

Using Ontologies to Enhance Data on Intimate Partner Violence

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Abstract

Intimate partner violence is among the social determinants of health, and for this reason is addressed in instruments intended to gather data on social determinants of health. Anticipating the need to integrate data on intimate partner violence in the OneFlorida+ Clinical Research Consortium, we propose an ontology-based approach to representing the referents of data on intimate partner violence gathered via two widely used instruments.

Keywords

ontology, intimate partner violence, domestic abuse, social determinants of health

1. Introduction

The negative health outcomes for victims of intimate partner violence (IPV) are both acute and chronic, they include physical and mental health outcomes, and they include increased risks for unhealthy behaviors [1,2]. For these reasons, IPV is considered to be among the social determinants of health (SDoH). SDoH are “non-medical factors that influence health outcomes,” and they include “the conditions in which people are born, grow, work, live, and age,” as well as the “forces and systems shaping the conditions of daily life” [3].

Recognition of the health impacts arising from socioeconomic factors has led to an increased emphasis in recent decades on researching and addressing SDoH [4,5], and on developing instruments to gather SDoH data [6,7]. These data gathered by different instruments are organized in different ways and may not be easily integrated without additional work. Axiomatically rich ontologies would provide a means to enhance meaningful integration of data organized by heterogeneous data models by providing the data with a computable semantics in order to achieve semantic interoperability [8].

We present here an ontology-based approach to modeling and enhancing IPV-related data derived from questions on two SDoH-focused

instruments. Newly developed terms are to be housed within the Ontology of Medically Related Social Entities (OMRSE), which focuses on the intersection of the medical and the social [9,10]. OMRSE uses the Basic Formal Ontology (BFO) as its upper-level ontology, and here we re-use classes only from other BFO-compliant ontologies [11]. Unless otherwise stated, all relations (object properties) used here are from BFO or the Relation Ontology (RO) [12].

2. IPV Data in PRAPARE and Epic

We focus here on the sort of data gathered as responses to IPV-related prompts in two SDoH-screening instruments.

First, the Protocol for Responding to and Assessing Patients’ Assets, Risks, and Experiences (PRAPARE) is an assessment tool designed to assist health care organizations and providers with collecting and using SDoH data about their patients [13]. Next, Epic Systems has an EHR software system with different modules for different domains of data, with Epic Healthy Planet being the module intended for gathering SDoH data [14].

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2.1. PRAPARE

PRAPARE categorizes two questions under “Safety and Domestic Violence” [15]:

Q1: *Do you feel physically and emotionally safe where you currently live?*

Q2: *In the past year, have you been afraid of your partner or ex-partner?*

In both cases, the response options include *Yes*; *No*; *Unsure*; and *I choose not to answer this question*. For Q2, there is an additional option: *as I have not had a partner in the past year*.

2.2. Epic Healthy Planet

Epic includes within Healthy Planet four questions that it places under the heading ‘Intimate Partner Violence.’ One question is the same in meaning as one of PRAPARE’s, and is phrased as follows with these response options:

Q3: *Within the last year, have you been afraid of your partner or ex-partner?*

Possible values are *Yes*; *No*; and *Patient refused*.

The other IPV-related questions from Epic have the same value options as the preceding one, and each asks whether the respondent has been abused in some way by a partner or ex-partner:

Q4: *Within the last year, have you been humiliated or emotionally abused in other ways by your partner or ex-partner?*

Q5: *Within the last year, have you been kicked, hit, slapped, or otherwise physically hurt by your partner or ex-partner?*

Q6: *Within the last year, have you been raped or forced to have any kind of sexual activity by your partner or ex-partner?*

From here on, we shorten “partner or ex-partner” to “ex/partner.” Having introduced the questions, we may now proceed with ontologically representing the entities and relations entailed by a ‘Yes’ or ‘No’ response to the first PRAPARE question and to a ‘Yes’ response to the others.

3. Intimate Partnerships

What makes it true that the person is either a current or former partner of the respondent is some current or past relationship between the respondent and that person. We represent the type of relationship in question—*intimate partnership*—as a subtype of BFO: *relational quality*, a type of quality that has a plurality of bearers. Similarly, Arp, Smith, and Spear [11] give *marriage bond* as an example in their overview of BFO: *relational quality*. To specify the nature of intimate partnerships, we draw upon the way the meaning of “intimate partner” is explained by the Centers for Disease Control and Prevention (CDC) [2]:

intimate partnership_{=def.} Relational quality inhering in persons by virtue of being each other’s spouse, boyfriend/girlfriend, dating partner, or ongoing sexual partner.

Axiomatically, each instance of *intimate partnership* inheres in at least two persons.

4. Referents of ‘the past year’

Taken literally, the referent of “the past year” or “the last year” is an interval with a length of exactly 365 days (exactly 8760 hours). But there are reasons to represent the referent of those phrases, as found in the questions considered here, as an interval lasting longer than a year.

Suppose that at noon on July 27 of the current year, I ask you whether some type of event has occurred within the past year. If we take “the past year” to denote an interval precisely 365 days long and ending at the moment the question is asked, then the question is about an interval extending back to noon on July 27 of last year (setting aside Leap Years). But we are not sure that anyone really interprets such phrases that way. For example, if you recall that sort of event happening most recently on July 27 of last year, we should not be surprised if you answer, “Yes,” even if it occurred earlier than noon that day. To account for this while positing an interval of precise length as the referent of “the past year,” we might then add twelve hours to the year in order to account for the question being asked at noon. But if we wish to account for all cases no matter how late in the day the question is asked, we might posit the interval is one year, twenty-three hours, fifty-nine

minutes, and fifty-nine seconds long. Or we could simply round up to one year and twenty-four hours.

Applying the above reasoning to “the past year” or “the last year” in the questions considered here, we stipulate the referent is an interval that ends precisely at the end of the day on which the question is asked, and extends back precisely 366 days (that is, precisely 8,784 hours). A further advantage is that this accounts for cases in which the available data include only the date for a given set of a responses, and not a time.

To better connect this interval to the respondent, we demarcate a proper temporal part of the respondent’s BFO: *history* that exactly occupies that interval. Since that part of the person’s history is temporally extended, it is not a process boundary; and thus, like any part of a process that is not a process boundary, it too is a process. Its relation to the relevant interval is *occupies temporal region*.

Other entities may be related to that interval via the part of the respondent’s history that occupies it. For an entity inhering in the respondent, the relevant history part *has participant at some time* that entity. For a process such an instance of abuse, the relevant history part *has proper occurrent part* that process.

5. Appraisals of Safety

For representing judgements of danger or safety, we make use of a set of terms in the Emotion Ontology [16]: *appraisal* and its subtype *appraisal of dangerousness*, which “represents an evaluation of how threatening an object or situation is.” The latter has *appraisal as dangerous* and *appraisal as not dangerous*, differing with respect to whether they represent the thing in question as a threat to the bearer.

6. Referent of ‘where you live’

We use OMRSE: *disclosure of residence* to represent the process that outputs (OBI: *has specified output*) a patient or other respondent’s residential data.² Here we focus on the ZIP code alone as the output of that process. It is represented with OMRSE: *residence ZIP code ICE*, which is about a geographic region in which

a postal delivery route denoted by a ZIP code is realized. That ICE and the appraisal of the respondent each stand in the *is about* relation to that location. Instead of IAO: *is about*, the domain of which is restricted to ICEs, we instead use the *is about* of Smith and Ceusters [17], the domain of which includes not only ICEs but also representations. The region is an instance of GEO: *geographical region*.³

7. Referents of ‘Yes’ or ‘No’ to Q1

We have outlined the basic elements for representing the referents of a response to Q1. Figure 1 below represents the referents of an answer to question Q1 about whether the respondent feels safe where they live.

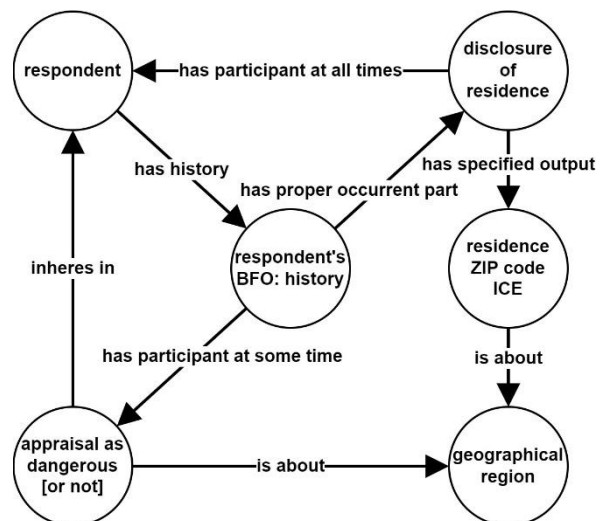


Figure 1: Referents of ‘Yes’ or ‘No’ to Q1

If the response is a ‘Yes,’ then the appraisal in Fig. 1 is an instance of *appraisal as not dangerous*. If ‘No,’ it is an instance of *appraisal as dangerous*. The rest is the same for each.

8. Referents of ‘Yes’ to Q2 or Q3

We turn next to representing the referents of a ‘Yes’ about whether the respondent has been afraid of an ex/partner. Figure 2 shows what they are and how they relate. This is the same for both the PRAPARE (Q2) and Epic (Q3) versions.

² http://purl.obolibrary.org/obo/OBI_0000299.

³ http://purl.obolibrary.org/obo/GEO_000000372.

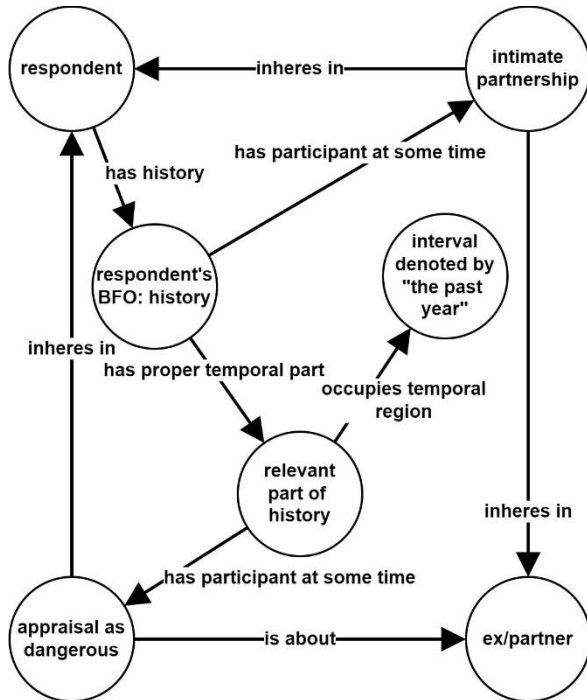


Figure 2: Referents of 'Yes' to Q2 or Q3

9. Types of Abuse

The three remaining questions Q4-Q6 are similar in structure to one another. Each asks whether the respondent has been abused by an ex/partner within the last year. They differ with respect to which type of abuse is the focus. As a starting point for representing these types of abuse and grouping them together under a more general classification, we draw upon the 'abuse' entry in the *APA Dictionary of Psychology* [18] in defining a general class of abuse:

abusive behavior_{=def.} Behavior that is cruel, violent, demeaning, or invasive.

In order to connect an act of abusive behavior to the involved persons in OWL, we make use of object properties that represent how that act relates to those persons. We introduce two object properties to distinguish the abuser's sort of participation from that of the abused:

has aggressor_{=def.} Relation between an abusive behavior and one who inflicts it upon someone or something else.

is abuse of_{=def.} Relation between an abusive behavior and one upon whom it is inflicted.

The domain of each is *abusive behavior*. The range of the former can be restricted to human beings, while that of the latter could be more general since there are nonhuman abuse victims.

We make use of these relations in axioms of *abusive behavior*: each instance stands in *has aggressor* to at least one person, and stands in the *is abuse of* relation to at least one person or animal.

We draw upon CDC definitions [2] in defining subclasses of *abusive behavior* corresponding to the types of abuse described in Q4-Q6.

psychologically abusive behavior_{=def.}

Abusive behavior in which the aggressor does or attempts to do the following: mentally or emotionally harm or exert control over another.

physically abusive behavior_{=def.}

Abusive behavior in which the aggressor does or attempts to do the following: harm, restrain, or coerce another through physical force.

sexually abusive behavior_{=def.}

Abusive behavior in which the aggressor does or attempts to do the following: force or coerce another to participate in a sexual act to which the latter has not freely given consent.

It is worth noting that a single episode of abuse can be or include an instance of multiple subtypes.

We include "does or attempts to do" in the three preceding definitions because cases of the same type of abuse may vary greatly concerning both outcome and intent. We mention attempts because failed attempts at abuse—a dodged punch for example—can be abusive.

While "attempts to" would suffice to cover both successful and failed attempts, we must also account for unintentionally abusive behavior. If for example one partner is repeatedly careless in a way that puts the other at risk of harm, then even without intent to harm, the pattern of neglecting to account for the other's safety may be abusive. We must then account for attempts at abuse whether or not they are successful, as well as for behavior that has abusive effects whether or not there is abusive intent.

Of course, to avoid disjunctive definitions, we could have instead developed a set of terms for each subtype of abuse, for example one for attempting to harm via physical force and another simply for causing harm via physical force. But

such terms would be less useful here, since a ‘Yes’ to one of the questions in consideration does not provide us with details such as whether the abuse was intentional or whether the respondent was indeed harmed.

10. Referents of ‘Yes’ to Q4, Q5, or Q6

We use the above terms to specify the type of abuse depending on which questions receive a ‘Yes.’ Apart from the type of abuse, the rest of the picture is the same for a ‘Yes’ to any of Q4-Q6:

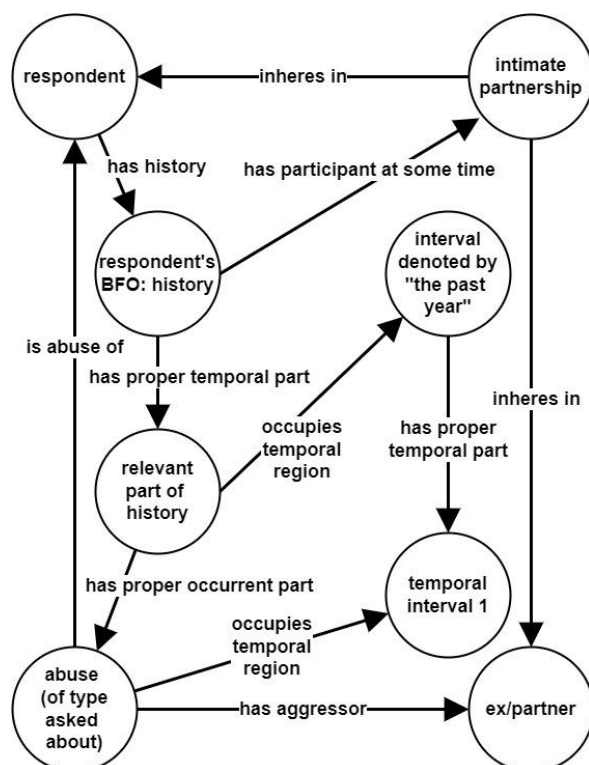


Figure 3: Referents of ‘Yes’ to Q4, Q5, or Q6

The entity labeled ‘temporal interval 1’ in Fig. 3 is the interval occupied by the instance of abuse.

11. Discussion and Conclusion

While each diagram above shows only the referents of a single response, the end result of multiple responses would be several such sets of referents all relating to the same respondent. As ontology-based models of responses to additional prompts are developed, they too may be transformed in the same manner and connected to the other data elements about the same respondent, yielding a larger representation of

health-relevant factors in the respondent’s life. That representation may be even larger if it incorporates the referents of EHR data about the same person. But this, too, requires additional ontological engineering that results in compatible, ontology-based models.

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