Explaining Variance in Breastfeeding Intentions and Behaviors Among a Cohort of Midwest Mothers Using a Theory of Planned Behavior-Based Structural Model

Anita Esquerra-Zwiers (aezwiers@hope.edu)
Hope College

Emilie Dykstra Goris
Hope College

Aaron Franzen
Hope College

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Abstract

Background

The Theory of Planned Behavior (TPB) has guided the investigation of breastfeeding since the 1980's, incorporating the major constructs of attitudes, subjective norms/normative beliefs, perceived behavioral control, and intentions. The purpose of this research study was to define a TPB-based structural latent variable model so as to explain variance in breastfeeding intentions and behaviors among a cohort of Midwest breastfeeding mothers.

Methods

The longitudinal descriptive study utilized questionnaire data collected from a convenience sample of 100 women with low-risk pregnancies with the intention to breastfeed at three separate time points (> 30 weeks antepartum, 10 and 60 days postpartum). Data were coded and analyzed using IBM SPSS, SAS and the *lavaan* package in R.

Results

Participants were predominantly White (94%, n=94), married (95%, n=95), college-educated (96%, n=96), and had previous breastfeeding experience (75%, n=75). The majority gave birth vaginally (79%, n=75). Varimax analysis revealed a plurality of factors within each domain. Attempts to fit a structural model, including both hierarchical and bi-factor latent variables, failed, revealing a lack of statistical significance and poor fit statistics.

Conclusion(s):

These findings illustrate the importance of using methods that fit the phenomena explained. Contributors to poor model fit may include outdated tools lacking cultural relevance, a change in social norms, or a failure to capture the possible influence of social media and formula marketing on breastfeeding behaviors. The null finding is a significant finding, indicating the need to revisit and refine the operationalization and conceptual underpinnings of the TPB through qualitative methods such as exploring the lived experiences of breastfeeding women in the Midwest region.

Background

The Healthy People 2030 targets (Center for Disease Control and Prevention, 2020) indicate a persistent deficit in the United States' breastfeeding trends, which suggest a need for comprehensive, holistic interventions targeting social, attitudinal, behavioral, and biological factors associated with breastfeeding. Investigations of the social, attitudinal, and behavioral determinants of breastfeeding have

been guided by the Theory of Planned Behavior (TPB) since the 1980s (Manstead et al., 1983). Primary constructs of the TPB include attitudes, subjective norms/normative beliefs, perceived behavioral control, and intentions toward a specified behavior (Steinmetz et al., 2016). When employed in breastfeeding research, the *behavior* is breastfeeding, while *intentions* are based on the duration and degree of certainty (exclusive or partial) about carrying out the breastfeeding behavior (Manstead et al., 1983). The *perceived behavioral control* construct encompasses the degree of expected ease or difficulty with breastfeeding, a perception derived from the mother's confidence in her ability to achieve breastfeeding expectations based on past or anticipated experiences (Duckett et al., 1998). *Attitudes* include the intensity of the mother's beliefs about the possible health effects of breastfeeding including consequences or benefits and risks of breastfeeding for both her and her infant's health, often defined by breastfeeding knowledge (Manstead et al., 1983). *Subjective norms/normalization beliefs* encompass the level of social pressures that mothers feel from family, friends, health professionals, and others, toward breastfeeding (Duckett et al., 1998).

In a review of 30 observational studies focused on the TPB, the Theory of Reasoned Action, or Breastfeeding Self-Efficacy, Lau and colleagues (2018) identified an unmet need to explore the TPB in relationship to breastfeeding behaviors. They demonstrated a lack of evidence for a positive relationship between breastfeeding duration and maternal attitudes, subjective norms, or perceived behavioral control. Lau and colleagues (2018) provided evidence that new studies are necessary to examine the relationship between breastfeeding motivation and duration. Specifically, Lau and colleagues identified a need to "further delineate the relationship between autonomous breastfeeding motivation and breastfeeding duration and exclusivity" (2018, p. 340). Their review, however, overlooked limitations of tools used to measure norms, attitudes, and perceived behavioral control as related to breastfeeding behaviors. In order to strengthen the evidence to support the TPB, the operational definitions of model antecedents must be carefully examined. The purpose of this research study was to define a TPB-based structural latent variable model so as to explain variance in breastfeeding intentions and behaviors among a cohort of Midwest breastfeeding mothers.

Methods

Design

In order to define a TPB-based structural latent variable model explaining variance in breastfeeding intentions and behaviors, this research team employed a longitudinal descriptive design. Questionnaire data were obtained using a modified version of Manstead's reconstructed Predictive [Breastfeeding] Questionnaire (Manstead et al., 1983).

Setting

Data were collected in the Midwest region of the United States as part of the Mother's Milk for Michigan Infants project from April 2018 - February 2019. The study was approved by Hope College's Human Subjects Review Board. All enrolled participants were provided written research materials and consented

prior to participation in the study. All the human subjects data was obtained in accordance with the guidelines of Hope College Human Subjects Review Board.

Sample

One hundred women with low-risk pregnancies and the intention to breastfeed were enrolled via convenience sampling after 30 weeks gestation and completed three questionnaires (antepartum, 10 and 60 days postpartum). Women were eligible to participate if they were 21 years of age or older, English proficient, intended to breastfeed with a singleton gestation, and lived within a 75-mile radius of the study site (see Table 1). The sample was recruited via social media, recruitment materials posted at local hospitals and businesses, and snowballing. Participants were provided with a $20 USD store card as partial compensation for their time and participation.

Table 1. Sample Characteristics (*N=100*)

Characteristic	*n* (%)
Maternal age, < 30 years	30 (30)
Race/ethnicity, White	94 (94)
Married	95 (95
College educated	96 (96
Household income > $75,000	55 (55)
Private insurance	84 (84)
Current employment status, Full-time	41 (41)
Primiparous	23 (23)
Previous breastfeeding experience	75 (75)
Vaginal birth[a]	75 (79)
Intention: Exclusively breastfeed at 1 month, Extremely likely	79 (79)
Intention: Exclusively breastfeed at 3 months, Extremely likely	80 (80)
Intention: Exclusively breastfeed at 6 months. Extremely likely	69 (69)
Was the mother providing any breast milk at Day 10[a]	93 (98)
Was the mother providing exclusive breast milk at Day 10[a]	89 (94)
Was the mother providing any breast milk at Day 60[b]	81 (94)
Mother providing exclusive breast milk Day 60[b]	76 (87)

[a] Missing values = 5, [b] Missing values = 13

Measurement

Antepartum Questionnaire. The Antepartum Questionnaire collected participant demographic data and included the Predictive Breastfeeding questions developed by Manstead et al. (1983) (see Table 2) using the TPB.

Table 2: Factor Loadings and Omega/Alpha Scores

Factor		Description of Item	Standardized Factor Loading (ω, α)
Attitudes	(Q)	*Response Options*: Strongly Disagree (1) to Strongly Agree (7)	(0.58, 0.68)
	(1)	BF protects baby from infection	0.14
	(2)	BF establishes close bond between mom and baby	0.18
	(3)	BF is embarrassing for mother	0.35
	(4)	BF is good for mother's figure	-0.02
	(5)	BF limits a mother's social life	0.24
	(6)	BF provides best nourishment for baby	0.25
	(7)	BF protects against infection	-0.76
	(8)	BF establishes close bond between mom and baby	-0.73
	(9)	BF does not make me feel embarrassed	-0.01
	(10)	BF is good for mother's figure	-0.72
	(11)	BF allows social activity	-0.48
	(12)	BF provides complete nutrition	0.16
	(13)	FF is convenient feeding method	0.05
	(14)	FF makes it possible for baby's father to be involved in feeding	0.16
	(15)	FF is expensive feeding method	0.27
	(16)	FF is trouble-free feeding method	-0.05
	(17)	FF allows one to see exactly how much milk baby has had	0.22
	(18)	FF provides incomplete nourishment for baby	0.19
	(19)	FF is convenient	-0.71
	(20)	FF allows for father's involvement	-0.72
	(21)	FF is expensive	0.12
	(22)	FF is trouble free	-0.72

Questions were reviewed for consistency with previously published breastfeeding studies using similar questionnaire data (Cabieses et al., 2014, Swanson, 2005). Participant demographic information included the maternal date of birth, marital status, annual household income, insurance type, the highest level of education, current employment status, race/ethnicity, and employment plans after the baby's birth. The Predictive Breastfeeding questions examined participants' attitudes, beliefs, social norms regarding breastfeeding, and behavior using a series of Likert-style questions. Breastfeeding intentions were measured using the Infant Feeding Intentions Scale (Nommsen-Rivers et al., 2010, Nommsen-Rivers & Dewey, 2009). Additional questions were included to address perceived behavioral control. The median duration to complete the Antepartum Questionnaire was 13.4 minutes (first and third quartile: 9.63, 17.52).

Day 10 & Day 60 Questionnaires. The targeted behaviors were exclusive breastfeeding at Day 10 and Day 60 postpartum. The Day 10 and Day 60 Questionnaires measured participants' feeding practices postpartum. A series of multiple-choice questions measured feeding method, mode of milk expression, and frequency of feeding to conceptualize exclusivity and duration of breastfeeding (see Table 2). The median durations to complete the Day 10 and Day 60 Questionnaires were 7.2 minutes (4.92, 11.72) and 5.1 minutes (3.03, 14.93), respectively.

Data Collection

The consent form and questionnaires were administered electronically via Qualtrics^{XM}(R). Eligible participants were invited to review and complete an online consent form. Once the consent form was

signed, participants were directed to complete the Antepartum Questionnaire. Participants were instructed to notify the research team when they gave birth. Based on the provided birth date, Day 10 and Day 60 Questionnaires were scheduled to be distributed to participants. No more than two reminders to complete any of the three questionnaires were sent to participants.

Data Analysis

Descriptive data were analyzed using IBM SPSS (Version 24). Additional data analysis were completed using SAS University Edition and the *lavaan* package in *R* for latent variable modeling (Rosseel, 2012). Analyses included confirmatory factor analysis, exploratory factor analysis including minimum average partial (MAP), very simple structure (VSS), parallels, and varimax rotation for the factor analysis. Finally, structural equation models (SEM) were utilized. MAP, VSS, and parallels provide the researcher a sense of how many factors may be present within any given set of data if one does not know how many should be present. A varimax factor rotation assumes that the different factors are not correlated with one another, thereby decreasing the possibility of a manifest variable strongly loading on more than one factor domain. The strategy was to begin with confirmatory analysis, fit a structural model, and then trim the model for best fit (See Figure 1).

When it was clear confirmatory factor analysis was insufficient, the strategy became exploratory factor analysis, fit latent variables (LVs) and trim manifest measures if necessary, and fit a structural model. Authors primarily relied on the Bayesian information criterion (BIC) to compare model fit between the first-order LV, hierarchical LV, and bifactor LV (described in more detail below). Model fit for each latent construct was assessed using cutoffs suggested by Schreiber and colleagues (2006) and the joint criteria suggested by Hu and Bentler (1999). Schreiber and colleagues (2006) suggest a Comparative Fit Index (CFI) of $\geq .95$, Tucker-Lewis Index (TLI) of $\geq .95$, a Root Mean Squared Error of Approximation (RMSEA) of $\leq .06$, and Standardized Root Mean Squared Residual (SRMR) of $\leq .08$, and Hu and Bentler (1999) suggest either CFI $\geq .96$ and SRMR $\leq .09$ or SRMR $\leq .09$ and RMSEA $\leq .06$. Scale reliability was assessed using McDonald's omega scores instead of alpha scores (McDonald, 2013, Revelle & Zinbarg, 2009, Zinbarg et al., 2005), and any missing data were handled with full information maximum likelihood in the structural models (Beaujean, 2014, Graham, 2009).

Results

From the original 100 participants, 87 completed all three questionnaires in full. Participants were predominantly White (94%, n=94), married (95%, n=95), college-educated (96%, n=96), and had previous breastfeeding experience (75%, n=75). The majority gave birth vaginally (79%, n=75). Complete sample characteristics are available in Table 1.

While the study aimed to define a TPB-based structural latent variable model explaining variance in breastfeeding intentions and behaviors among a cohort of Midwest breastfeeding mothers, this did not fit the data. The theoretical model from Duckett et al. (1998) was not a good fit, as many of the observed

variables were not significantly related to one another within constructs in the confirmatory analysis (See ω and α in Table 2 and fit statistics in Table 3).

Table 3. Fit measures for the Four Latent Measures

	CFI	TLI	RMSEA	SRMR
Attitude: First Order	0.37	0.307	0.154	0.147
Attitude: HLV	0.743	0.699	0.123	0.098
Norms: First Order	0.412	0.295	0.193	0.154
Norms: HLV	0.889	0.851	0.094	0.062
Perceived Behavioral Control: First Order	0.629	0.536	0.204	0.166
Perceived Behavioral Control: HLV	0.864	0.809	0.144	0.112
Intentions: First Order	0.942	0.826	0.248	0.033

Specifically, attitudes, subjective norms, and perceived behavioral control were not single factors, while breastfeeding intentions was a single factor (ω=0.92 and α=0.91). As such, the analysis progressed to exploratory factor analysis with a combination of a factor analysis with varimax rotation, and a MAP, VSS analysis, and parallels. This indicated that each domain within the TPB model was not a single factor, except for breastfeeding intentions. The feeding attitude factor was more accurately modeled as five factors, subjective norms as three factors, and perceived behavioral control as three factors. Additionally, the items that factored together did not always indicate a clear conceptual category. For example, the attitude item regarding expense factored with infection and nutrition (see Table 2 for question wording). This conceptual problem, however, did not apply to formula feeding items, which did cluster together quite well. Once new factor clusters were identified, analyses progressed to an attempt to fit a structural variable model approximating the TPB.

The structural variable model approximating the TPB was attempted in four forms. First, a first order LV was specified (see Figure 1). Reinforcing what is indicated by the ω and α scores (Table 2), only the Intentions domain was close to having an acceptable fit (Table 3, SRMR=0.03, CFI=0.94). Second, as many of the latent measures within the TPB model, beginning explicitly with attitudes, had multiple factors, the researchers attempted to create latent variables that still approximated the theoretic model with a bi-factor LV specification and then a hierarchical LV. The first of these was a bi-factor model (See Figure 2), which uses a single latent general factor for the structural model that is composed of shared variance within the observed variables still present after first modeling domain-specific factor variance.

For example, attitudes are composed of five factors. A bi-factor latent variable model first models the five factors and then attempts to model any remaining variance that could be in common amongst all observed variables as a general factor. None of these bi-factor LVs would converge, so there are no fit measures to include in Table 3. The second of the models approximating the TPB was a hierarchical latent variable model (See Figure 3).

Similar to the bi-factor model, the hierarchical model first fits the subfactors (five for breastfeeding attitudes), but unlike the bi-factor model, it then fits the variance that is in common between these lower-order latent variables (as opposed to the observed variables as seen in the bi-factor model). The BIC did decrease with all of these HLVs, and many of the fit statistics also improved with this specification, but the best fit was with Norms, and this, while close, still did not hit acceptable model fit (RMSEA=0.09 and SRMR=0.06).

In a final attempt to fit a SEM approximating the TPB, analyses explored which of the factors from each domain of the TPB were most conceptually clear and best fit the overall theoretical argument of the model. Subsequently, just those factors (e.g. one factor from attitudes instead of all five) were included. The model fit indicated that the overall structure was not reliable and did not always converge. Thus, the reliability of even the significant paths is questionable.

Discussion

This study attempted to use the TPB to explain variance in breastfeeding intentions and behaviors among a cohort of Midwest breastfeeding mothers. To do so, the research team used SEM to fit constructs within the TPB as latent variables and model breastfeeding behaviors. The constructs, however, did not hold up when modeled in this population. These issues with poor model fit may have gone unnoticed had the research team not opted to use SEM. This is especially apparent when considering construct alpha scores. The alpha scores for each construct with the TPB would have been acceptable, or nearly acceptable, for a traditional regression model ($\alpha >$ than 0.7). However, latent variables can parse measurement error more accurately. Alpha scores are based upon correlations among variables, but McDonald's (2013) omega score is based upon item factor loadings. In this way, unlike alpha, omega scores do not assume that all items contribute equally to constructs or that item errors are not correlated with one another (Yang & Green, 2011). When all observed variables measure the construct in the same way, as assumed in an alpha score, the omega score would be identical to an alpha (Zinbarg et al., 2005). In the case of the present data, the omega scores for the constructs are unacceptably lower than the alpha scores, indicating that they are less reliable than would otherwise be known (see Table 2).

Guo and colleague's (2016) meta-analysis is a welcome addition to breastfeeding behavior research as understood through the TPB. However, the results rely heavily on published correlation matrices that make use of additive scales that implicitly and statistically assume equal item variance within construct domains. The selected methods inadvertently obfuscate how poorly the unreliable instrument fits the lived experience, confirming the need to refine and update the instrument.

For some time, research focused on the formation of beliefs and values and the actions that flow from socialization has highlighted the importance of close ties. Exposure to relationships, social structures, and one's position within them, shape perceptions of the world that are then replicated in behaviors

(Bourdieu, 1977; Veenstra & Burnett, 2014). Typical Midwest family structures and relational ties within the Midwest, and this location, specifically, likely have a large influence on mothers' perceptions of default desirable behaviors, including breastfeeding behaviors.

Study participants were primarily recruited via social media (Facebook), indicating this cohort of childbearing women is active on social media and, at least in this case, social media activity is connected to actions. Recent research has shown that women are more active in seeking out health information than men and that the internet plays a key role in this information consumption (Manierre, 2015). This idea holds true to seeking specific information tied to breastfeeding (Alianmoghaddam et al., 2019; Bridges et al., 2018; Regan & Brown, 2019; Wagg et al., 2019). As such, the content and slant of breastfeeding information presented on social media is likely a key unmeasured variable for the patterning of breastfeeding behaviors. However, the questionnaires utilized in this study failed to gather data related to the influence of social media and social networking sites on the attitudes, subjective norms/normative beliefs, perceived behavioral control, and intentions toward breastfeeding behaviors.

While the overall efforts to fit a SEM for the TPB failed, variables related to formula feeding clustered together quite well in this study. The uniformity of messaging by the formula industry may explain why those items may more clearly factor out together. Strong, uniform messaging is also a key reason why mothers may discontinue breastfeeding (Rollins et al., 2016). Although formula marketing is down in the US, it may be that there remains a long-standing impact on formula feeding attitudes. In contrast, breastfeeding messaging remains uncoordinated and unclear, even among (health care?) providers (Garner et al., 2015; Radzyminski & Callister, 2015).

Limitations

The limitations of this study include convenience sampling, a limited sample size, homogeneity of the study sample, and the use of previously developed questionnaires with a limited ability to capture the constructs under investigation. Despite these limitations and null findings, this study remains particularly valuable to nursing science, in which the development of interventions is driven by theory. Among dissertations focused on breastfeeding research during the last 10 years, approximately eight dissertations utilized the TPB as a guiding theory. This does not encompass the multitude of studies in maternal and child health currently underway, nor published manuscripts using the TPB as a guiding framework.

Conclusion

This research highlights limitations in tools developed to measure the TPB theoretical constructs of attitudes, subjective norms/normative beliefs, perceived behavioral control, and intentions related to breastfeeding behavior. Despite the fact that data in this study are composed of a relatively homogeneous sample of mothers from the same community, attempts to fit an SEM failed. The research team speculates that these deficits may be related to the use of outdated tools lacking cultural relevance,

a change in social norms, and a failure to capture the possible influence of social media and formula marketing on breastfeeding behaviors.

In addition, this study demonstrates the importance of using methods that fit the phenomena explained. The research team used SEM to fit constructs within the TPB as latent variables and model breastfeeding behaviors, which did not hold up when modeled. These issues with poor model fit may have gone unnoticed had the research team not opted to use SEM. As a result, the present null finding is a significant finding indicating the need to revisit and refine the operationalization and conceptual underpinnings of the TPB through qualitative methods such as exploring the lived experiences of breastfeeding women in the Midwest region.

Abbreviations

TPB: Theory of Planned Behavior

MAP: Minimum Average Partial

VSS: Very Simple Structure

SEM: Structural Equation Models

LV: Latent Variable

BIC: Bayesian Information Criterion

CFI: Comparative Fit Index

TLI: Tucker-Lewis Index

RMSEA: Root Mean Squared Error of Approximation

SRMR: Standardized Root Mean Squared Residual

Declarations

Ethics approval and consent to participate. This study was approved by the Hope College Human Subjects Review Board. All participants completed a written informed consent to participate in this study. All the human subjects data in the manuscript was obtained in accordance with the guidelines of Hope College Human Subjects Review Board.

Consent for publication. NOT APPLICABLE

Availability of data and materials. Participant consent was not obtained to make the data publicly available. Requests for data can be made to the corresponding author.

Competing interests. The authors have no conflicts of interest with this work.

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Authors' contributions. AEZ was responsible for substantial contributions to the conception, design, acquisition, analysis, interpretation, and drafted work. She has approved the submitted version for publication and can be held personally accountable for her own contributions.

EDG was responsible for substantial contributions to the conception, design, acquisition, and drafted work. She has approved the submitted version for publication and can be held personally accountable for her own contributions.

AF was responsible for substantial contributions to the analysis, interpretation, and drafted work. He has approved the submitted version for publication and can be held personally accountable for his own contributions.

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Figures

Figure 1: Theory of Planned Behavior and Breastfeeding Behavior Structural Model

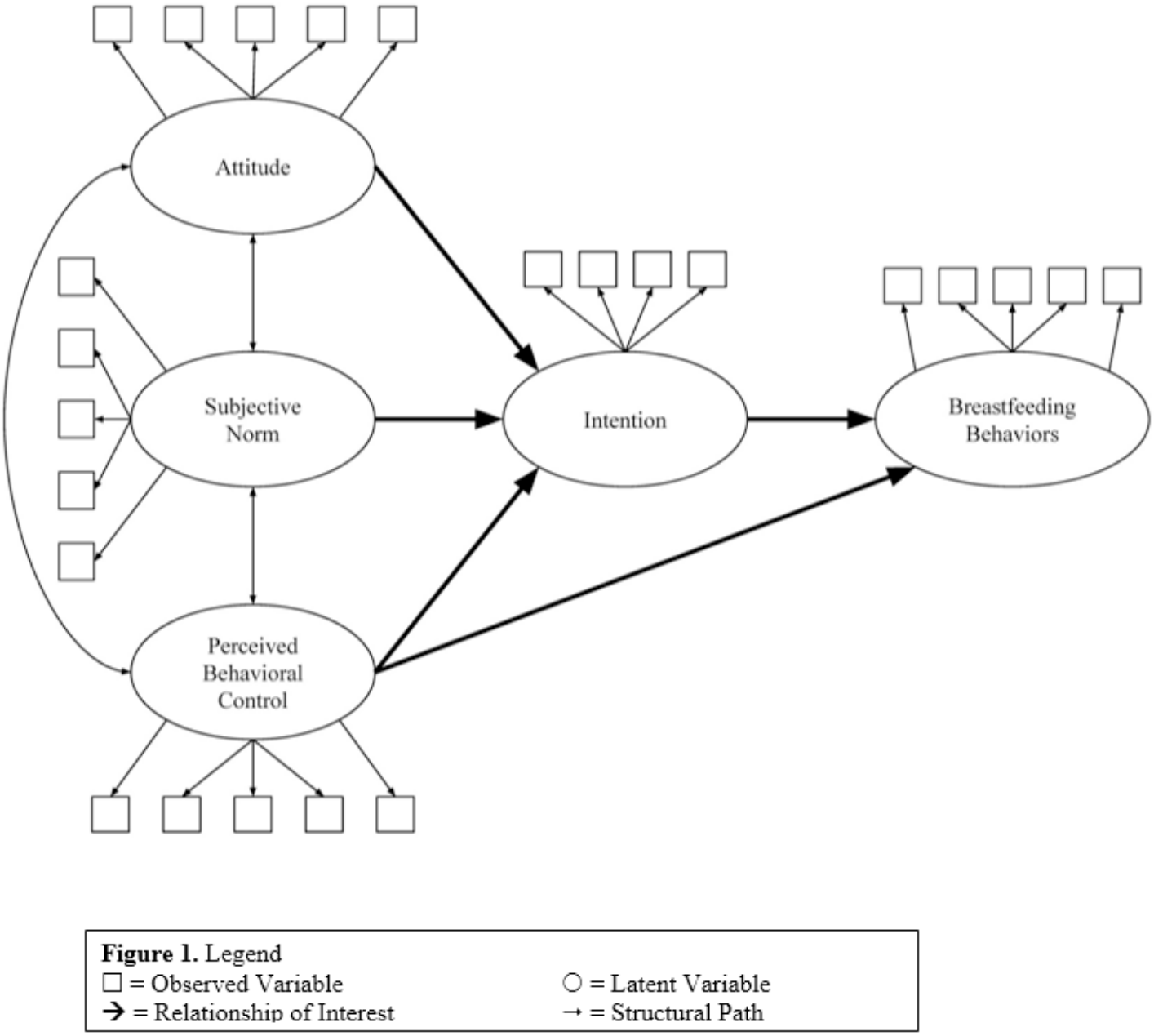

Figure 1

See image above for figure legend

Figure 2: Bi-Factor Latent Variable Example for Breastfeeding Attitudes

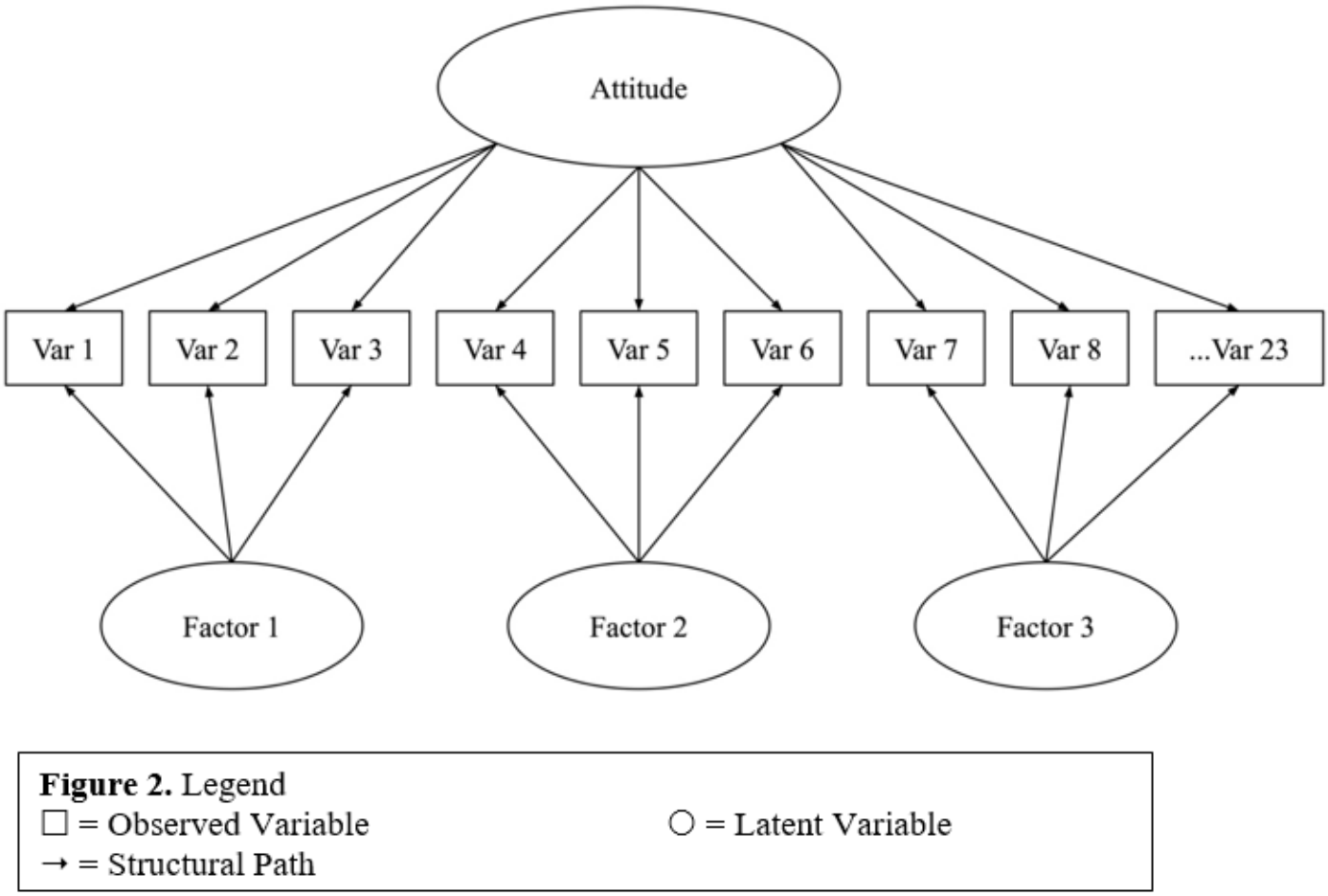

Figure 2

See image above for figure legend

Figure 3: Hierarchical Latent Variable Example for Breastfeeding Attitudes

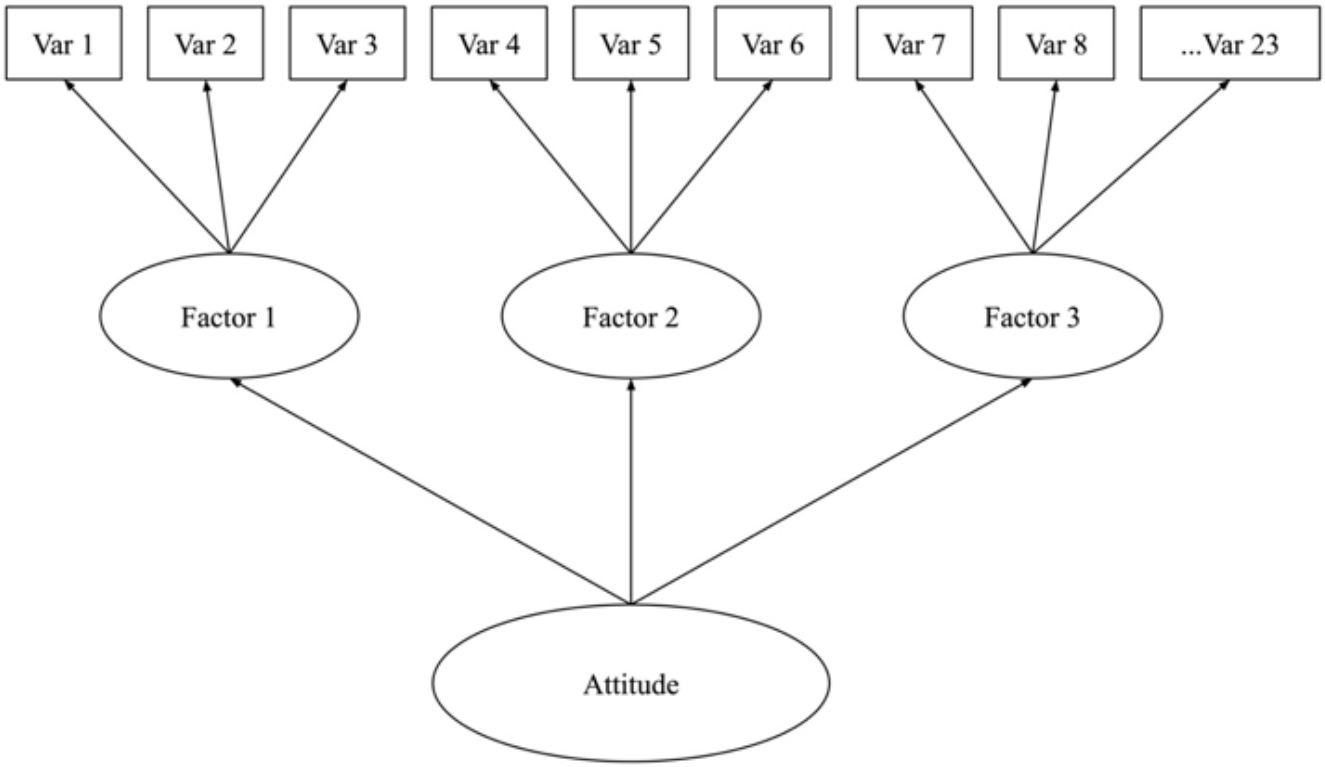

Figure 3. Legend
□ = Observed Variable ○ = Latent Variable
→ = Structural Path

Figure 3

See image above for figure legend