The Role of Perceived Risk in Consumer Acceptance of Health-Related Technologies

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Acknowledgements

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Background & Significance

Consumer Adoption of Health-related Technologies

- Davis (1989) developed the Technology Acceptance Model (TAM)
  - Primarily focused on employee adoption of workplace technologies
  - Later work has extended TAM to health care professionals
  - Little work has focused on consumer adoption of health-related technologies
- Health behavior models may provide factors to extend the TAM
  - Health Belief Model (HBM)
  - Perceived risk (Bauer, 1960)

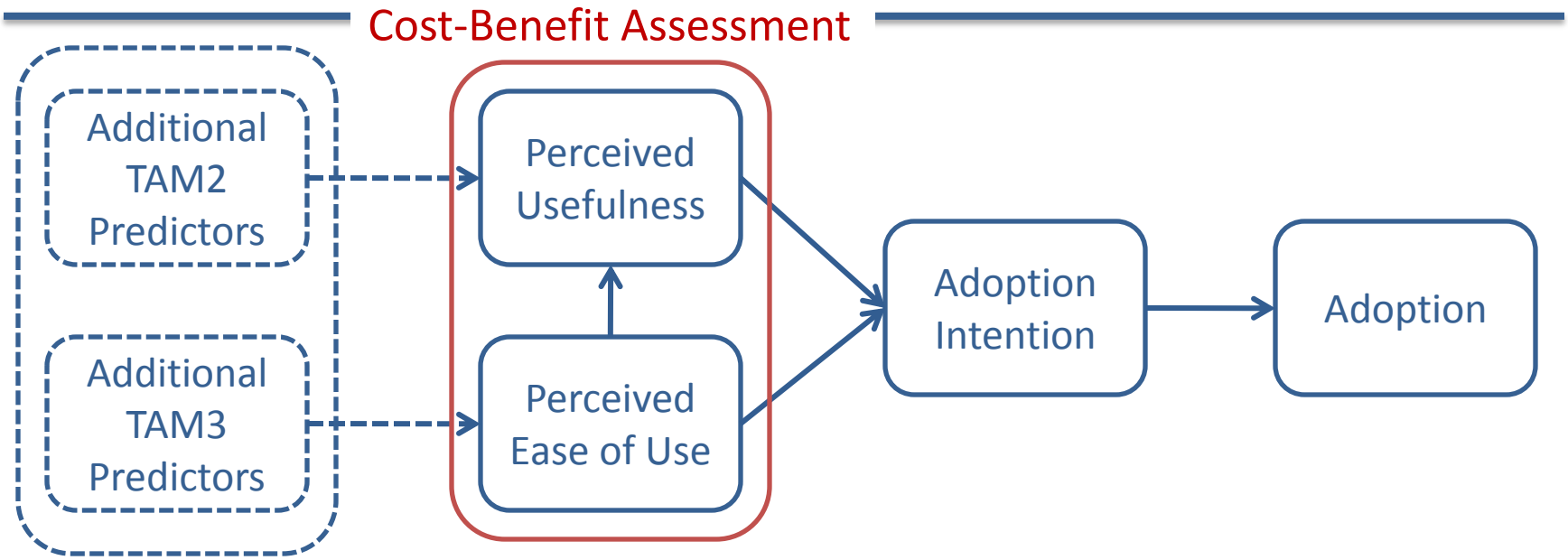
Background & Significance

Research Objectives

1. To incorporate constructs from the perceived risk literature into the Technology Acceptance Model (TAM)
2. To explore the dimensions of perceived risk which are relevant in a health care context
3. To test the associations among the variables present in the HealthTAM

Theoretical Foundation

Technology Acceptance Model

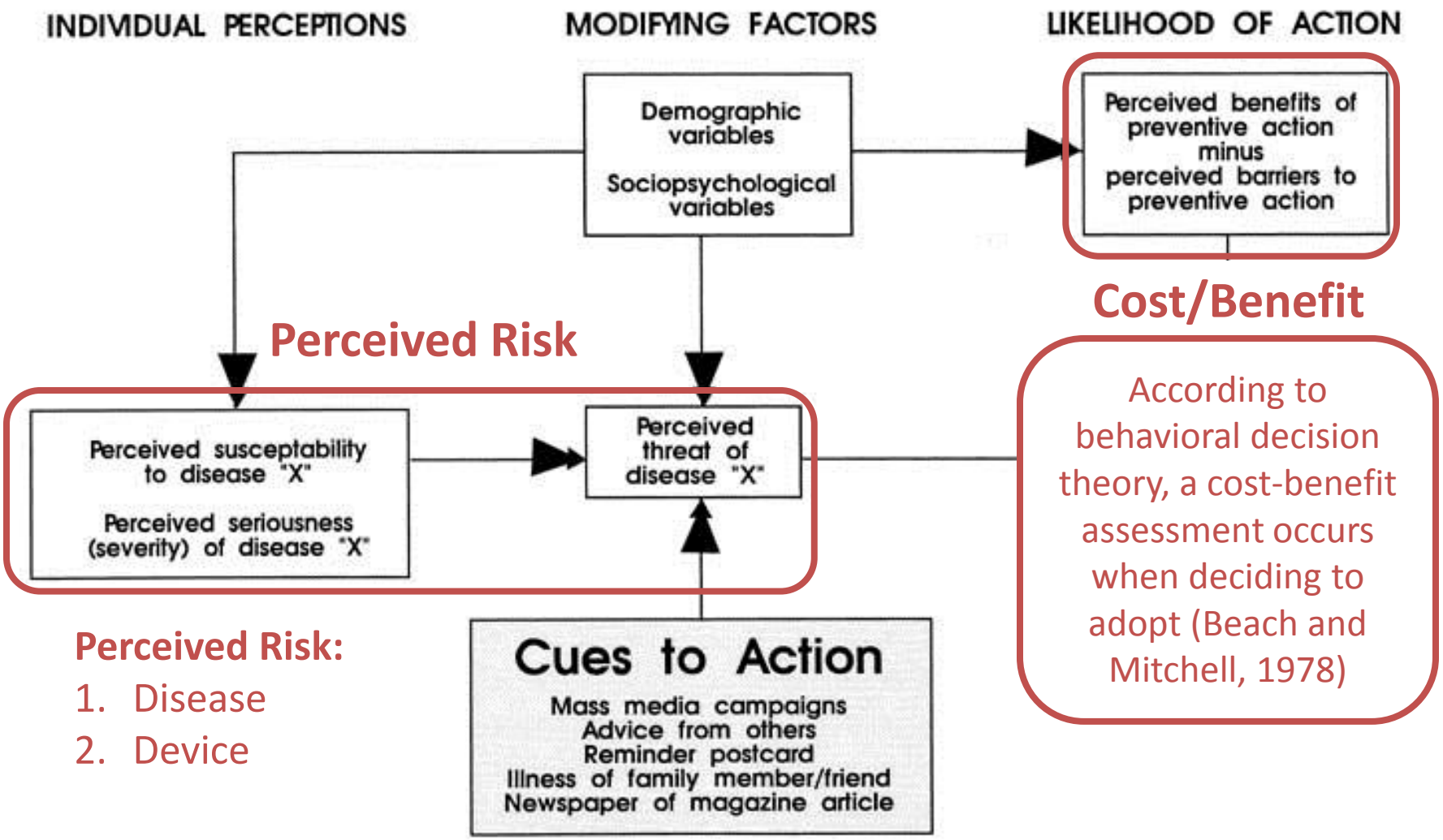


Construct	Description
Perceived usefulness	the degree to which a person believes that using a particular system would enhance his or her performance
Perceived ease of use	the degree to which a person believes that using a particular system would be free of effort

Davis, F. D. (1989). Perceived Usefulness, Perceived Ease of Use and User Acceptance of Information Technology. *MIS Quarterly , 13* (3), 319-339.

Theoretical Foundation

Health Belief Model



Perceived Risk:

1. Disease
2. Device

Figure from: Ashford, R., & Blinkhorn, A. S. (1999). Marketing dental care to the reluctant patient. *British Dental Journal , 186* (9), 436-441.

Literature Review

Perceived Risk

Construct	Description
Perceived risk	the degree to which a person believes that adopting a particular system will result in negative outcomes

- Inconsistencies in the definitions and measurement of the dimensions of perceived risk in the literature (Brewer, 2007)
- Perceived risk in health behavior literature has largely ignored the conceptualization of risk from the marketing literature
- Conceptualization of perceived risk in the marketing literature provides a more inclusive explanation of the overall risk perception that occurs when making decisions.

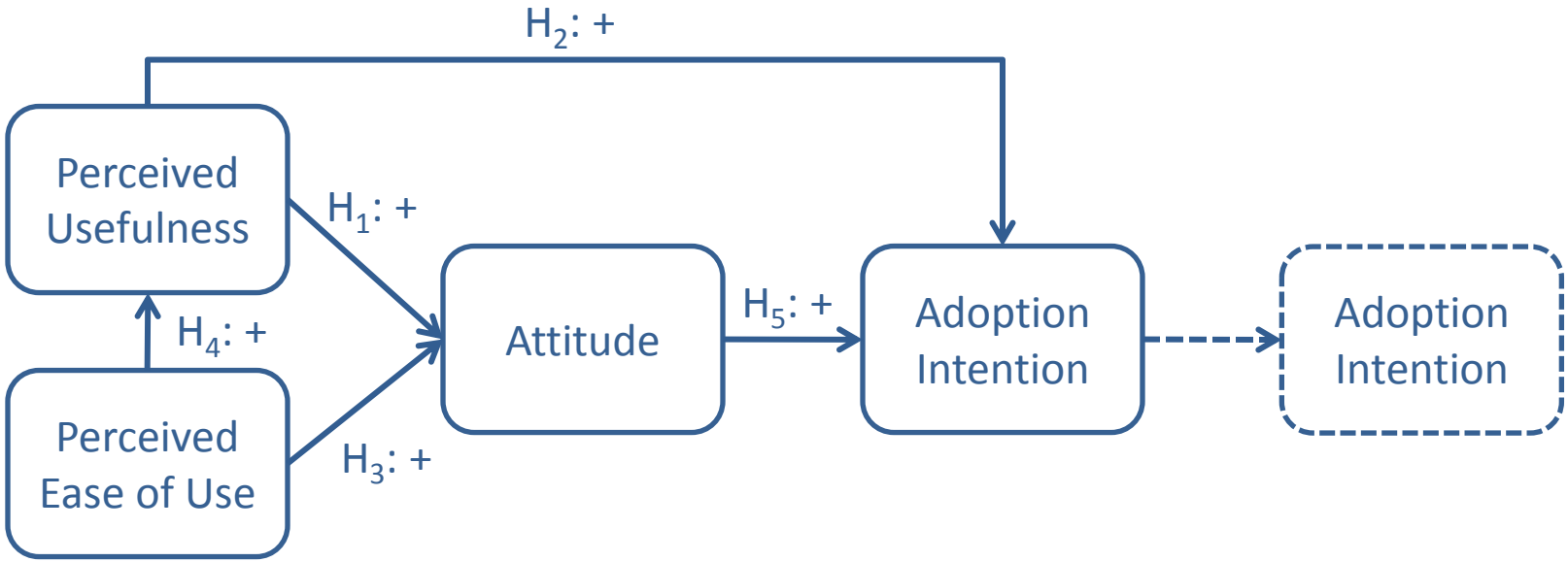
Brewer, N. T., Chapman, G. B., Gibbons, F. X., Gerrard, M., & McCaul, K. D. (2007). Meta-Analysis of the Relationship Between Risk Perception and Health Behavior: The Example of Vaccination. *Health Psychology , 26* (2), 136-145.

Literature Review

Dimensions of Perceived Risk

Dimension	Description (Jacoby and Kaplan, 1972)
Financial	The potential loss of money associated with the item purchase
Performance	The potential loss due to item failure after purchase
Psychological	The potential loss of self-image or self-concept as the result of the item purchase
Time	The potential loss of time and effort associated with purchasing the item
Social	The potential loss of esteem, respect, and/or friendship offered to the consumer by other individuals
Safety	The possibility that individuals may be harmed*
Overall	A general measure of perceived risk when all criteria are evaluated together

LaRoche, M., McDougall, G. H., Bergeron, J., & Yang, Z. (2004). Exploring how intangibility affects perceived risk. *Journal of Service Research* , *6* (4), 373-389.



H_1: Perceived usefulness will be positively related to attitude.

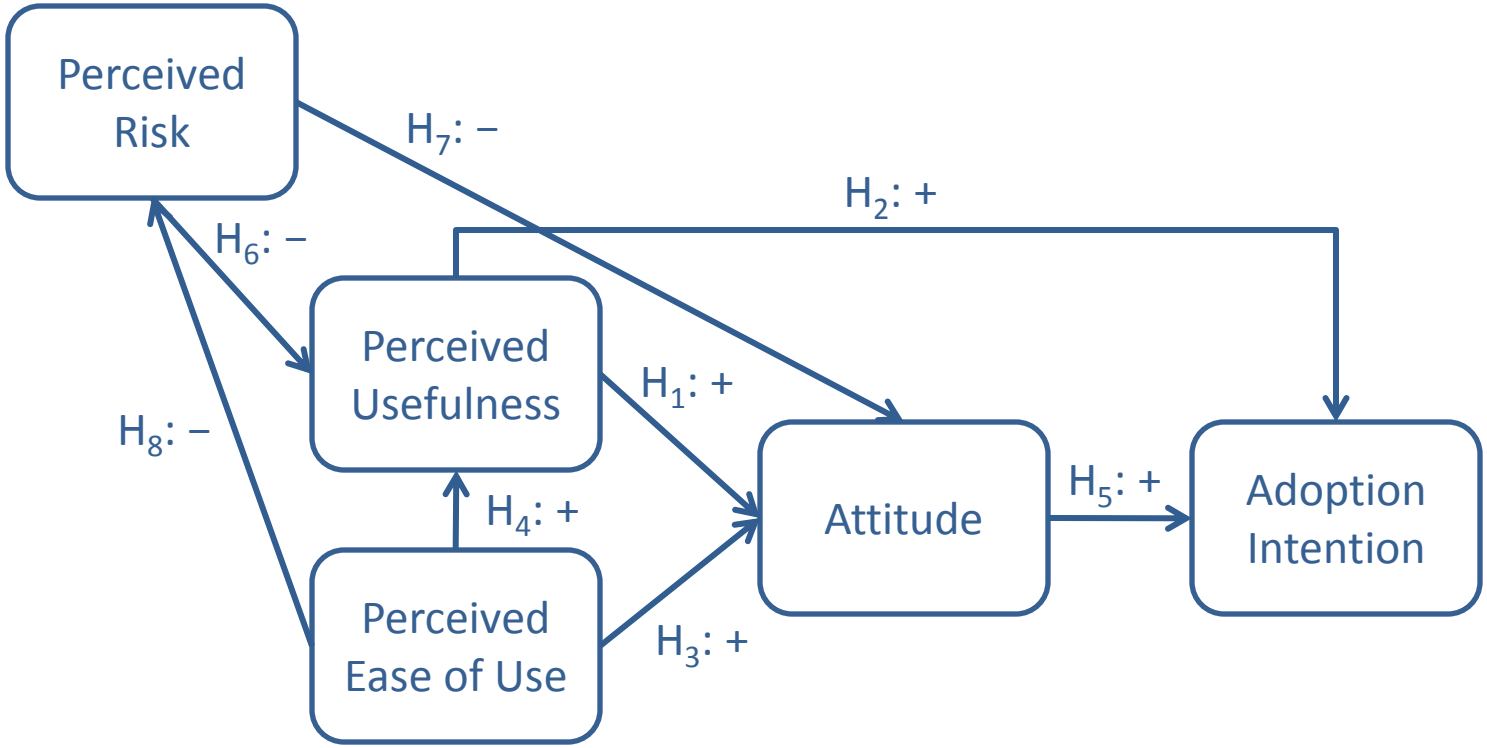
H_2: Perceived usefulness will be positively related to adoption intention.

H_3: Perceived ease of use will be positively related to attitude.

H_4: Perceived ease of use will be positively related to perceived usefulness.

H_5: Attitude will be positively related to adoption intention.

Proposed Model (HealthTAM)



H_6: Perceived risk will be negatively related to perceived usefulness.
H_7: Perceived risk will be negatively related to attitude.
H_8: Perceived ease of use will be negatively related to perceived risk.

Research Methodology

Sample and Vignette

- National online panel of individuals with diabetes (n=409) completed a cross-sectional, Internet-based, self-administered survey
- Vignette which describes a new device designed to allow individuals with diabetes to monitor blood sugar levels without the use of lancets or the need to draw blood
  - Prototype of technology was described
  - Grounded in actual technology to enhance believability

Research Methodology

Vignette

- According to Davis and Venkatesh (2004), if individuals have a good idea of their current tasks they need to accomplish, they will be able to align those tasks with a noninteractive prototype description (i.e., a vignette)
- Each time an interaction with the device was described in the vignette, the device was carefully compared to a blood-based glucose testing device to reduce the ambiguity of using the device
  - Based on the dimensions of perceived risk

Research Methodology

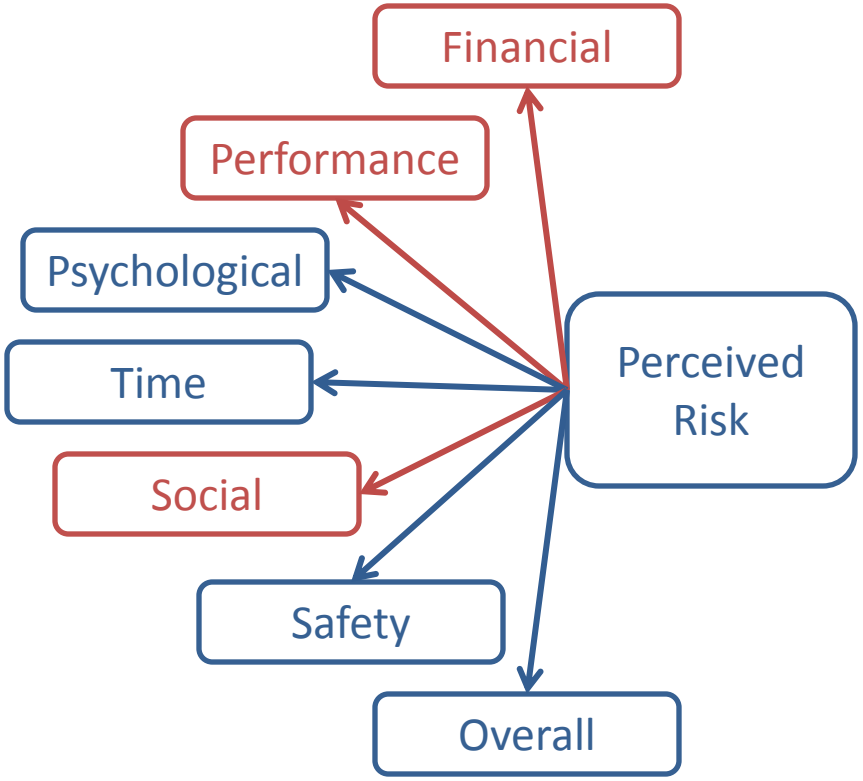
Analysis

- Report frequencies and percentiles on key demographics
- Andersen and Gerbing's (1988) two-step structural equation modeling approach was used to examine the relationships in the HealthTAM model
  - Measurement Model (Hair, 2006 and Bollen, 1989)
    - Reliability assessment
      - Cronbach's alpha coefficients
    - Validity assessment
      - Confirmatory Factor Analysis (maximum likelihood estimation)
  - Structural Model (Bollen, 1989)
- Test for common methods bias (Podsakoff, 2003)

Measurement Model Specification

Perceived Health Risk Dimensions

- Three dimensions of perceived risk were eliminated from the measurement model:
  - social risk
  - Performance risk
  - financial risk



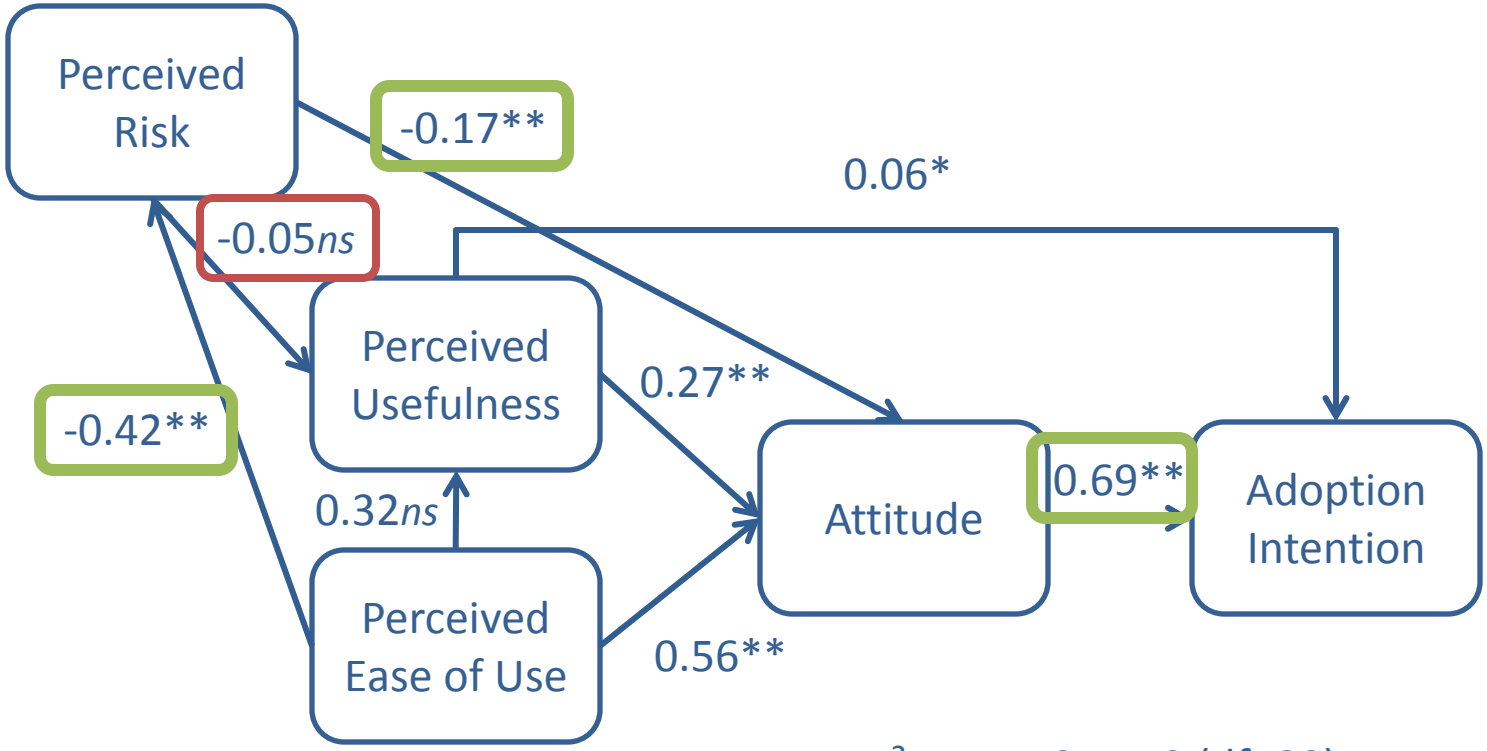
Measurement

Validity and Reliability

- Discriminant validity was assessed according to Anderson and Gerbing (1988) and Van der Sluis et al. (2005)
- Convergent validity was assessed as suggested by Fornell and Larcker (1981)
- Cronbach's alpha reliability coefficients were found to be around 0.9 for each of the constructs (Cronbach, 1951)

Structural Model Results:

Standardized Regression Coefficients



χ^2	244.49 (df=80)
CFI	0.973
RMSEA	0.071

* indicates p<0.05
** indicates p<0.01

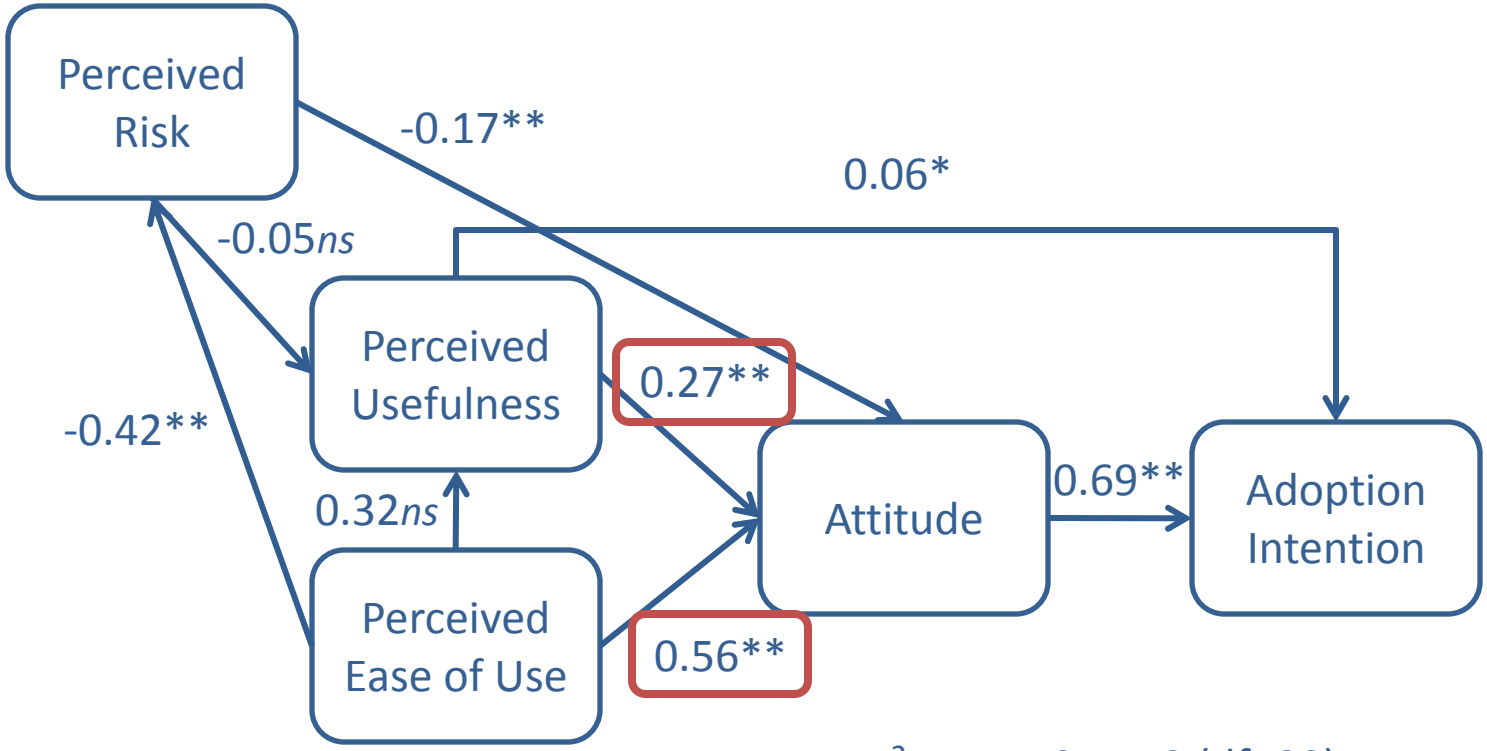
After adjusting for common methods variance

HealthTAM Relationships:
Perceived Risk and Perceived Usefulness

- Zeithaml (1981) found that as the **intangibility** of a product increases, the more difficult risk assessments become
- Murray and Schlacter (1990) also found that **perceived risk** increases as intangibility increases
- Therefore, the perceived intangibility of the blood glucose device in the vignette may explain the nonsignificant relationship between **perceived risk** and **perceived usefulness** ($\beta = {}^{-}0.05$, $p=0.693$).

Structural Model Results:

Standardized Regression Coefficients



χ^2	244.49 (df=80)
CFI	0.973
RMSEA	0.071

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After adjusting for common methods variance

HealthTAM Relationships:

Perceived Usefulness and Perceived Ease of Use

- The technology acceptance literature has generally found **perceived usefulness** to be the strongest predictor of **attitude** (and **adoption intention**)
- One might expect **perceived usefulness** and **perceived ease of use** to perform uncharacteristically if the individuals were not able to make the connection between the vignette and a tactile experience.
- **Perceived usefulness** may be grounded to current experience with blood sugar testing
- The innovative method of testing may have influenced the relationship between **perceived ease of use** and **attitude**

Study Contributions

- Incorporates elements of perceived risk into the technology acceptance model
- Identifying dimensions of perceived risk relevant to health care
- The first (known) application of the TAM in a consumer sample of individuals with a specific health condition
- Identifies dimensions of perceived risk relevant to a health care context

Study Limitations

1. A novel device used to measure blood glucose levels may not be generalizable to other types of health-related technology adoption
2. This cross-sectional study does not provide evidence of a causal relationship between the variables
3. The use of a vignette in this study may have influenced the results

QUESTIONS AND COMMENTS

Perceived Health Risk Dimensions:
Social Risk

- The **social risk** dimension performed poorly as measured, possibly because the social aspects of a common health condition like diabetes may not be stigmatizing to individuals who engage in blood sugar testing

Perceived Health Risk Dimensions:

Performance Risk

- Given no other information, one might think that **performance risk** should be the principal driver of an adoption decision.
  - The vignette included a statement about the product being approved by the Food and Drug Administration (FDA)
  - So, performance may not be a concern to the consumer, if the technology was affirmed by the FDA
  - This finding may address the trust that individuals have in drugs and medical products in the United States.

Perceived Health Risk Dimensions:

Financial Risk

- **Financial risk** was removed from the measurement model, which may be a function of insurance coverage
- Those individuals with insurance – despite the slightly increased copayment mentioned in the vignette – may be desensitized to medical payments, when compared to those individuals who pay out of pocket for their medical expenses
  - In other words, individuals with insurance might interpret "a little more than the average cost" differently than individuals who pay for medical and prescription expenses out of pocket.

Appendix A:
Vignette

As you might know, people who wish to test their blood sugar usually use a lancet to stick their finger or forearm to draw blood.

Then, they apply a few drops of blood to a testing strip that is placed in a blood glucose device to obtain a blood sugar level.

Due to recent advances, new ways of collecting blood glucose values may soon be available to people with diabetes.

Scientists are working on a new way to test blood sugar through a saliva (or spit) test.

Testing blood sugar by drawing blood

Appendix A:
Vignette

Imagine that you are looking at the diabetes supplies in a typical pharmacy you might visit. These supplies include blood sugar meters, testing strips, lancets and alcohol swabs. While you are browsing this selection, you notice a new blood sugar testing device.

This new testing device is similar in size to a typical blood sugar testing device (a little smaller than a deck of cards or a bar of soap). It requires strips similar to a typical blood sugar testing device. However, the “strip” required for the saliva test looks like a candy sucker stick with a small swab on the end.

New Sugar Testing "Swabs"

Appendix A:
Vignette

You pick up the new saliva-based testing device box and find the directions on the back.

To test blood sugar using this new device, a person would place a flavorless swab in their mouth and hold it between the gum and cheek for 5 to 10 seconds.

Then they would place the stick into the testing machine, which will provide a blood sugar reading in about 5 to 10 more seconds.

Overall, the process will take about the same amount of time as testing blood sugar using drops of blood.

Appendix A:
Vignette

This new saliva-based device would require testing just as often as the blood-based devices (the same number of times that the doctor would recommend for a blood-based device).

In other words, when comparing the new saliva-based testing device to the blood-based devices, there is no difference in how often a person will test.

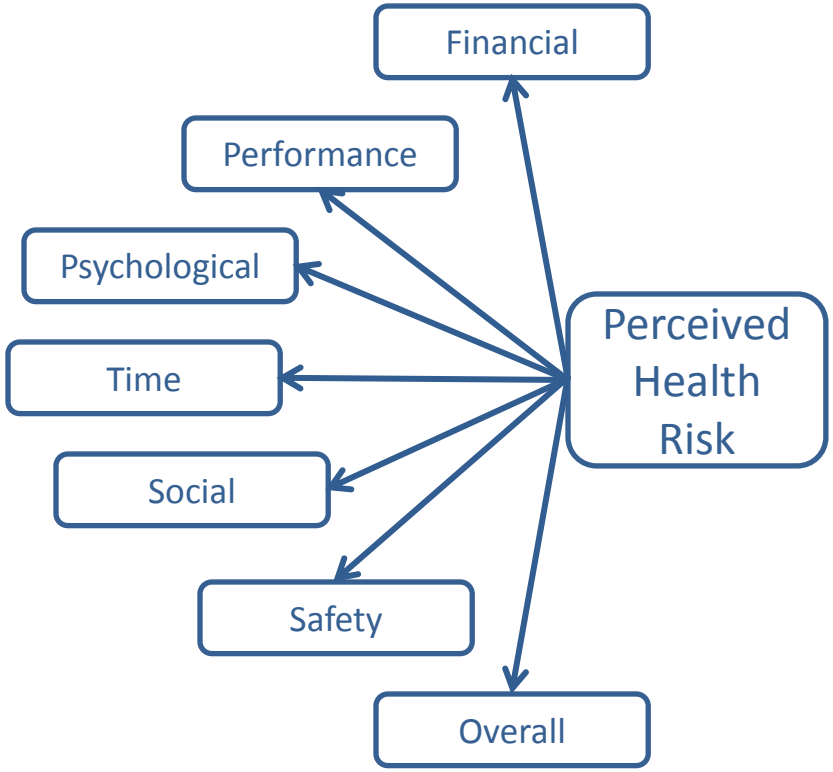
The new saliva-based testing device has been approved by the Food and Drug Administration (FDA).

The blood sugar levels given by the new saliva testing device are nearly as accurate as devices which use blood.

Literature Review

Perceived Health Risk

- Perceived health risk is the label given to this contextual application of the perceived risk dimensions originally conceptualized and refined by Jacoby and Kaplan (1972)
- Jacoby and Kaplan (1972) note that not all dimensions of perceived risk will be relevant in every situation



Jacoby, J., & Kaplan, L. B. (1972). The components of perceived risk. *Annual Conference of the Association for Consumer Research*, (pp. 382-393).

Sample Characteristics

Table 6 - Sample Summary Statistics

Sample Characteristics (n=409)			
Age (years)		***Education***	
Median	51	Some grade school	0.3%
Range	23 – 80	Some high school	2.1%
Gender		High school diploma or GED	20.5%
Female	61.9% (n=253)	Some college	28%
Male	38.1% (n=156)	Trade or technical School	2.7%
		Associate's Degree	11.1%
		Bachelor's Degree	22.3%
		Master's Degree	11.1%
		Doctoral Degree	1.8%
Ethnicity		***Income***	
African-American	5.4%	Under $5,000	1.8%
American Indian/Alaska Native	-	$5,000 to $9,999	4.5%
Asian/ Asian Indian	3.4%	$10,000 to $14,999	6.9%
Caucasian (White)	86.8%	$15,000 to $24,999	10.8%
Hispanic	4.2%	$25,000 to $34,999	13.9%
Native Hawaiian/ Pacific Islander	-	$35,000 to $49,999	17.8%
Other	0.2%	$50,000 to $74,999	20.5%
		$75,000 to $99,999	14.8%
		$100,000 and over	9.0%
Diabetes Diagnosis (years)		**Insurance Coverage**	
Range	1957-2009	Yes	85.5%
		No	14.5%

Table 6 (cont.)

In general, would you say your health is:	
Excellent	3.0%
Very Good	19.6%
Good	44.3%
Fair	26.2%
Poor	6.9%

On average, how often do you CURRENTLY test your blood sugar?	
Four (4) or more times per day	13.0%
Two (2) to three (3) times per day	41.0%
One time per day	18.7%
Several times per week	10.2%
Several times per month	7.2%
Less than 1 time per month	3.9%
I do not currently test my blood sugar	6.0%

What type of medications do you currently use for your diabetes?	
Tablets taken by mouth	54.2%
Insulin or other injections	16.3%
Both tablets and injections	19.6%
I do not currently take medications for my diabetes	9.9%

Average amount spent on blood sugar testing per month:	
$0	19.6%
$1 to $9	10.8%
$10 to $19	10.2%
$20 to $29	12.3%
$30 to $39	10.5%
$40 to $49	4.2%
$50 to $59	9.3%
$60 to $69	4.5%
$70 to $79	1.8%
$80 to $89	3.6%
$90 to $99	1.8%
Over $100	5.1%


Spokane
Montana
North Dakota
South Dakota
Oregon
Wyoming
Nebraska
Nevada
Utah
Colorado
New Mexico
Texas
Louisiana
Mississippi
Alabama
Florida
Wisconsin
Illinois
Iowa
Kansas
Oklahoma
Arkansas
Tennessee
Kentucky
Virginia
North Carolina
South Carolina
Maryland
Delaware
New Jersey
Connecticut
Rhode Island
District of Columbia
Maine
Montreal
Toronto
Québec
Tijuana
Ensenada
Mexicali
Juárez
Hermosillo
Chihuahua
Ciudad Obregón
Culiacan
Rosales
Monterrey
Saltillo
Nuevo Laredo
Reynosa
Heroica Matamoros
San Antonio
Houston
Gulf of Mexico
500 km

For the statements that follow, DEVICE refers to the new saliva-based blood sugar testing device. Please read each statement carefully. Your thoughtful responses are very important to the research team.

You may have to scroll down to see all of the statements. Please click NEXT after you have responded to each of the statments.

Please respond to the following statements, where 1-strongly disagree and 7-strongly agree.

	1 Strongly Disagree	2	3	4	5	6	7 Strongly Agree
Interacting with the device will not require a lot of my mental effort.	○	○	○	○	○	○	○
Using the device will be favorable.	○	○	○	○	○	○	○
Using the device will enhance my ability to manage my diabetes.	○	○	○	○	○	○	○
I will find it easy to get the device to do what I want it to	○	○	○	○	○	○	○

Interacting with the device will not require a lot of my mental effort.	○	○	○	○	○	○	○
Using the device will be favorable.	○	○	○	○	○	○	○
Using the device will enhance my ability to manage my diabetes.	○	○	○	○	○	○	○
I will find it easy to get the device to do what I want it to do.	○	○	○	○	○	○	○
Using the device will be good.	○	○	○	○	○	○	○
My interaction with the device will be clear and understandable.	○	○	○	○	○	○	○
Using the device will increase my ability to do what I need to do every day.	○	○	○	○	○	○	○
I find the device will be easy to use.	○	○	○	○	○	○	○
Assuming I had access to the device, I intend to use it.	○	○	○	○	○	○	○
Using the device will not require a lot of my mental effort.	○	○	○	○	○	○	○
Given that I had access to the device, I predict that I would use it.	○	○	○	○	○	○	○
I find the device would be useful for managing my diabetes.	○	○	○	○	○	○	○
Using the device will improve my performance on managing my diabetes.	○	○	○	○	○	○	○
Using the device will be clear and understandable.	○	○	○	○	○	○	○

REMEMBER: The word "device" refers to the new saliva-based blood sugar testing device. Please read each statement carefully. Your thoughtful responses are very important to the research team.

Please respond to the following statements, where 1-strongly disagree and 7-strongly agree.

	1 Strongly Disagree	2	3	4	5	6	7 Strongly Agree
All things considered, I think I would be making a mistake if I use the device.	○	○	○	○	○	○	○
The demands on my schedule are such that using the device concerns me, because it would create even more time pressures on me that I do not need.	○	○	○	○	○	○	○
The thought of using the device causes me concern because some friends would think I was just being showy.	○	○	○	○	○	○	○
When all is said and done, I really feel that using the device poses problems for me that I just don't need.	○	○	○	○	○	○	○
Using the device could lead to an inefficient use of my time from learning how to operate it.	○	○	○	○	○	○	○

strongly disagree and 7-strongly agree.

	1 Strongly Disagree	2	3	4	5	6	7 Strongly Agree
All things considered, I think I would be making a mistake if I use the device.	○	○	○	○	○	○	○
The demands on my schedule are such that using the device concerns me, because it would create even more time pressures on me that I do not need.	○	○	○	○	○	○	○
The thought of using the device causes me concern because some friends would think I was just being showy.	○	○	○	○	○	○	○
When all is said and done, I really feel that using the device poses problems for me that I just don't need.	○	○	○	○	○	○	○
Using the device could lead to an inefficient use of my time from learning how to operate it.	○	○	○	○	○	○	○
If I use the device, I think I would be held in higher esteem by my friends and family.	○	○	○	○	○	○	○
Using the device makes me concerned that I would have to spend too much time learning how to use it.	○	○	○	○	○	○	○
Overall, the thought of using the device causes me to be concerned with experiencing some kind of loss (e.g., loss of money, health, prestige, etc...).	○	○	○	○	○	○	○
Using the device would cause me to be thought of as being foolish by some people whose opinion I value.	○	○	○	○	○	○	○

Please respond to the following statements, where 1-strongly disagree and 7-strongly agree.

	1 Strongly Disagree	2	3	4	5	6	7 Strongly Agree
If I bought the device for myself, I would be concerned that the financial investment I would make would not be wise.	○	○	○	○	○	○	○
If I bought the device for myself, I would be concerned that I really would not get my money's worth from this product.	○	○	○	○	○	○	○
My purchasing the device would be a bad way to spend my money.	○	○	○	○	○	○	○
Because the device may not be completely safe, when I contemplate using it, I become concerned about potential physical risks associated with this product.	○	○	○	○	○	○	○
Using the device leads to concerns about whether the product could lead to some uncomfortable physical side-effects.	○	○	○	○	○	○	○
One concern I have about using the device is how safe it is to use.	○	○	○	○	○	○	○

Please respond to the following statements, where 1-strongly disagree and 7-strongly agree.

	1 Strongly Disagree	2	3	4	5	6	7 Strongly Agree
The thought of using the device makes me feel uncomfortable.	○	○	○	○	○	○	○
The thought of using the device causes me to experience unnecessary tension.	○	○	○	○	○	○	○
If I were to use the device, I become concerned that it will not provide the level of benefits (including sugar control) that I would be expecting.	○	○	○	○	○	○	○
The thought of using the device causes me to be concerned for how really dependable and reliable that product would be.	○	○	○	○	○	○	○
As I consider using the device, I worry about whether the product will really perform as well as it is supposed to.	○	○	○	○	○	○	○
The thought of using the device gives me a feeling of unwanted anxiety.	○	○	○	○	○	○	○