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Influence Diagrams for Articles

This primer discusses how to construct influence diagrams to capture the theories described in articles that you read. We focus on six types of articles, (1) a quantitative research study, (2) a qualitative research study, (3) a meta-analysis, (4) a traditional literature review, (5) a laboratory experiment, and (6) a study using path analysis. For each article type, we first describe the heuristics we use to construct an influence diagram. We then present an example of diagram construction using an open access article that can be downloaded from our website. We do not comment on the quality of the methodology, the psychometrics, nor the internal or external validity of the studies. Our focus is on the theory and deriving a summary influence diagram for it.

For all article types, it is important to have unambiguous definitions of the constructs in the influence diagram. At the top of the page that contains the diagram, we list the key variables in the theory and the abbreviations we use for them in the diagram. We include *definitional notes* for each variable if we feel there are definitional details that are important to take into consideration in the context of the diagram. The constructed diagram is not intended to be a summary of the entire study nor a critique of it. Rather, its purpose is to capture at a glance the essence of the core theory addressed in the research.

Not all research is amenable to theory summarization in the form of an influence diagram. Some research, for example, develops taxonomies with no presumed causal influences between variables. Other research is purely descriptive. Influence diagrams are relevant when causal relationships are the focus of the theory underlying the research.

When we use the binder method discussed in the main text in Chapter 7, and after the initial binder has been constructed with original first pages that have been sorted into categories, we often place an influence diagram and a one page summary/critique of the study after the original first page of the article. The original first page has a summary of the study in the form of the abstract. The diagram captures the tested theory in more detail and the one page summary/critique provides critical comments. We assign a rating on the summary/critique page ranging from -3 (very poor) to +3 (very good) to reflect our overall evaluation of the quality of the article.

An influence diagram usually draws each distinct construct in its own rectangle. Some theories specify a superordinate concept, like social support, and then theorize about dimensions or facets of it, such as emotional support, tangible support, and

informational support. If all of the facets of the superordinate concept are presumed to have the same structural relationships with other variables in the theoretical system, then as a way of reducing clutter, one can draw a single box with the superordinate construct appearing at the top and the individual facets listed underneath it. You will see examples of this below. A caution for use of such superordinate boxes is that the causal relations among the constructs within the box are not specified.

There is no correct strategy for extracting an influence diagram. We describe heuristics we have found useful, but feel free to adapt them as you see fit. We use Microsoft Visio to draw our diagrams. We create template Visio files that we work from. To construct a diagram, we open in Visio the template we think will be most easy to edit to create our figure and use that file accordingly, ultimately pasting a copy of it into our Word document. We typically do not include disturbance terms in our diagrams, unless we think it is important for the underlying theory. We provide copies of our templates and a brief tutorial on using Visio on our webpage.

QUANTITATIVE RESEARCH STUDIES

Heuristics for Diagram Construction

For quantitative research studies, we draw an influence diagram to represent the theory that was tested, not the broader theories discussed in the Introduction. The steps we use for generating the influence diagram are as follows:

1. Read the article in its entirety to obtain an overview of it. Some articles report multiple studies. Often, the first set of studies is preliminary research that culminates in the final reported study, which is positioned by the author as the primary theory test. In such cases, we focus our diagram only on the final study. If the initial studies contribute information that is noteworthy in its own right, we draw a diagram for each study.

2. Make a list of the variables measured as described in the Method section. These are the key variables in the theory. Introduction sections often describe these variables but do so in a broader context, developing conceptual logic models for them (see Chapter 4 in the main text). The Introduction may reference variables other than those measured. The measured variables are the key variables for which empirical tests are to be performed so they almost always will be the variables in the influence diagram you draw.

3. For each variable listed, make any relevant definitional notes. For example, if you think the conceptual definition provided by the author is too grandiose relative to the measure of it, then you might make a note of this and state what you think better reflects

the more circumscribed construct that the measure is tapping into.

4. Sometimes, authors will measure a construct but not analyze it. Sometimes they will analyze a variable that was never mentioned in the Introduction or Method sections. Scan through the Results section and if any variables should be added or dropped from the list of key variables based on its inclusion or omission from the data analysis, do so.

5. Sometimes, a measured variable is not part of the theoretical narrative but is considered a nuisance variable that is necessary to control statistically, i.e., it is a covariate.[1] If the author explicitly identifies such variables and they are in your key variable list, remove them. If the author does not label a variable as a control variable but is treating it as a nuisance variable, then delete it from the list of key variables.

6. At the top of the page before the diagram and after the list of key variables, make a list of the covariate/control variables. Make any notes for them that you deem appropriate (e.g. if they are taken into account for some endogenous variables but not others).

7. Using the list of key variables, we first identify variables that are outcomes and place those on the right side of the diagram. We place their determinants on the left side of the diagram. We place mediators, if any, between them and add moderators where relevant.

The Omidvar et al. Article

This article focused on healthy/unhealthy life styles of pregnant women. The outcome was measured by a well-known standardized instrument known as the HPLP II, which measures six domains of healthy behaviors, namely nutrition, physical activity, health responsibility, stress management, interpersonal relationships, and self-actualization. For multi-faceted scales like the HPLP II, researchers sometimes calculate a total score across all of the facets and analyze it. Other researchers treat each facet as a separate construct and analyze the facet scores separately. Omidvar et al. chose the latter approach. The authors sought to link each of these six behaviors to five psychosocial variables, namely, anxiety, stress, depression, marital dissatisfaction, and social support. Thus, there are six outcomes and five conceptual determinants of each.

Some of the predictors also were measured by multi-faceted scales. Omidvar et al. used the total score strategy when this was the case. Because we are interested in diagramming the theory they tested, our influence diagram reflects this, even though we

[1] Some articles refer to any predictor in a regression equation as a covariate. We use the term here to refer to nuisance variables that are not part of the theoretical narrative but that need to be controlled for methodological reasons.

likely would have approached the analyses differently. As a general rule, one needs to be cautious about using total scores across facets because doing so can lead to aggregation bias; only a few of the separate facets may be relevant or predictive but the aggregation process obscures this.

For the Omidvar et al. study, we were familiar with all of the constructs and scales used, so our definitional notes are at a minimum. We make note that the authors used the HPLP II and other standard scales when making our list of key variables but we do not elaborate beyond that because, as noted, we are familiar with the psychometric histories of all of the scales. This particular study was conducted in Iran and with Iranian women, but the psychometrics of most of the scales and their meanings were evolved with U.S. populations. Potential difficulties because of this are more methodological in character and the point should be recorded in one's broader summary/critique of the article, but we do not consider such matters here because our focus is on drawing the influence diagram.

If we were unfamiliar with the healthy lifestyles constructs, we would want to provide conceptual definitions of them. The authors provide an explicit conceptual definition of a healthy lifestyle but they do not elaborate conceptual definitions of the six outcome facets. A bit of searching on the internet yielded the following conceptual definitions from the HPLP II scale developers (provided verbatim here):

Nutrition involves knowledgeable selection and consumption of foods essential for sustenance, health, and well-being. It includes choosing a healthful daily diet consistent with guidelines provided by the Food Guide Pyramid.

Physical activity involves regular participation in light, moderate, and/or vigorous activity. It may occur within a planned and monitored program for the sake of fitness and health or incidentally as a part of daily life or leisure activities.

Health responsibility involves an active sense of accountability for one's own well-being. It includes paying attention to one's own health, educating oneself about health, and exercising informed consumerism when seeking professional assistance.

Stress management entails the identification and mobilization of psychological and physical resources to effectively control or reduce tension.

Interpersonal relations entails utilizing communication to achieve a sense of intimacy and closeness within meaningful, rather than more casual, relationships with others.

Self-actualization focuses on the development of inner resources and is achieved through transcending, connecting, and developing. Transcending puts us in touch with our most

balanced selves; it provides us with inner peace and opens us to possibilities of creating new options for becoming something more by going beyond who and what we are. Connecting is the feeling of harmony, wholeness, and connection with the universe. Developing involves maximizing human potential for wellness through searching for meaning, finding a sense of purpose, and working toward goals in life.

Some of these definitions are a bit fuzzy, but one gains a sense of their general meaning. Examination of the scale items themselves might provide a better sense of the constructs.

Table 1 in the article provided descriptive statistics. Table 2 in the article provided a preliminary analysis to determine if gestational age (early, mid, late in pregnancy) is associated with any of the study variables (in general, it was not). Table 3 in the article presents additional descriptive statistics, namely the correlations between the primary study variables. The analyses that represented the primary theoretical focus of the article were in Table 4, so we direct our attention to it. (Not becoming distracted by ancillary analyses is important for the construction of influence diagrams).

The authors report analyses in Table 4 both with and without covariates but do not explain why. The analyses with the covariates are more protective against what is known as *omitted variable bias* or *left out variable error*. For example, age (a covariate) might be a cause of anxiety (a predictor) such that older people tend to be more anxious. Age also might be a cause of physical activity (an outcome) such that older people are less likely to be physically active. The common cause of age on these two variables will inflate the negative correlation between them over and above any causal effect that anxiety has on physical activity (see the text in Chapter 7 on spurious effects). This will lead to an inflated estimate of the causal impact of anxiety on physical activity if age is ignored in the data analysis. Thus, it is best to include it as a covariate. We make this methodological point to provide background for why our focus was on the modeling that included the covariates. Note that we do not include the covariates in our influence diagrams because they were not part of the theoretical narrative. Rather, they were nuisance variables that needed to be controlled to remove bias from the analysis.

The analyses were a series of six multiple regressions, one for each healthy lifestyle as predicted from the five predictors. As noted in the appendix to Chapter 16, a traditional multiple regression analysis ignores causal relations among the predictors (i.e., it implicitly assumes they do not exist), assumes all the relationships between variables are linear, assumes there are no moderated relationships, and assumes there is no reciprocal causality. Basically, it assumes each predictor has a direct effect on the outcome, nothing more. Figure 1 presents the influence diagram we would create. Note

Figure 1

Key Variables

1. Healthy life style: Nutrition (Nutrition), Physical activity (Phys Activity), Health responsibility (Responsible), Stress management (Stress Manage), Interpersonal relationships (Interpersonal), and Self-actualization (Self-Actualization) – all taken from the HPLP II.

2. Pregnancy-specific stress (Preg Stress) – taken from the PDQ

3. Social support (SSupport) – all taken from SSQ

4. Anxiety: state (S-Anx), trait (T-Anx) – from the STAI

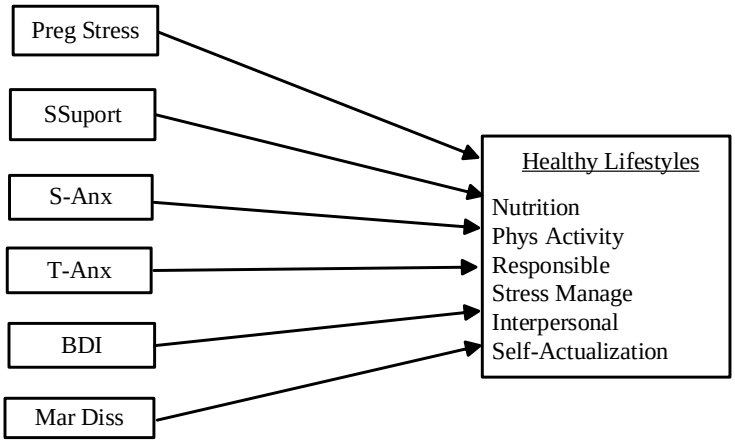
5. Depression: BDI

6. Marital dissatisfaction (Mar Diss) – from the MSS

Covariates

Age, education, gestational age

Main Theory



All relationships are assumed to be linear

also that no causal relationships are assumed to exist among the various outcomes because each outcome was treated in a separate analysis. This seems theoretically dubious. For example, physical activity (one outcome) is a way of managing stress

(another outcome) for some people, hence there may be a causal link between these two outcomes. In our opinion, the underlying tested theory is somewhat underdeveloped given all of the above and we would note this in our summary/critique.

It is possible to summarize the results of the significance tests for the various paths in the figure, but we do not do so here. We usually include such summaries in our one page written summary/critique that complements the abstract (via the binder method discussed in the main text).

There is another feature of the theory in Figure 1 worth mentioning. Technically, the theory is questioned if any of the tests of the path coefficients in the model fail to support the existence of the paths posited. Such non-significance did, in fact, occur in the Omidvar et al. study. Faced with such an outcome, many theorists will revise the theory to include only those paths that were empirically supported and this was the tact taken by the authors. In the final analysis, however, Figure 1 captures the theory that was tested in this study.

QUALITATIVE RESEARCH STUDIES

Heuristics for Diagram Construction

For qualitative research studies, we draw an influence diagram to represent the theory that emerges from the data. The steps for generating the influence diagram are as follows:

1. Read the article in its entirety to obtain an overview.

2. Make a list of the key variables that are to be included in the theory and write relevant definitional notes for each one.

3. Qualitative studies rarely make use of covariates, and if they do, it usually is done so as part of the sampling strategy (e.g., gender is held constant by only studying females). To the extent covariates are relevant, make note of this.

4. In general, we first identify variables that are outcomes and place those on the right side of the diagram. We place their determinants on the left side of the diagram. We place mediators, if any, between them and add moderators, as appropriate.

Depending on the article, we sometimes find that an influence diagram cannot capture the richness of the qualitative data, so the summary/critique page takes on that much more importance. We try to emphasize in the diagram the core conclusions authors point to.

The Visram et al. Article

This article focuses on younger and older adolescent perceptions of energy drinks. It sought to understand factors that impact adolescent use of such drinks. We found the study both useful and frustrating from the perspective of causal theorizing. The study generated a list of variables that were thought to impact energy drink use and organized those variables into a taxonomy [the four Ps of marketing (product, price, place, promotion), plus more]. This was useful. However, like the Omidvar et al. article, the study was lax about specifying presumed causal relations among many of the variables.

In causal thinking, one seeks to be explicit about distal causes, mediators, moderators, direct causes, and reciprocal causality that operate in the theoretical system. We felt the authors did not address such matters in the level of detail that good causal theorizing demands. The eminent scientist, Judea Pearl, has long argued for the use of influence diagrams to specify causal models because such diagrams force theorists to make *all* of their causal assumptions explicit. Effective theorizing involves more than just listing variables. To be fair, the authors do state or imply a few causal relationships among predictors in their narrative and we capture these specifications in the influence diagram below. As well, one can argue that a first step in theory building is generating a list of relevant variables and the article certainly makes a contribution in this way. However, we encourage you to always try to move beyond variable listing in your theorizing so as to formulate stronger theories.

Table 1 in the article provides the key list of variables and concepts that emerged as organized around the four Ps of marketing. We were already familiar with the marketing framework but had we not been, we would have elaborated it on our separate summary/critique page. Figure 2 presents the influence diagram we derived. As with the Omidvar et al. study, there are omitted arrows in this diagram that we believe should be present. However, Figure 2 captures the essence of the theory offered by the researchers.

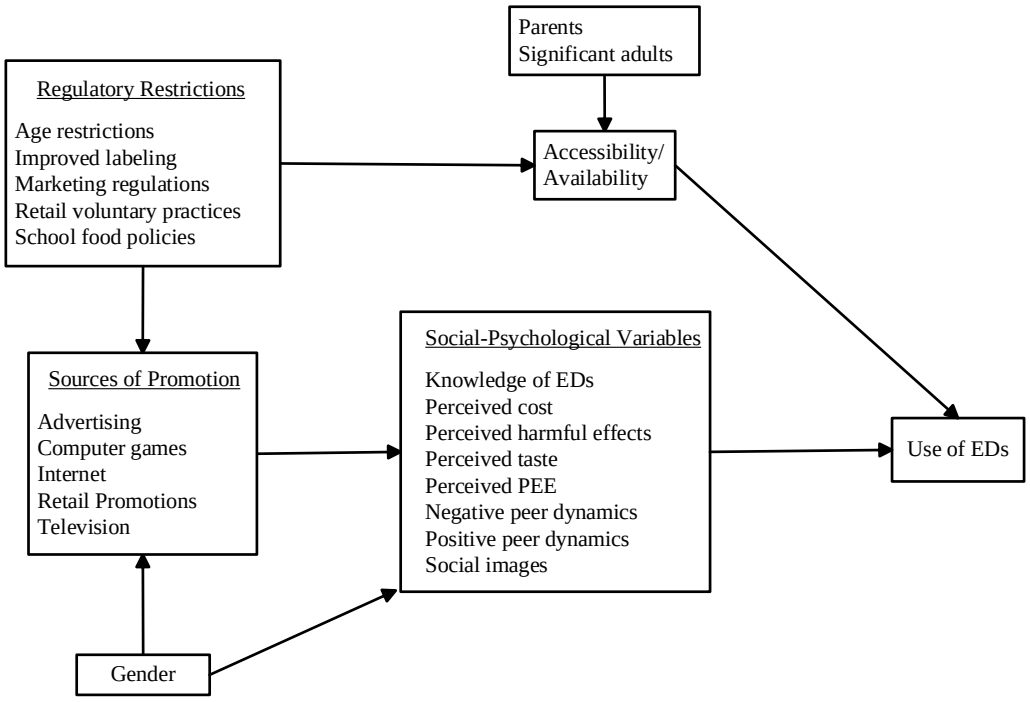
Technically, this theory “emerged” from the data and now requires empirical validation. Some qualitative theorists would argue that the theory already has an empirical basis because all of the constructs were mentioned by study participants or they directly followed from what the participants talked about. While there is some merit to such assertions, we also do not doubt there will be exceptions to many of the paths posited in Figure 2 as a function of specific instantiations of the constructs, the populations studied, and/or the contexts studied. In this sense, the theory requires more empirical work and elaboration for it to gain status as a strong theory.

Figure 2

Key Variables

Most variables are described in general terms and not given specific definitions by authors. PEE = performance enhancing effects; ED = energy drinks

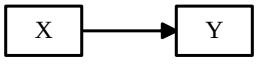
Main Theory



META-ANALYSES

Heuristics for Diagram Construction

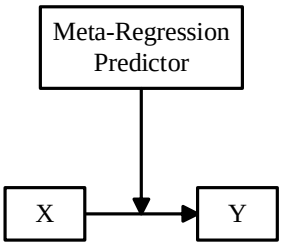
Meta-analyses often analyze bivariate effect size indices across studies. The effect size indices typically represent a simple direct effect of the form



That is, the effect size index is a standardized path coefficient linking variables X and Y.

Meta-analyses often calculate the average effect size that was observed across studies. If a meta-analysis does nothing more than report the average effect size, then the above diagram captures the form of the theory addressed. A criticism of meta-analysis is that it focuses on theories that are too simplistic – that we as a discipline have moved beyond the evaluation of simple bivariate, direct effects like the above.

Many meta-analyses perform meta-regressions. These are multiple regression analyses that use the effect size indices across studies as the outcome and study characteristics as predictors. Meta-regressions enrich the theory being tested and usually focus on moderated relationships that have the following form:



For example, a meta-regression might predict study variations in the estimated effect of X on Y as a function of the proportion of females in each study in the meta-analysis. In this case, the moderator variable is gender and it is thought to impact the effect of X on Y, per the diagram above.

Meta-regressions, like traditional multiple regression, assume there are no causal relationships among the predictors, that all relationships are linear, and they ignore mediation. There is a branch of meta-analysis, called *SEM meta-analysis*, that uses structural equation modeling in conjunction with meta-analyses to rectify these shortcomings (see Cheung, 2015). However, use of these methods can be challenging.

In theory, meta-analyses are not restricted to the analysis of effect sizes. They also can be used to analyze means and proportions across studies and, as such, can evaluate the full range of causal types described in Chapter 7 in the main text. Despite this, most meta-analyses you will encounter focus on average direct effects and moderated effects in the form of meta-regression.

Many meta-analyses conduct subgroup analyses as a function of the methodological quality of the study to determine if method quality affects the conclusions. We typically do not include these types of analyses in our influence diagram because they are motivated by methodology rather than the theory being tested. This is not to say they are unimportant. They just are not relevant to our discussion here.

The steps we use for generating the influence diagram are as follows:

1. Read the article in its entirety to obtain an overview of it.

2. Make a list of the variables measured as described in the Method section. These are the key variables in the theory.

3. For each variable listed, make any relevant definitional notes.

4. As with quantitative research studies, sometimes, authors will measure a construct but not analyze it. Sometimes they will analyze a variable that was never mentioned in the Introduction or Method sections. Scan through the Results section and if any variables should be added or dropped from the list of key variables based on its inclusion or omission from the data analysis, do so.

5. Sometimes, a measured variable is not part of the theoretical narrative but is considered a nuisance variable that is necessary to control statistically, i.e., it is a covariate. If the author explicitly identifies such variables and they are in your key variable list, remove them. If the author does not label a variable as a covariate but is treating it as a nuisance variable in the analyses, delete it from the list of key variables.

6. At the top of the page before the diagram and after the list of key variables and their abbreviations, make a list of the covariates. Make any notes for them that you deem appropriate.

7. Using the list of key variables, we first identify variables that are outcomes and place those on the right side of the diagram. We place their determinants on the left side of the diagram. We place mediators, if any, between them and add moderators, as appropriate.

The Moon et al. Article

This article focuses on what is called the *widowhood effect*. This effect refers to the rise in mortality risk among men or women who are experiencing bereavement from the recent death of their spouse. The meta-analysis focused on prospective studies only. Contrasts were made between those who experienced a spousal death as compared to a matched “control” sample of people who had not experienced a spousal death. The outcome was the occurrence of the person’s own death within a specified time period. The widowhood effect predicts that more people will die within a relatively short time period if they are experiencing bereavement than if they are not. The relationship between these variables was documented using a relative risk (RR) index that is the proportion of people who subsequently died within the target time period for those who had experienced a spousal death divided by the corresponding proportion for those who

had not experienced a spousal death. If the probabilities are equal, then the relative risk equals 1.0 because the two probabilities are the same. A relative risk of 1.15 means it was 15% more likely that those who experienced a spousal death died within the specified time period than those who had not experienced a spousal death. A RR of 0.90 means the proportion of people who subsequently died within the time period among those who experienced a spousal death was 90% that of those who had not experienced a spousal death, i.e., that the proportion was smaller than those who did not experience spousal bereavement. Figure 3 presents the influence diagram we generated.

Figure 3

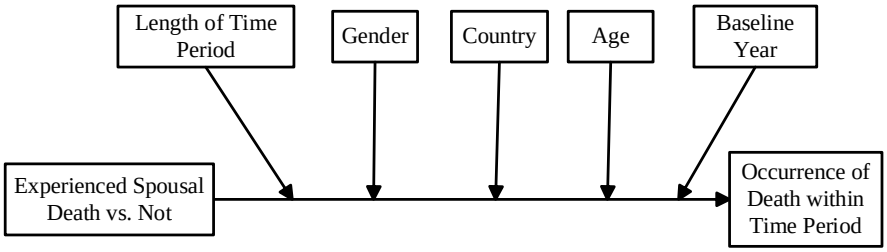
Key Variables

Mortality (target person died or not within a specified time period); spousal death experience (experienced a spousal death versus did not experience a spousal death); length of time period (time since spousal death is < 6 months vs. ≥ 6 months); country (USA vs. Europe); age of target person (< 65 vs. ≥ 65; baseline year (to examine cohort effects - birth years ranged from 1860 to 1993).

Covariates

Covariates varied by study. They included financial strain, ethnicity, US-born, health behaviors (smoking, drinking), FEV1 (maximal amount of air you can forcefully exhale in one second), cholesterol, body mass index (BMI), co-morbidities (diabetes, angina, ischemia, previous myocardial infarction (MI), other cardiovascular diseases, respiratory diseases and other chronic diseases), social class, education, occupation, deprivation categories, relative ages of each spouse, and the number of children. Most were not defined by the authors.

Main Theory



All relationships for quantitative variables are assumed to be linear

Technically, this theory was not consistent with the data reported by Moon et al.

because not every path in the theory was empirically supported; several of the path/regression coefficients in the meta-regressions were statistically significant but several were not statistically non-significant. Again, faced with such results, many theorists will revise the theory to include only those paths that were empirically supported, leaving open the possibility that the "negative" results reflect methodological shortcomings, boundary conditions, or fragile effects as discussed in Chapter 15. We do not detail the results here because our focus in only on drawing the influence diagram for the theory that was tested. The summary/critique page would summarize the results.

TRADITIONAL LITERATURE REVIEWS

Heuristics for Diagram Construction

Many literature reviews do not use meta-analysis but instead focus on documenting our current state of knowledge in a given substantive domain and describing needed future research, all while imposing a conceptual framework onto the literature. Of primary interest is identifying what that conceptual framework is.

The steps we use to generate an influence diagram for these types of articles are:

1. Read the article in its entirety to obtain an overview of it.

2. Make a list of the variables emphasized in the review the theory.

3. For each variable listed, make any relevant definitional notes, as described earlier.

4. Using the list of variables, we first identify variables that are outcomes and place those on the right side of the diagram. We place their determinants on the left side of the diagram. We place mediators, if any, between them and add moderators, as appropriate.

The Grimmond et al. Article

The Grimmond et al. article focused on experiences and perceptions of suicide by youth. It is unique because it limited itself to qualitative research that has been conducted on the topic. It seems odd to us that one would purposely ignore all quantitative studies on suicide in youth when trying to build a comprehensive theory of youth suicide, but there are social scientists who advocate for such orientations. We do not discuss this issue further so as not to get sidetracked.

The Grimmond et al. article presents four frameworks for the analysis of suicide (see their Table 6). One framework focused on factors impacting suicidality. The second framework addressed factors impacting recovery from a suicide attempt. The third

framework addressed two contexts within which programs on suicide are offered, schools and treatment settings. School settings were discussed primarily in terms of prevention whereas treatment settings were discussed primarily in terms of suicide recovery. The fourth framework described community wide norms and beliefs, presumably on the assumption that these more broad based factors impact the suicide related outcomes articulated in the first two frameworks.

We personally think it would have been better to develop two theories, one focused on suicide behavior and the other on suicide recovery. The community and school variables would be represented within these theories as distal, macro-level constructs that impact suicide behavior/recovery, probably through some of the more specific determinants described in the first two frameworks. The treatment variables would be integrated into the suicide recovery theory.

Figure 4 presents our influence diagrams, one for each of the four theories. The authors provide few conceptual definitions, so we do not elaborate them. This is unfortunate because, for example, it is not clear why "mood swings" are placed in the superordinate category of "behaviors" and not in the category of "feelings and emotions." Nor is it clear why a clearly psychological construct like "lack of future orientation" is called a "behavior" or why "academic challenges" is considered a peer relationship. A more extended discussion of definitions would have clarified these ambiguities.

Notably, Grimmond et al., offer several mini-theories that specify mediation (mechanisms) within some of the superordinate categories. We do not elaborate them here for the sake of brevity. Grimmond et al. also contrast their framework with extant theories of youth suicide, which is laudable because it provides insights into what is new in their framework. Most of their comments in these comparisons emphasize convergence rather divergence between their theory and extant theories. Novelty derives from divergence, so it would have been helpful for that to receive greater attention.

There are many details in the Grimmond et al. theory that strong causal theories require and that are lacking. For example, at least some consideration of the causal relationships among the long list of specified determinants across the theories in Figure 4 would have been helpful, as well as greater consideration of moderated effects between the variables and possible boundary conditions. Reverse causal dynamics almost certainly operate between some of the variables. As we stated before, it is helpful to know the key constructs relevant to the outcomes one is trying to understand, but strong theories move beyond the mere presentation of variable lists. We also found it odd that many of the variables thought to trigger suicide behavior were not mentioned as being relevant to suicide recovery. One would think there would be overlap. For example, if alcohol and drug use trigger suicide behavior, would not addressing them be relevant to recovery?

Figure 4

(a) Triggers of Suicidal Behavior

Key Variables

Few conceptual definitions were given. Labels map onto those used by authors.

Main Theory

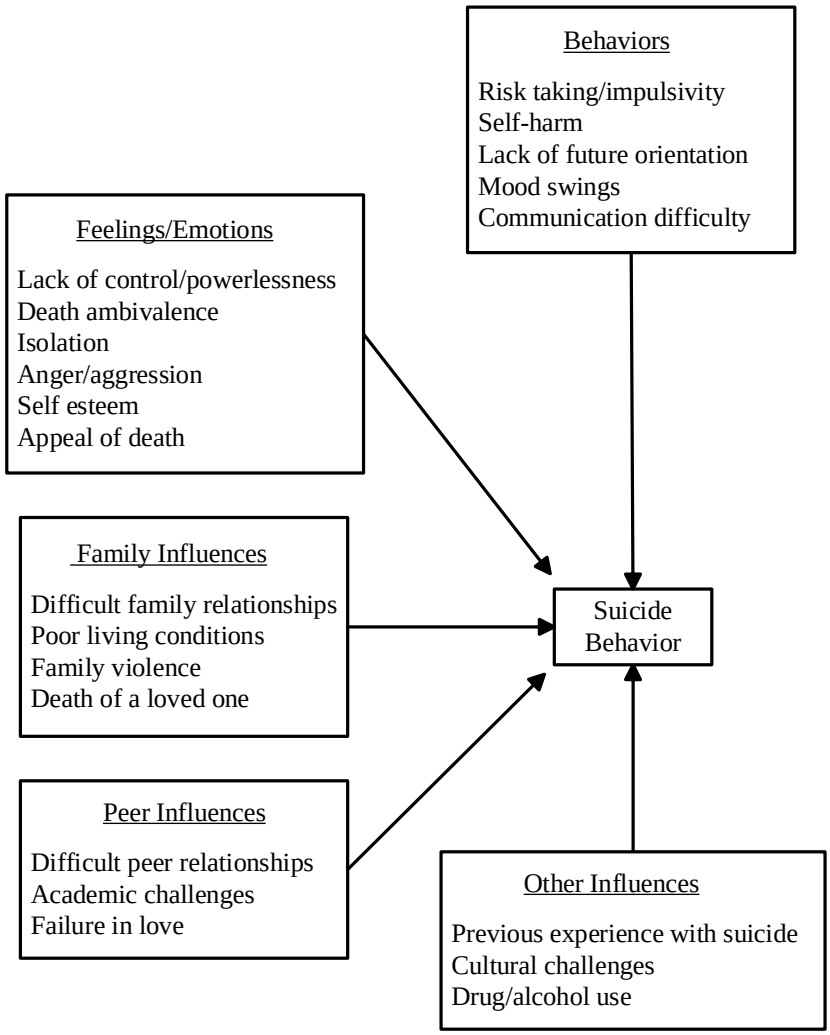


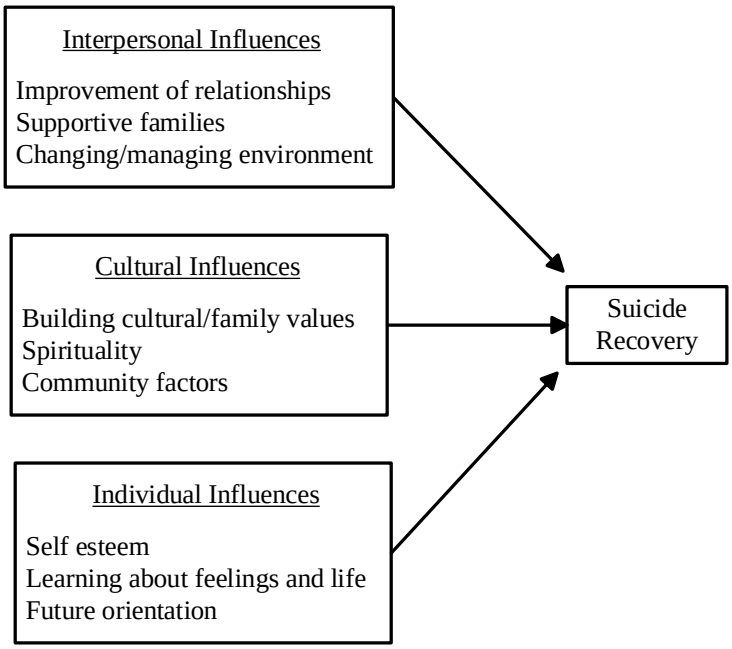
Figure 4 (cont.)

(b) Suicide Recovery

Key Variables

Few conceptual definitions were given. Labels map onto those used by authors.

Main Theory



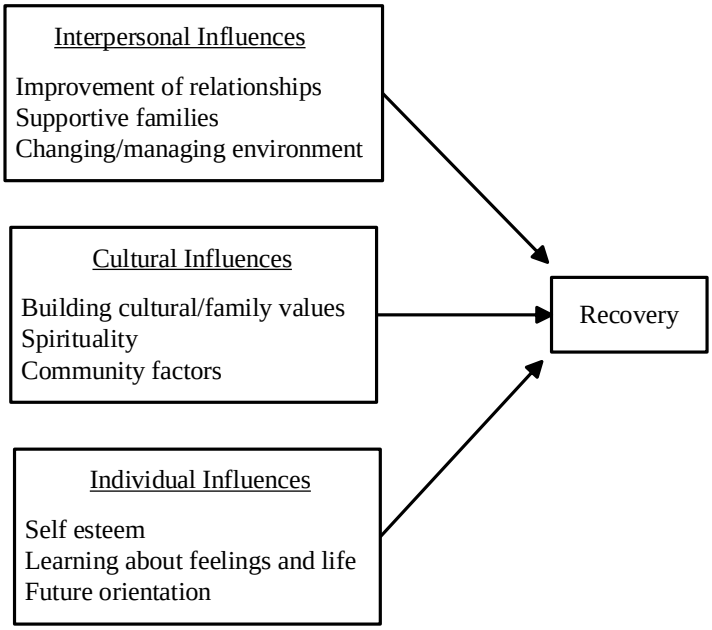
c) Treatment and Prevention Programs

Key Variables

Few conceptual definitions were given. Labels map roughly onto those used by authors.

Main Theory

Figure 4 (cont.)



c) Treatment and Prevention Programs

Key Variables

Few conceptual definitions were given. Labels map roughly onto those used by authors. Variables were stated in article in terms of positive practice but are rephrased here to represent variables with different levels (e.g., suicide education is the extent to which schools vary in suicide education efforts; suicide support/education for parents is the extent to which schools vary in such support; whole person orientation is the extent to which treatments use a whole person orientation). Conceptual distinctions are, at times, ambiguous, such as clarifying potential overlap between whole person and holistic approaches to treatment.

Main Theory

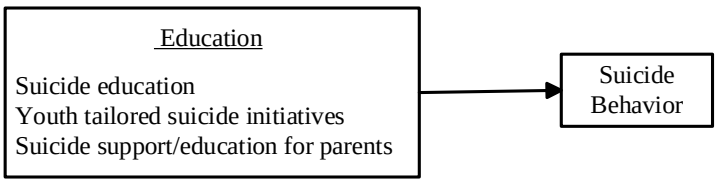
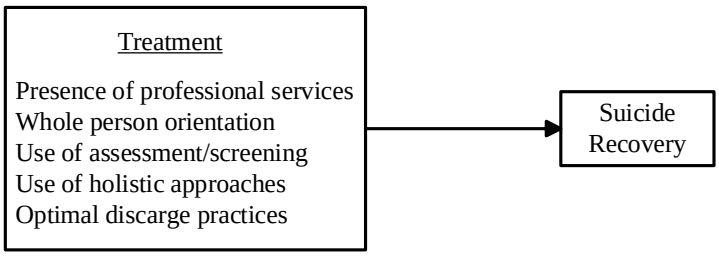


Figure 4 (cont.)

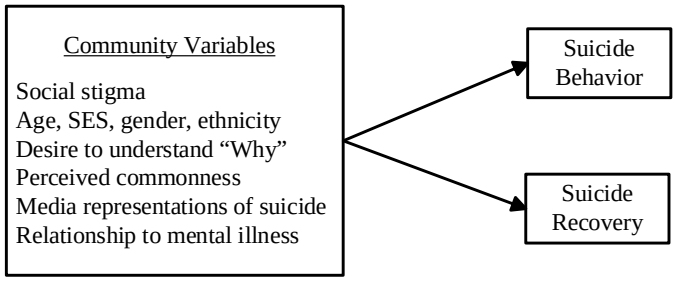


d) Suicide in the Wider Community

Key Variables

Measured/conceptualized at the community level. Authors do not provide conceptual definitions. Labels are similar to those used by authors. Few conceptual definitions were given. Labels map roughly onto those used by authors.

Main Theory



LABORATORY EXPERIMENTS

Heuristics for Diagram Construction

The steps we use for drawing influence diagrams for laboratory studies are the same steps we use for quantitative research if the laboratory study is quantitatively oriented. If the study is qualitatively oriented, we use the same steps outlined above for qualitative research. The primary difference with laboratory research relative to non-laboratory research is methodological – in laboratory research, the values for a given presumed cause in the theoretical system are not directly measured but rather they are created by

the experimenter through a set of manipulations. One still works with variables and their presumed causal relationships; it is just that the values of a variable are created rather than observed. We do not repeat the diagramming steps here because they have been spelled out in prior sections.

The Anderson and Barrett Article

The Anderson and Barrett article focused on how attributions of food sources impact food perceptions and eating behavior for meat products. In study 1, Anderson and Barrett served students comparable samples of beef jerky to taste but some of the samples were labeled as being sourced from a "humane farm" and other samples sourced from a "factory farm," with brief descriptions of the farming practices for each type. This manipulation was designed to induce varying degrees of attributions that the animals had suffered. After the information was provided, participants rated the samples in terms of their appearance (unappealing to appealing), smell (unappealing to appealing), taste (not very good to very good), how enjoyable they were (not enjoyable to enjoyed very much), how much they would be willing to pay for them (from $0 to $20), how likely they would be to eat the sample again (would never eat it again to would definitely eat it again) and how much of the sample the participant actually consumed when tasting the samples. Study 2 replicated Study 1 but instead of beef jerky, roast beef was used as the target product and a control condition was added in which a neutral label was provided for some of the samples. As well, a "factory farm+" condition was added that conveyed that the animals were treated well even though the farm itself was a factory farm. The outcome was a single rating of how much the participant liked the samples they tasted. Study 3 replicated Study 1 but (a) focused on ham, (b) added a control condition with no label and (c) obtained ratings on sensory perceptions, namely the extent to which samples were perceived as savory, salty, sweet, bitter, sour, fresh, and greasy.

Figure 5 presents the influence diagram. Note that we took some liberties by not detailing every possible attribution combination for every possible outcome. We instead tried to capture the essence of the overall theoretical framework across studies. An alternative approach would be to draw a separate influence diagram for each study.

PATH ANALYSIS EXAMPLE

Heuristics for Diagram Construction

For studies that use SEM or path analysis, the task of drawing an influence diagram is often simplified because most such articles include an influence diagram. Here are the

Figure 5

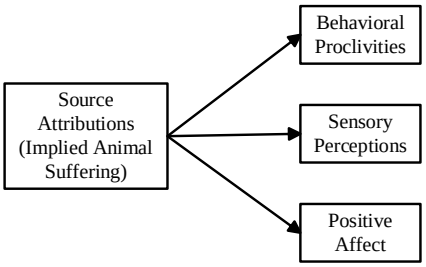
Key Variables

Across the three studies, manipulated attributions of source of meat (humane farm vs. factory farm vs. factory farm that treats animals well vs. control) – abbreviated as "source attribution." Outcomes included behavioral proclivities toward the product (likelihood of eating again, amount willing to pay, amount consumed), sensory perceptions for the product (savory, salty, sweet, bitter, sour, fresh, greasy, smell), and positive affect for the product (likeability, enjoyableness, quality of overall taste).

Covariates

There were no covariates.

Main Theory



(Note: Not all source conditions were tested for all outcome dimensions. Different forms of control groups were used)

steps we use to draw our influence diagram (without repetition of the rationale of the steps, which has been provided earlier):

1. Read the article in its entirety to obtain an overview of it.

2. Make a list of the variables measured as described in the Method section. These are likely the key variables in the theory.

3. For each variable listed, make any relevant definitional notes.

4. Sometimes, authors will measure a construct but not analyze it. Sometimes they will analyze a variable that was never mentioned. Scan through the Results section and if any variables should be added or dropped from the list of key variables, do so.

5. Sometimes, a measured variable is not part of the theoretical narrative but is a covariate, i.e., a nuisance variable. If the author explicitly identifies such variables and they are in your key variable list, remove them. If the author does not label a variable as a covariate but is clearly treating it as such, then delete it from the list of key variables.

6. At the top of the page before the diagram and after the list of key variables, make a list of the covariates. Make any notes for them that you deem appropriate (e.g. if they are taken into account for some endogenous variables but not others).

7. If possible, use the influence diagram provided by the author. If this is not possible, then using the list of key variables, identify variables that are outcomes and place those on the right side of the diagram. Place their determinants on the left side of the diagram. Place mediators, if any, between them and add moderators where relevant.

The Duarte et al. Article

The Duarte et al. article studied self-evaluative processes (shame, self-criticism, social comparison), weight-related affect, and depressive/anxiety symptoms as determinants of the control of eating behavior reflected by disinhibition and susceptibility to hunger. The study focused on women attending a weight control program. Duarte et al. present an influence diagram for their theory in their Figure 2, but the theory they tested was more complex than this because of additional regression analyses they performed. First, their diagram omits causal paths that they tested but that they found to be statistically non-significant. Duarte et al. engaged in a (somewhat controversial) process known as theory trimming, namely eliminating statistically non-significant paths and re-estimating the model without those paths. Because the omitted paths were, in fact, empirically tested, we want our influence diagram to reflect the fully tested model. We added the omitted paths. Our description of results on our accompanying summary/critique page would indicate the significant paths. Second, Duarte et al. posit causal effects of the weight-related variables on depression but chose to analyze these in separate regression analyses. This is not apparent in their Figure 2. We added them, accordingly. Third, because many of the exogenous variables had the same presumed structural relationships with mediators and outcomes, we grouped them into a single box to reduce clutter. Fourth, Duarte et al. included correlated disturbance terms for two mediators. The correlation was not of theoretical interest, so we excluded it. Finally, Duarte et al. included correlations between the exogenous variables in their diagram. We omitted them to reduce clutter and because they are implied in traditional influence diagrams. Figure 6 presents our diagram. Its derivation required careful reading of the analyses Duarte et al. performed.

Figure 6

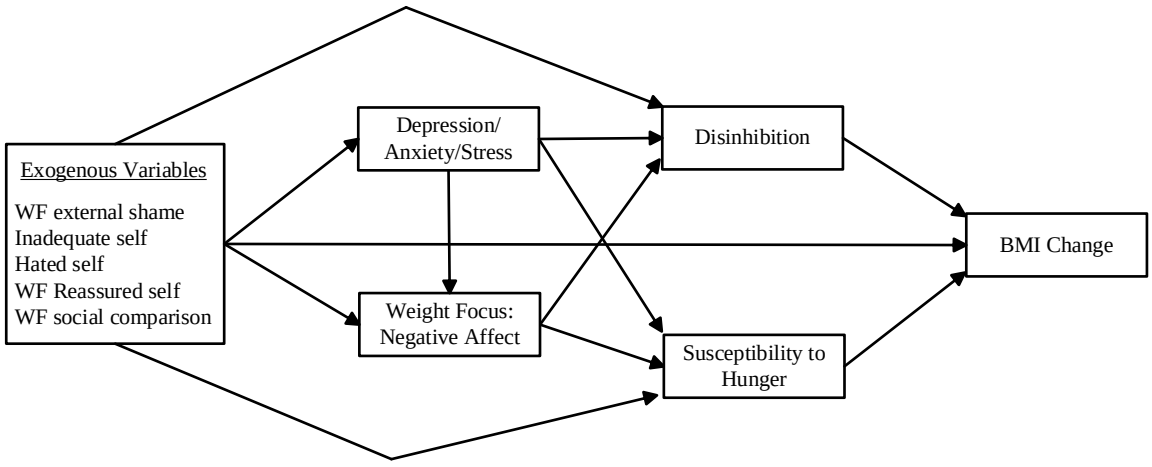
Key Variables

Several variables were measured but not included in the analyses, without explanation. WF (weight focused) negative affect = negative feelings based on weight (no other detail); WF external shame = how others judge them based on their weight, body shape, and eating; inadequate self = sense of feeling internally put-down and inadequate; hated self = a sense of self-dislike and desire to hurt oneself; WF reassured self = ability to be encouraging and concerned for self when things go wrong; WF social comparison = how a person compares herself with others in terms of general competencies and attractiveness and how well the person thinks he/she 'fits in'; depression/anxiety/stress (not s standard scale); TEFQ disinhibition = frequency of loss of control over eating; TEFQ susceptibility to hunger = subjective perceptions of hunger and food cravings; BMI change = change in body mass index since program enrollment. Reference connections of most of the above to standardized scales.

Covariates

No covariates

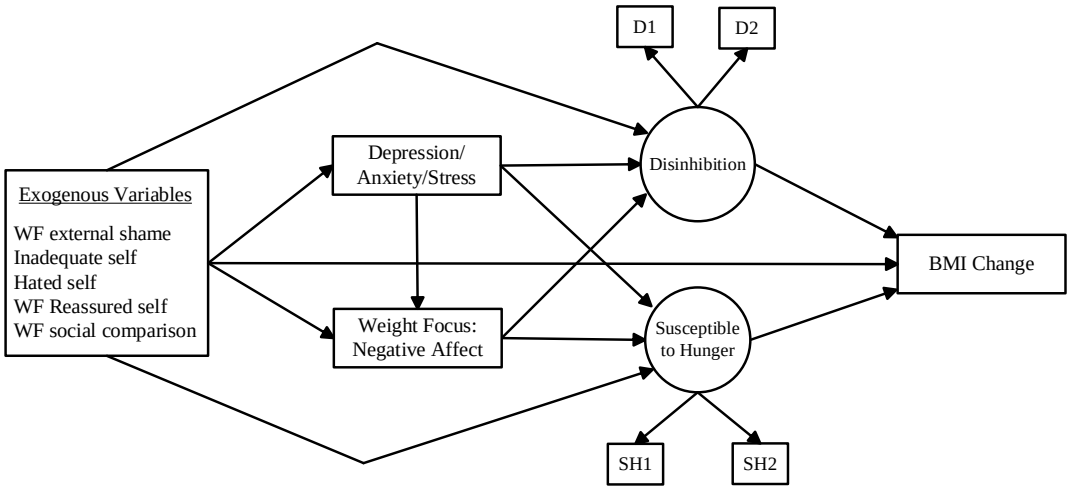
Main Theory



All relationships for quantitative variables are assumed to be linear control groups were used)

You will encounter casual modeling studies similar to Duarte et al. that have more than one indicator of certain constructs, hence latent variables. Figure 7 presents the influence diagram that might have been presented by the authors if disinhibition and susceptibility to hunger each had two interchangeable indicators (SH1 and SH2 for susceptibility to hunger and D1 and D2 for disinhibition; again, we omit residual terms).

Figure 7



In this case, the core structural theory is the same as in the Duarte et al. study; all that has been added is a measurement model and it generally is not of substantive interest. Thus, when you encounter models with latent variables in them, you should focus on the structural variables represented by the latent constructs rather than the measures of them.

CONCLUDING COMMENTS

Hopefully, the above discussion of the six articles gives you a sense of how to extract tested theories from an article. There are some trends across the six studies that are worth noting. First, note the lack of attention to interaction/moderator relationships across the studies. They are virtually non-existent. Second, note the lack of attention to functions between continuous variables other than monotonic linear. We doubt that linear functions are so common in the real world. Third, note the lack of attention to reciprocal causal dynamics. Fourth, note the tendency for the more complex theories to offer "lists of variables" with little attention to the complex dynamics that likely operate between them. Finally, note the general absence of conceptual definitions for key constructs with the accompanying assumption that the variable labels "speak for themselves." You might want to avoid these traps as you approach your own theorizing.

We can't stress enough the importance of evaluating the theoretical contributions of your theory in terms of the criteria of novelty, utility, and scope as discussed in Chapter 3 in the main text. What new knowledge and insights are you adding? How is it useful? To

what areas can the theory be applied or generalized?

We covered a range of study designs for theory extraction. You will encounter other types, but many will involve variants of what we have discussed. For example, mixed method research uses both the quantitative and qualitative extraction strategies described above. With practice, drawing influence diagrams for articles becomes second nature. It is a good exercise to engage in because it often reveals gaps in theories that might otherwise go unnoticed.

REFERENCES

Cheung, M. (2015). *Meta-analysis: A structural equation modeling approach.* New York: Wiley.