



An Ontological Representation of Money with a View Toward Economic Determinants of Health

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Background

Money and Health are Closely Intertwined

- Higher income is associated with access to better schools, nutrition, recreational resources, and housing¹
- Healthcare centers and organizations have become increasingly interested in collecting data on the social and economic factors that can impact a patient's health

Screening for Social Determinants of Health by Clinicians

- Existing screening tools:
 - PRAPARE Screening Tool
 - Epic Healthy Planet
 - Accountable Health Communities (AHC) Health-Related Social Needs (HRSN) Screening Tool
- These tools are used in community health centers, hospitals, and private practices to help better assess the needs and risks of their most vulnerable patients



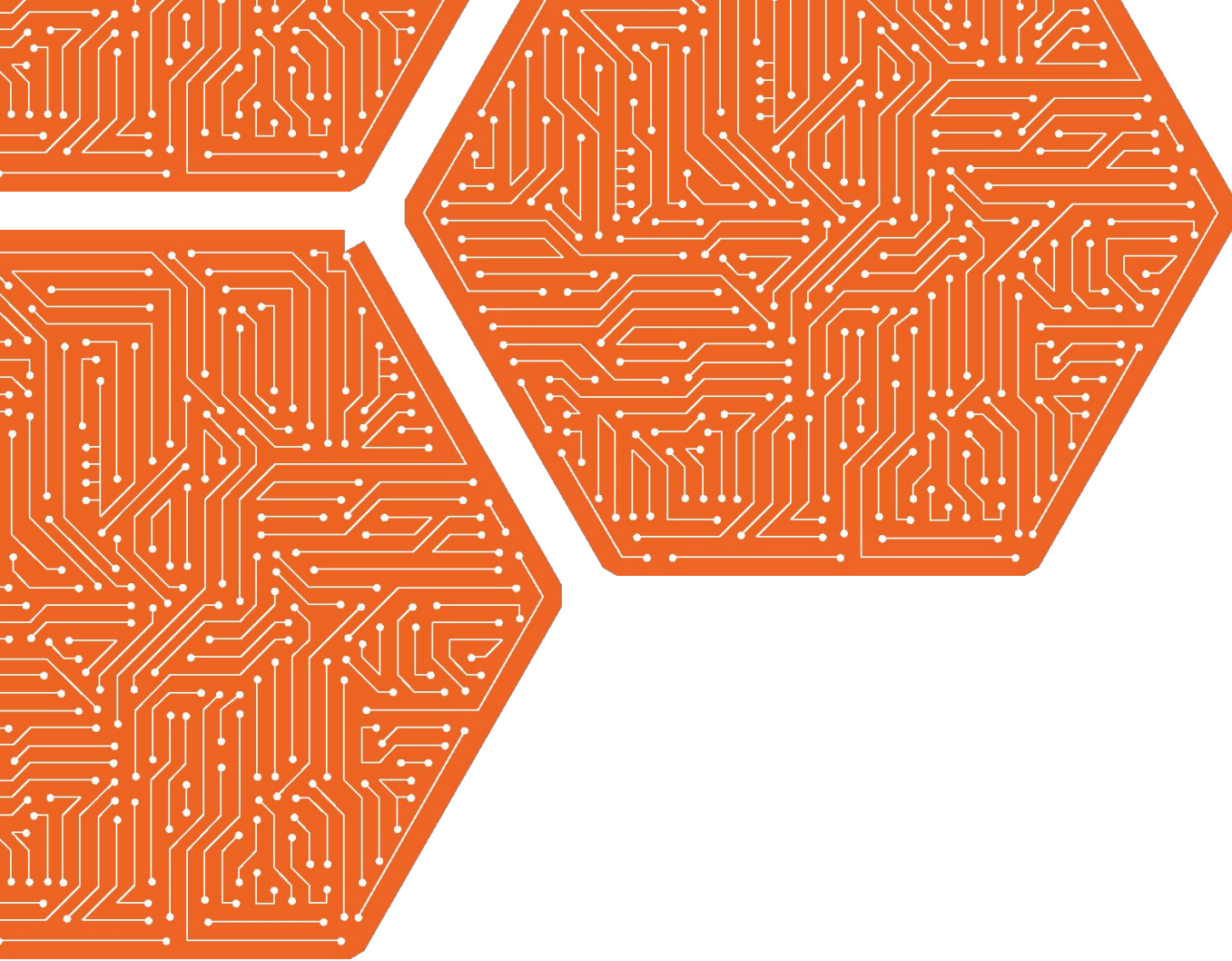
PRAPARE®: Protocol for Responding to and Assessing Patient Assets, Risks, and Experiences
Paper Version of PRAPARE® for Implementation as of September 2, 2016

13. During the past year, what was the total combined income for you and the family members you live with? This information will help us determine if you are eligible for any benefits.

<input type="checkbox"/>	I choose not to answer this question
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14. In the past year, have you or any family members you live with been **unable** to get any of the following when it was **really needed**? Check all that apply.

Yes	No	Food	Yes	No	Clothing
Yes	No	Utilities	Yes	No	Child Care
Yes	No	Medicine or Any Health Care (Medical, Dental, Mental Health, Vision)			
Yes	No	Phone	Yes	No	Other (please write):
I choose not to answer this question					



What is Money?

Four “Functions” of Money

- **Medium of Exchange**

Something that is widely accepted by a group of people in exchange for goods and services.

- **Measure of Value**

Something that serves as a standard unit of measurement for the value of a good or service.

- **Standard of Deferred Payment**

Something that is widely accepted by a group of people to value and settle a debt.

- **Store of Value**

Something that retains its value after being stored and retrieved at a later date.

Money is a Type of Debt

“The main obstacle to the adoption of a truer view of the nature of money is the difficulty of persuading the public that ‘things are not the way they seem...’”

A. Mitchell Innes, *The Credit Theory of Money*, 1914

Money in Modern Economic Systems

- A banknote issued by a central bank represents an obligation of that bank's government to accept it as a means of paying for taxes, fines, or government debt instruments (e.g., treasury securities)
- In the U.S., legally, federal reserve notes are liabilities of the Federal Reserve Banks
- Historic examples of debts being used as money:
 - Cigarette money in WWII POW camps¹
 - Babylonian clay tablets²

1. A. Mitchell Innes. What Is Money? *Bank Law J.* 1913 May.
2. R.A. Radford. The Economic Organisation of a P.O.W. Camp. *Economica.* 1945;12(48):189–201.

Existing representations of ‘money’

- **money (GSSO:010609) - Gender, Sex, and Sexual Orientation Ontology**

Any item or verifiable record that is generally accepted as payment for goods and services and repayment of debts, such as taxes, in a particular country or socio-economic context.

- This definition does not account for the fact that money is considered a debt and therefore has an associated claim that the owner of that money possesses

- **money (NCIT:C78415) – National Cancer Institute Thesaurus**

The official currency issued by a government or national bank.

- NCIT also defines ‘Government’ (NCIT:C78315) as “The political organization by which a state or nation is ruled,” so this definition would exclude the euro and other forms of money not issued by a government

In BFO terms, what is a debt?

What it is not

- BFO: occurrent – neither debt nor money can be divided into temporal parts
- BFO: material entity – money and debt can be immaterial (e.g., checking deposit)
- BFO: immaterial entity – debt is not a site, continuant fiat boundary, or spatial region, and therefore cannot be an immaterial entity
- BFO: specifically dependent continuant – there can be multiple material and digital forms of money and debt, which are transferable from one source to another

This leaves ‘generically dependent continuant’ (GDC)

- There can be multiple records of a particular debt and multiple instances of a type of currency
- Like other GDCs (e.g., a Coca-Cola symbol), money can be identified by a copyable pattern that is concretized as a BFO: quality (e.g., patterns of ink on a plastic bottle)
- But is this sufficient?

Defining 'debt obligation'

Parent class: 'directive information entity' (IAO:0000033)

- Definition: "An information content entity whose concretizations indicate to their bearer how to realize them in a process."
 - Any concretization of a debt will typically indicate how the debt is to be realized
 - In the case of currency, the concretization indicates an obligation of the issuing government to recognize it as payment for taxes or treasury bonds
 - In the case of an online record of your checking account, the concretization indicates an obligation of a commercial bank to provide you with funds upon request up to the amount held there

debt obligation =_{def} A directive information entity that prescribes that something will be transferred from some human or organization that is the bearer of a duty holder role to another human or organization that is the bearer of a claimant role.

- Each obligation will have an associated claimant role and duty holder role to indicate which party bears the claim and which bears the debt, respectively

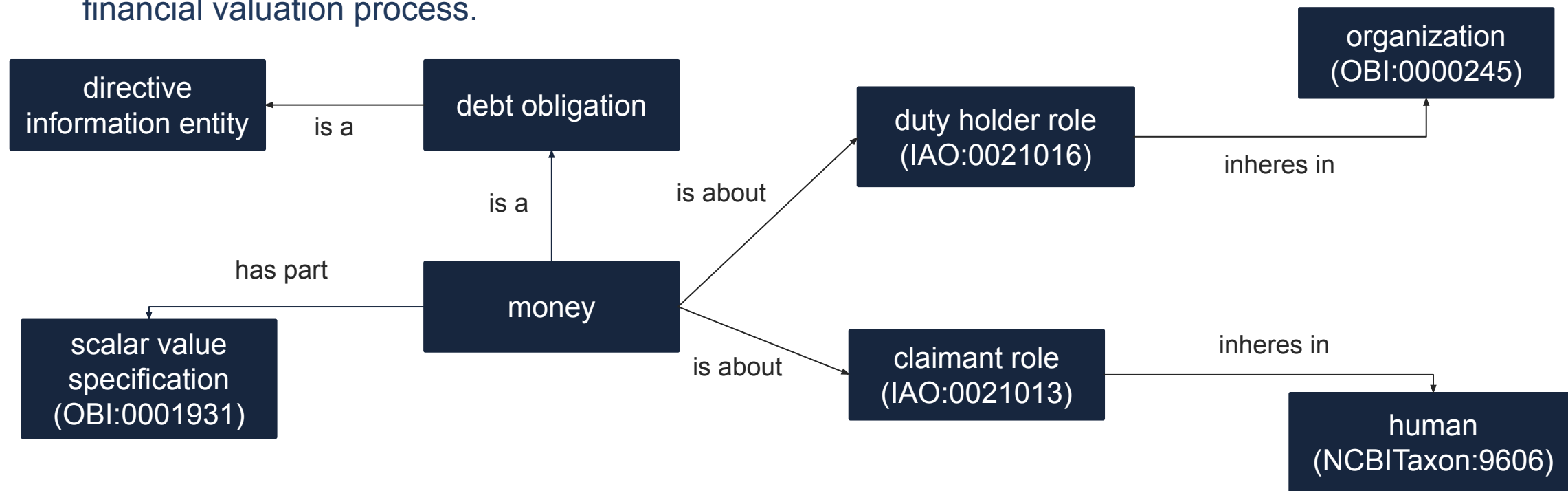
Defining 'money'

money =_{def} A debt obligation between two parties that has as part a scalar value specification and whose concretizations indicate that their bearers can be used in a financial transaction or payment of debt, or as a measure of the value of some entity in a financial valuation process or prospective financial valuation process.

- The scalar value specification for a type of currency is whatever value has been assigned to it by the issuing government (e.g., a US one-dollar bill will have a scalar value specification of "\$1")
- The scalar value specification of other forms of money, such as cigarettes in POW camps, will be equal to 1 unit of that form of money or will derive this value from other commodities of the same type (e.g., a hand-rolled cigarette might be worth two Red Cross cigarettes, and thus it will have a scalar value specification equal to two Red Cross cigarettes)

Defining 'money'

money =_{def} A debt obligation between two parties that has as part a scalar value specification and whose concretizations indicate that their bearers can be used in a financial transaction or payment of debt, or as a measure of the value of some entity in a financial valuation process or prospective financial valuation process.



Financial Transaction and Payments of Debt

- 1. financial transaction** =_{def.} A planned process whereby one participant partly or completely fulfills an obligation to another participant by transferring ownership of some other debt obligation, which is typically money.
 - Note, it could be other forms of debt obligations such as bonds
- 2. payment of debt** =_{def.} A planned process whereby ownership of some entity of value is transferred by one participant to another to fulfill some obligation, on their behalf, after some service is performed or the ownership of some entity is exchanged.
 - Note, some debts can be paid with material entities: if I borrow \$5 and pay it back by buying you lunch

Various processes in which money is used

- 3. financial valuation process** =_{def.} A planned process that has as specified output some scalar measurement datum that is about an entity—such as a material good or a service—and is measured in terms of the quantity of some other entity.

- 4. prospective financial valuation process** =_{def.} A planned process that has as specified output some predicted value that is about an entity—such as a material good or a service—and is measured in terms of the quantity of some entity at some point in the future.

Currency

currency =_(def) A material entity that is the bearer of a concretization of money and is created by some governmental organization or on behalf of some governmental organization that has authorized its creation.

Some facts about currency

- Currency is anything that has been declared by a government to be an acceptable means of settling debts and/or as a medium of exchange
- Currencies are physically manufactured and issued by government institutions
- Note: by government fiat (i.e., laws), copying and counterfeiting is prohibited and increasingly made physically challenging, but these actions absolutely remain physically possible, and thus do not in any way detract from the definition of currencies as GDCs

Limitations and Future Work

- 1.** Our definition of 'money' aligns with current types of money that may be fundamentally different from some historic types of money (e.g., we are not aware of a debt-based account of cowry shells), thus potentially limiting its generalizability
- 2.** We did not represent certain various entities that are used as forms of payment in financial transactions, such as checks or bonds, or other financial assets – this remains as future work
- 3.** Other future work includes representing entities involved in digital transactions and financial assets relevant to health and healthcare

Acknowledgements

Our Funder

This project is sponsored in part by the University of Florida Clinical and Translational Science Institute, which is supported in part by the NIH National Center for Advancing Translational Sciences under award number UL1TR001427. The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institutes of Health.

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Special thank you to the ICBO reviewers, as well as attendees to the 8th Clinical and Translational Science Ontology Workshop (https://ncorwiki.buffalo.edu/index.php/Eighth_Clinical_and_Translational_Science_Ontology_Workshop).