
- Results released to agency or organization
- Results released to participants/parents
- Results released to employer or school
- Other (describe)

The Data will be used for a Masters Thesis and results may also be released to participants, employers or the school (Arizona State University)

Minors under the age of 18
Adults who are unable to consent
Participants who are not fluent in the English Language
Must live in the United States of America

4 Inclusion and Exclusion Criteria

Describe the criteria that define who will be included or excluded in your final study sample. If you are conducting data analysis only describe what is included in the dataset you propose to use.

Indicate specifically whether you will target or exclude each of the following special populations:

- Minors (individuals who are under the age of 18)
- Adults who are unable to consent
- Pregnant women
- Prisoners
- Native Americans
- Undocumented individuals

Minors under the age of 18
Adults who are unable to consent
Participants who are not fluent in the English Language
Must live in the United States of America

5 Number of Participants

Indicate the total number of participants to be recruited and enrolled*:* 190

6 Recruitment Methods

- Describe who will be doing the recruitment of participants.
- Describe when, where, and how potential participants will be identified and recruited.
- Describe and attach materials that will be used to recruit participants (attach documents or recruitment script with the application).

Tanvi Tendolkar (Student) will be in charge of recruiting participants. Participants will be recruited through Amazon Mechanical Turk from January 2020 to February 2020. Since it is a public forum for surveys, participants who are apart of Amazon Mechanical Turk will be able to view and take the survey.

7 Procedures Involved

Describe all research procedures being performed, who will facilitate the procedures, and when they will be performed. Describe procedures including:

- The duration of time participants will spend in each research activity.
- The period or span of time for the collection of data, and any long term follow up.
- Surveys or questionnaires that will be administered (Attach all surveys, interview questions, scripts, data collection forms, and instructions for participants to the online application).
- Interventions and sessions (Attach supplemental materials to the online application).
- Lab procedures and tests and related instructions to participants.
- Video or audio recordings of participants.
- Previously collected data sets that that will be analyzed and identify the data source (Attach data use agreement(s) to the online application).

The data will be collected through Amazon Mechanical Turk. The Survey will take 25-30 minutes. The data will be used to build a pathfinder network and a second test will be administered to validate the pathfinder network. The second test will also be administered through Amazon Mechanical Turk and will also offer at $1 compensation. The second test cannot be formed until the first survey collection is done and the pathfinder network is built.

Written copy of the Consent form will be found in Appendix A and the survey will be found in Appendix B at the end of this IRB form.

8 Compensation or Credit

- Describe the amount and timing of any compensation or credit to participants.
- Identify the source of the funds to compensate participants
- Justify that the amount given to participants is reasonable.
- If participants are receiving course credit for participating in research, alternative assignments need to be put in place to avoid coercion.

There will be a $1 compensation for the first survey and there will be a $1 compensation for the second survey. $1 is being paid due to the fact that the surveys are short and that is the average pay through Amazon mechanical Turk which is the forum that is being used to administer the tests and give compensations

The funds will come from my own personal fund (out of pocket).

9 Risk to Participants

List the reasonably foreseeable risks, discomforts, or inconveniences related to participation in the research. Consider physical, psychological, social, legal, and economic risks.

There is no risk to the participants.

10 Potential Benefits to Participants

Realistically describe the potential benefits that individual participants may experience from taking part in the research. Indicate if there is no direct benefit. Do not include benefits to society or others.

They will be able to contribute to building stronger trust between medical technology companies and hospitals as well as help improve safety when it comes to cardiovascular technology.

11 Privacy and Confidentiality

Describe the steps that will be taken to protect subjects' privacy interests. "Privacy interest" refers to a person's desire to place limits on with whom they interact or to whom they provide personal information. Click here for additional guidance on ASU Data Storage Guidelines.

Describe the following measures to ensure the confidentiality of data:

- Who will have access to the data?
- Where and how data will be stored (e.g. ASU secure server, ASU cloud storage, filing cabinets, etc.)?
- How long the data will be stored?
- Describe the steps that will be taken to secure the data during storage, use, and transmission. (e.g., training, authorization of access, password protection, encryption, physical controls, certificates of confidentiality, and separation of identifiers and data, etc.).
- If applicable, how will audio or video recordings will be managed and secured. Add the duration of time these recordings will be kept.
- If applicable, how will the consent, assent, and/or parental permission forms be secured. These forms should separate from the rest of the study data. Add the duration of time these forms will be kept.
- If applicable, describe how data will be linked or tracked (e.g. masterlist, contact list, reproducible participant ID, randomized ID, etc.).

If your study has previously collected data sets, describe who will be responsible for data security and monitoring.

The only people who will have access to the data will be the people listed in the Training portion of the form. The data will be stored on Tanvi Tendolkar's personal computer as well on a secure hard drive that will be secured in a locked cabinet. The data will be stored until May 31 of 2020.

12 Consent Process

Describe the process and procedures process you will use to obtain consent. Include a description of:

- Who will be responsible for consenting participants?
- Where will the consent process take place?
- How will consent be obtained?
- If participants who do not speak English will be enrolled, describe the process to ensure that the oral and/or written information provided to those participants will be in that language. Indicate the language that will be used by those obtaining consent. Translated consent forms should be submitted after the English is approved.

Tanvi Tendolkar will be in charge of consenting participants. The consent form will be administered through Amazon Mechanical Turk before the actual Survey begins. They will have to choose to agree to consent or not to agree to consent through the online survey. If they choose not to give full consent, they will not continue and the survey will end immediately. If they choose to give consent, they will be able to proceed to the rest of the survey and if they choose to not complete the survey they can just exit out of the window that they are taking the survey on and none of the information provided before their voluntary termination will be saved.

13 Training

Provide the date(s) the members of the research team have completed the CITI training for human participants. This training must be taken within the last 4 years. Additional information can be found at: Training.

Tanvi Tendolkar – April 2019
Dr. Russell Branaghan – November 14, 2019