



Foresight

Tackling Obesities: Future Choices — Obesity System Atlas

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1 Introduction

This report presents the visual representations of the obesity system map developed during a qualitative systems mapping exercise undertaken for the Foresight Tackling Obesities: Future Choices project. It should be read in conjunction with the project report *Tackling Obesities: Future Choices – Building the Obesity System Map*, which includes a full description of the detailed methodology used to create these maps and discussion of how to interpret them.

The aim of the Foresight Tackling Obesities: Future Choices project was to ‘produce a long-term vision of how we can deliver a sustainable response to obesity in the UK over the next 40 years’. In the systems mapping work, a qualitative, causal loop model was developed in order to:

- help us understand the complex systemic structure of obesity
- contribute to developing a tool that helps policy makers respond to obesity in the generation, definition and testing of possible policy options.

Mapping the obesity system

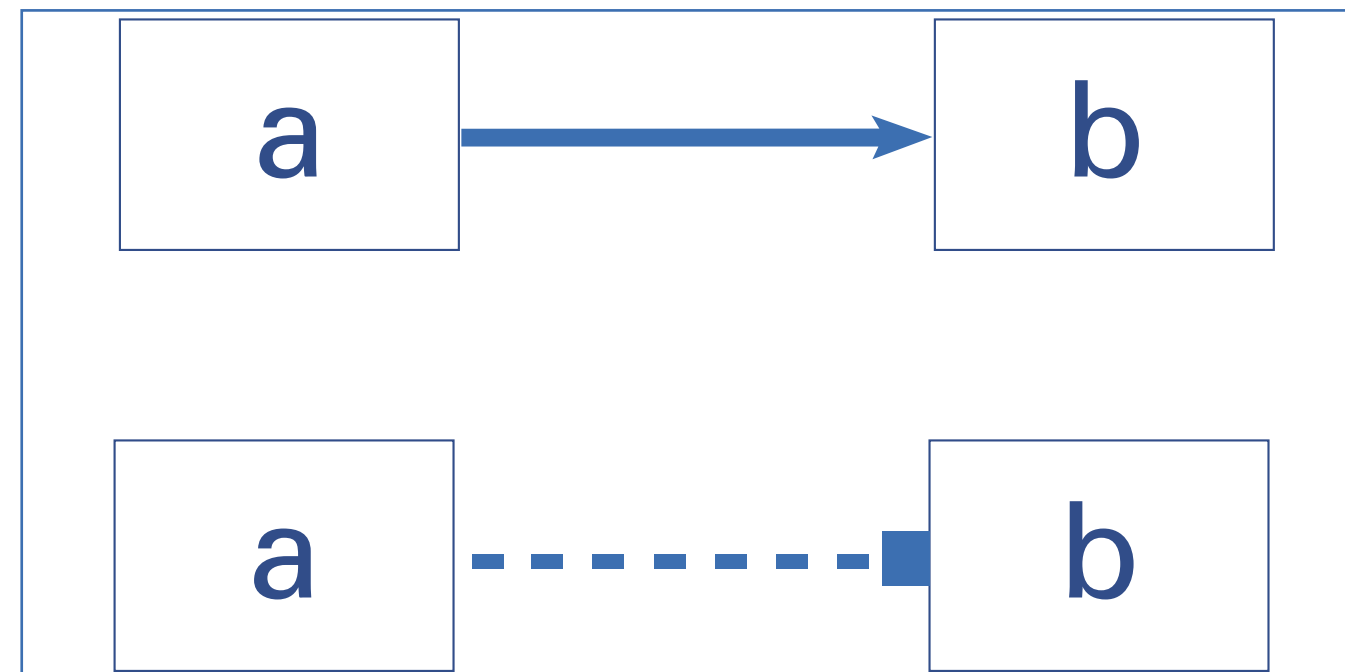
A system can be considered to be ‘a structured set of objects and/or attributes together with the relationships between them’. The system under study in the present project is the ‘obesity system’. The key assumption underlying this qualitative mapping exercise is that obesity is the result of the interplay between a wide variety of factors, deriving, for example, from a person’s physical make-up, eating behaviour and physical activity pattern. **The obesity system is therefore pragmatically defined here as the sum of all the relevant factors and their interdependencies that determine the condition of obesity for an individual or a group of people.** The obesity system, as defined above, has been visualised in a particular format: a causal loop model (or diagram). In the remainder of this report, this causal loop model will very often be referred to as ‘the system map’.

Variables and linkages

In a causal loop model, the system’s elements (factors, variables) are represented by boxes, and the causal relationships between two variables are represented by arrows. The variable at the tail of the arrow has a causal effect on the variable at the point.

In addition, a distinction can be made between positive and negative causal relationships. A positive causal relationship implies that both variables will change in the same direction: if variable *a* (at the tail) increases, then also variable *b* (at the point) will increase (and if *a* decreases, then *b* decreases). A negative relationship, on the other hand, implies that variables change in opposite directions (if *a* increases, *b* will decrease and if *a* decreases, *b* will increase). Figure 1 shows how this is visualised in a causal loop model:

Figure 1: Positive (above) and negative (below) causal relationship as visualised in a causal loop model



Causal linkages can be further differentiated by their strength and by the time delays they are subject to. Strong linkages imply that even small changes in the tail variable will have an impact on the level of the dependent variable. Weak linkages do not propagate these small changes as effectively. Causalities can also vary in the length of delays that occur before their effects are apparent. Time lags could not be incorporated directly into the obesity system map. However, they certainly have a bearing on the system and would need to be incorporated into any further editions of the map.

When building and working with causal loop models (system maps), a few caveats are appropriate:

- The sign of the relationship – positive or negative – is dependent on the particular conceptualisation of the variables. For example, a positive relationship can be seen between ‘social rejection of smoking’ and ‘smoking cessation’. However, the sign of this relationship will reverse if the tail variable is rephrased as ‘social tolerance for smoking’. Whether a variable is phrased in a positive or a negative way is dictated by what the modeller thinks is most intuitively understandable.
- Variables are considered to vary over a scale. So variable names need to be selected in such a way that they can take on high and low values, which is why many variables are prefaced with ‘level of ...’, ‘number of ...’, ‘degree of ...’, ‘importance of ...’ etc.

- The arrows between the variables represent causal linkages. These should not be mistaken for other kinds of linkages that are sometimes present in 'box and arrow' diagrams. Particularly given the biological nature of some subsystems in the obesity system, these connections could be mistakenly seen as mass, energy or information (signal) flows.

Feedback loops

The causalities discussed so far are linear causalities (from *a* to *b*). Circular causalities (e.g. from *a* to *b* to *a*) in system maps are called feedback loops. They are an important feature of causal loop models because they help to explain the dynamic behaviour of the system.

There are two kinds of feedback loops: reinforcing (or positive) and balancing (or negative) loops. Reinforcing loops encapsulate exponential growth, while balancing loops push the system towards equilibrium.

An example of a reinforcing loop from the obesity system map is:

- If the 'demand for convenience' by consumers increases, the 'convenience of food offerings' from food manufacturers is likely to increase in response. If then consumers habituate themselves to these convenient offerings, they will lose cooking skills. Therefore an increase in the 'convenience of food offerings' triggers 'de-skilling' of people. And this, in turn, increases the demand for convenience. And so on, until compromises on taste or price flatten the dynamic.

A balancing loop is at the very core of the obesity system:

- When human beings' 'level of available energy' goes down, they experience a 'physical need for energy'. The stronger that need is, the more effort is invested in 'acquiring new sources of energy' or in 'preserving the energy' that is already available. This, in turn, leads

to a higher level of available energy, which finally dampens the physical need for energy. And so the system remains in equilibrium.

The primary purpose of the systems mapping work was to help us understand how the broad range of variables influences energy balance, leading to it becoming imbalanced.

Purpose of causal loop models

A causal loop model is a device to describe the systemic structure of a complex problem. As such, it serves three very general purposes:

- **to make sense of complexity.** Individuals who have been deeply involved in the construction or study of a causal loop model will appreciate its considerable heuristic power. In particular, once the top-level architecture of a model (rather than its fine detail) has been thoroughly absorbed, it becomes a powerful filter for identifying relevant variables and an aid to thinking about the issue.
- **to communicate complexity.** The anatomy of a system map – particularly with a fairly large number of variables and many causal linkages between them – is a clear confirmation of the inescapably systemic and messy nature of the issue under study. This approach highlights the need for broad and diversified policies or strategies to change the dynamics of the system.
- **to support the development of a strategy to intervene in a complex system.** Careful study of a causal loop model will reveal features that help in deciding where to intervene most effectively in the system. These features are: leverage points, feedback loops and causal cascades.

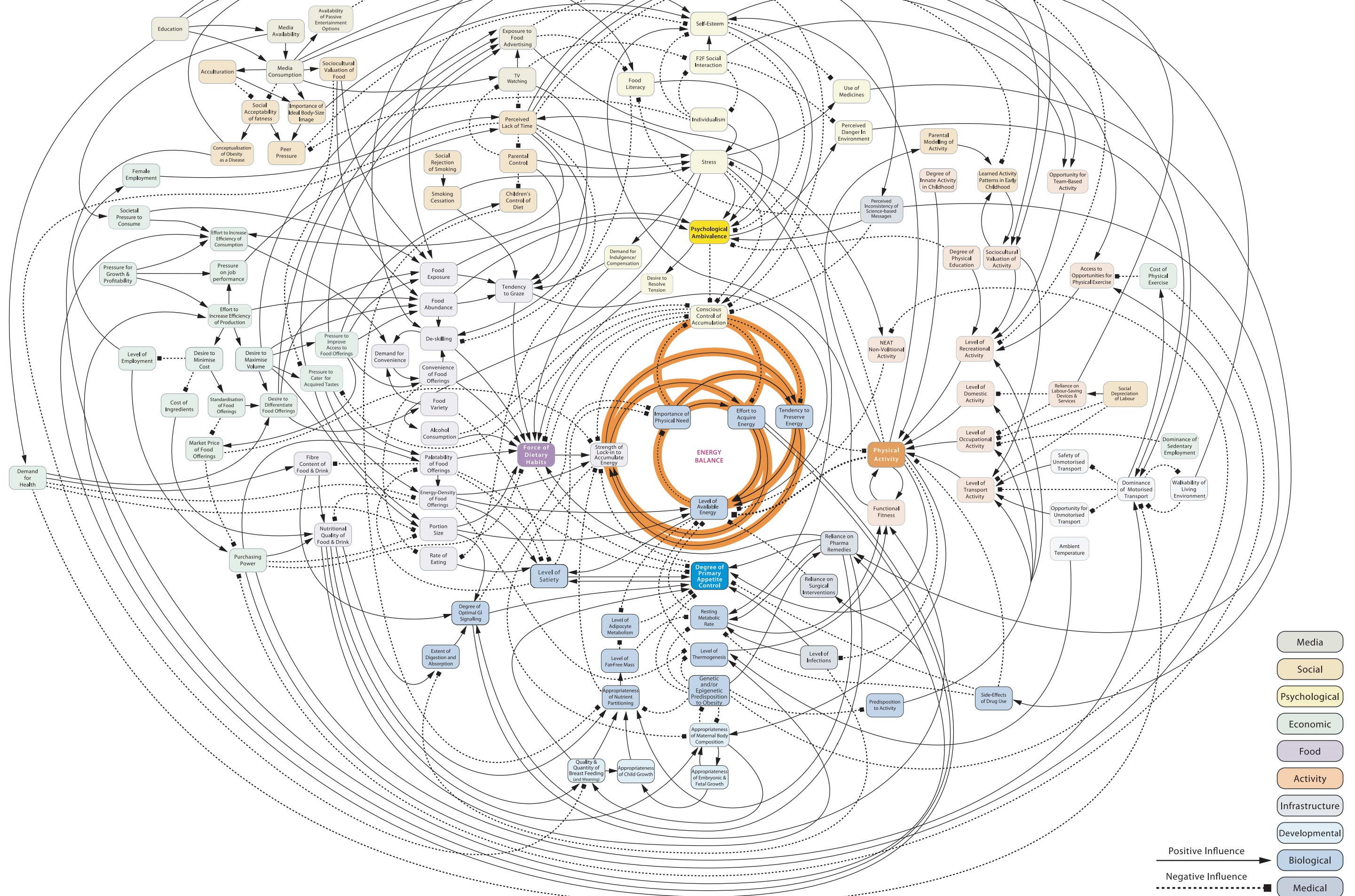
Please refer to [Tackling Obesities: Future Choices – Building the Obesity System Map](#) for more detail on systems mapping and the obesity system maps.

2 Obesity System Maps

Group	Map number	Title/description
1. Full Map	Map 0	Full Generic Map
2. Core System Engine	Map 1	System Engine: Foundational Loop
	Map 2	System Engine: Reinforcing Loop (Lock-in)
	Map 3	System Engine: Balancing Loop (Conscious Control)
3. Thematic clusters	Map 4	Full Generic Map: Thematic Clusters (empty)
	Map 5	Full Generic Map: Thematic Clusters (filled)
	Map 6	Full Generic Map: Physiology Cluster
	Map 7	Full Generic Map: Individual Activity Cluster
	Map 8	Full Generic Map: Environmental Activity Cluster
	Map 9	Full Generic Map: Individual Psychology Cluster
	Map 10	Full Generic Map: Social Psychology Cluster
	Map 11	Full Generic Map: Food Production Cluster
	Map 12	Full Generic Map: Food Consumption Cluster
4. Relationships between clusters	Map 13	Full Generic Map: Linkages between Physiology and Physical Activity Area
	Map 14	Full Generic Map: Linkages between Physical Activity and Psychology Area
	Map 15	Full Generic Map: Linkages between Psychology and Food Environment Area
	Map 16	Full Generic Map: Linkages between Food Environment and Physiology Area
	Map 17	Full Generic Map: Linkages between Psychology and Physiology Area
	Map 18	Full Generic Map: Linkages between Physical Activity and Food Environment Area
5. Key variables	Map 19	System Engine + 4 Key Variables
	Map 20	System Engine + 4 Key Variables+ 1 st Tier Variables
	Map 21	System Engine + 4 Key Variables + 1 st /2 nd Tier Variables
6. Leverage points	Map 22	Education
	Map 23	Tendency to Graze
	Map 24	Purchasing Power
	Map 25	Stress
	Map 26	Appropriateness of Maternal Body Composition
7. Weighted linkages	Map 27	Weighted Causal Linkages
8. System map embedded in scenarios	Map 28	System Map Embedded in Scenario 1 – a. The Affluent
	Map 29	System Map Embedded in Scenario 1 – b. The Less Affluent
	Map 30	System Map Embedded in Scenario 2
	Map 31	System Map Embedded in Scenario 3
	Map 32	System Map Embedded in Scenario 4
9. Policy response ideas	Map 33	Mapping of Policy Response Ideas
10. Segmented map	Map 34	Segmented Map: Children

Map 0

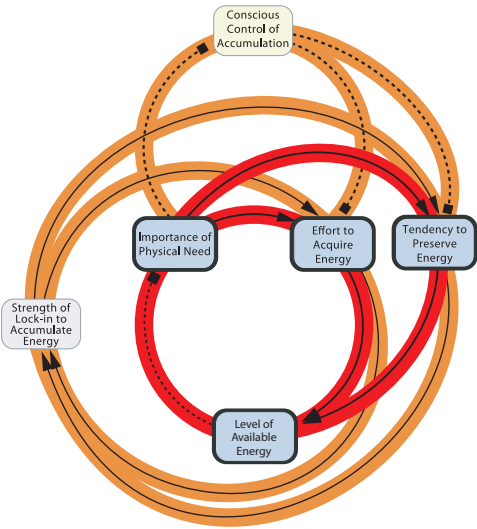
Full Generic Map



Map 1

System Engine

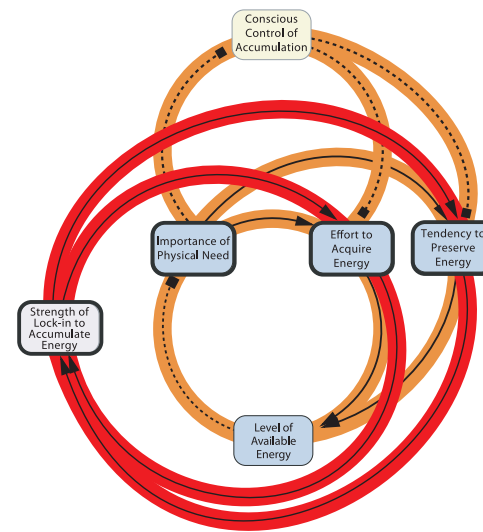
Foundational Loop



Map 2

System Engine

Reinforcing Loop (Lock-in)

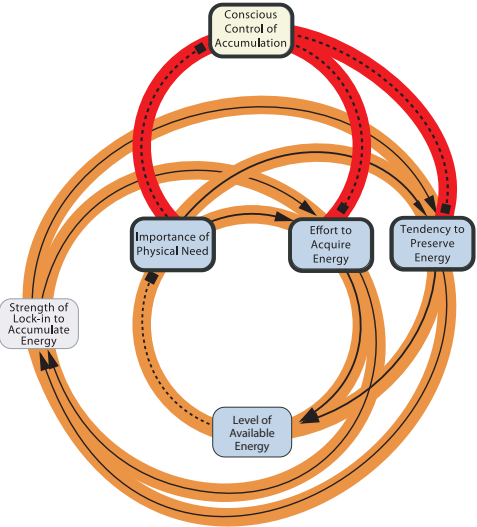


Map 3

System Engine

Balancing Loop

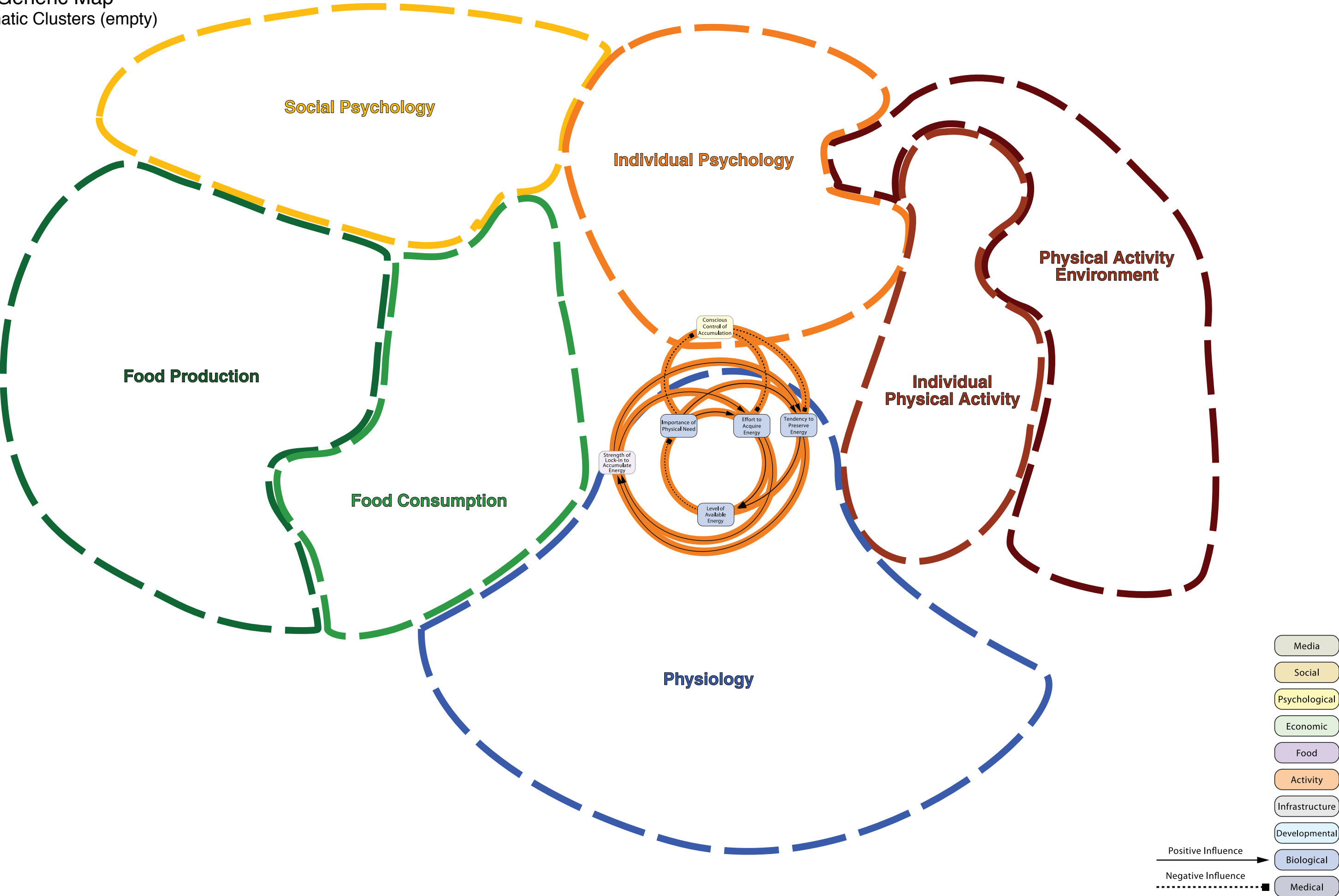
(Conscious Control)



Map 4

Full Generic Map

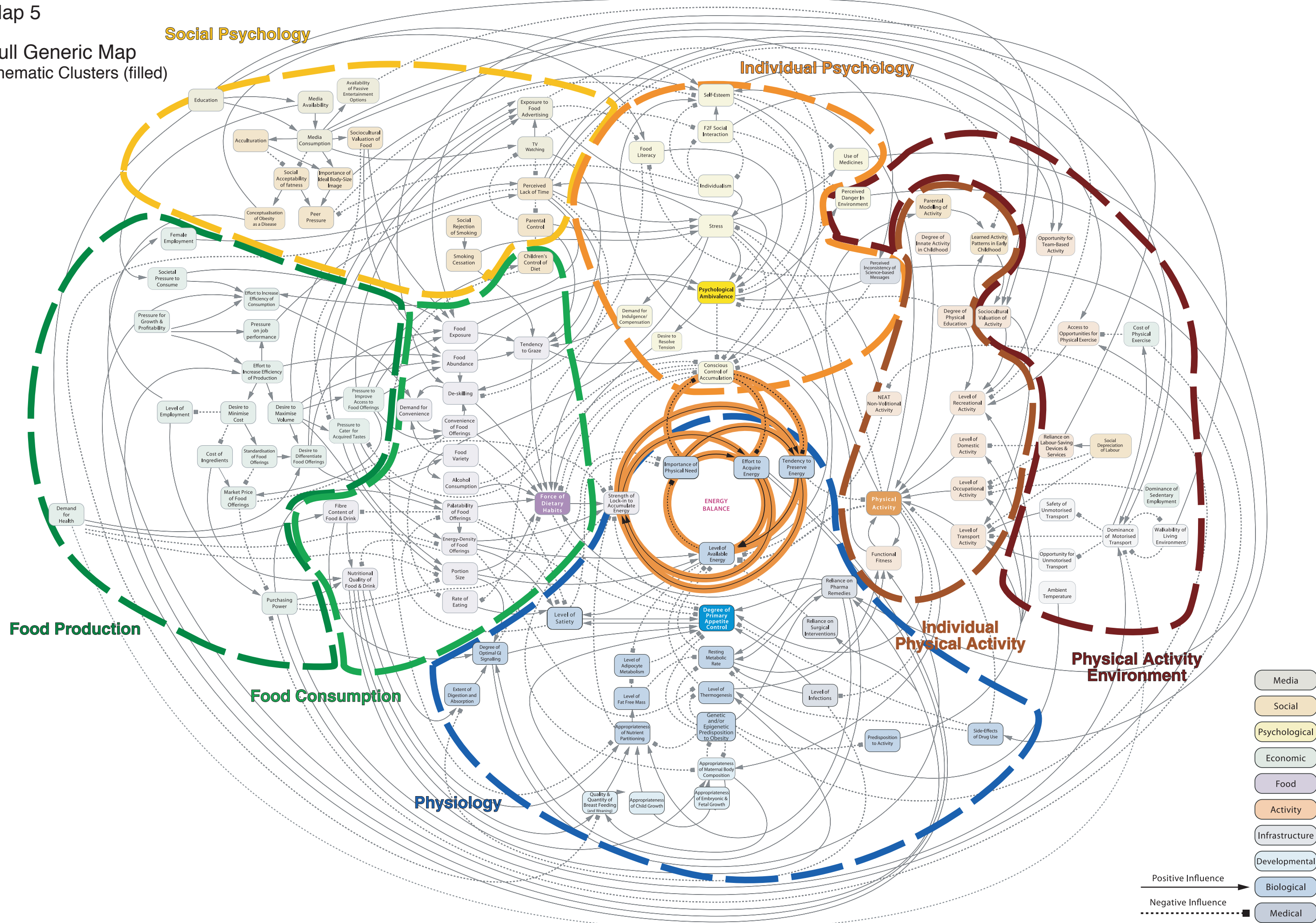
Thematic Clusters (empty)



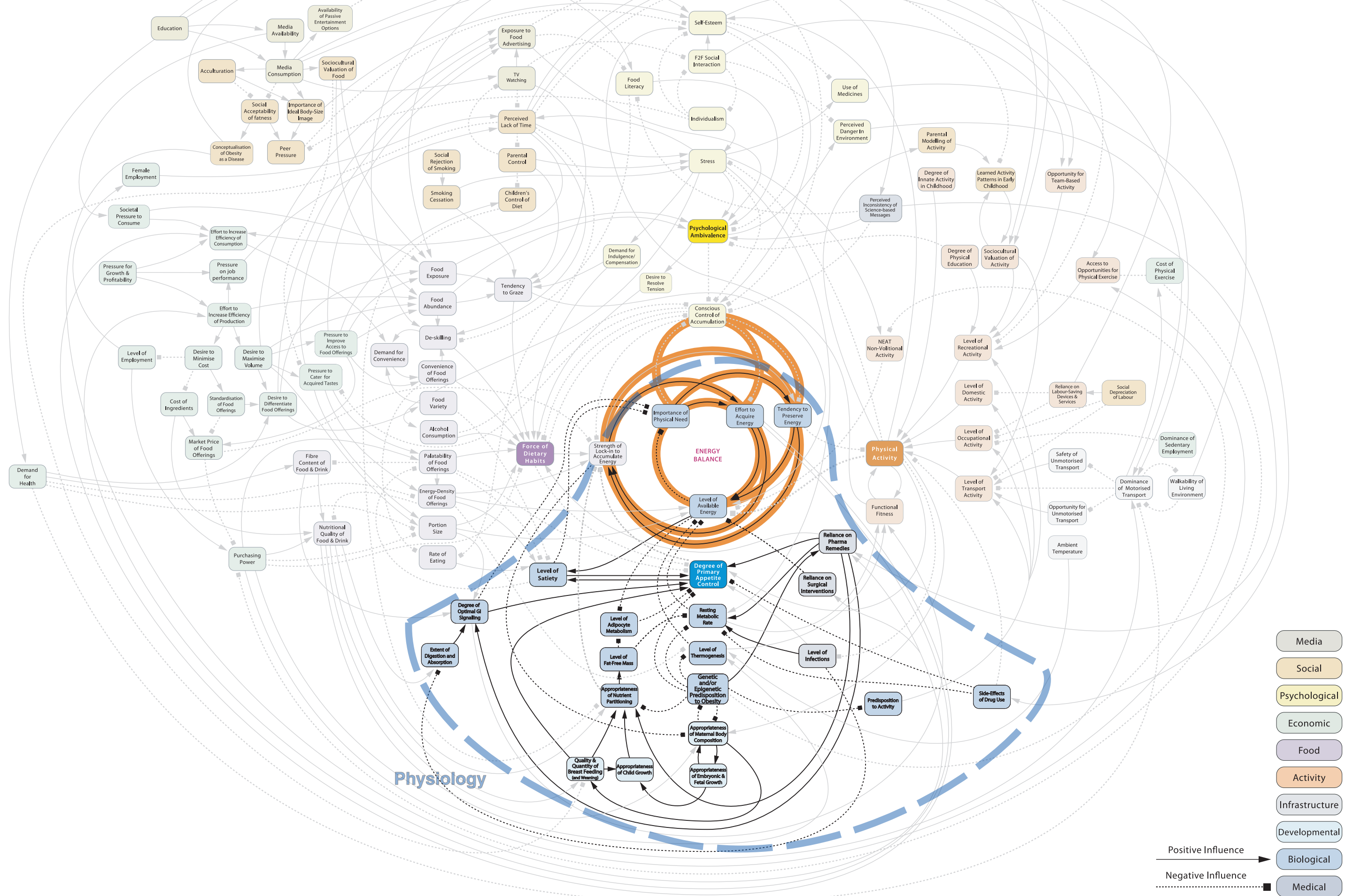
Map 5

Full Generic Map

Thematic Clusters (filled)



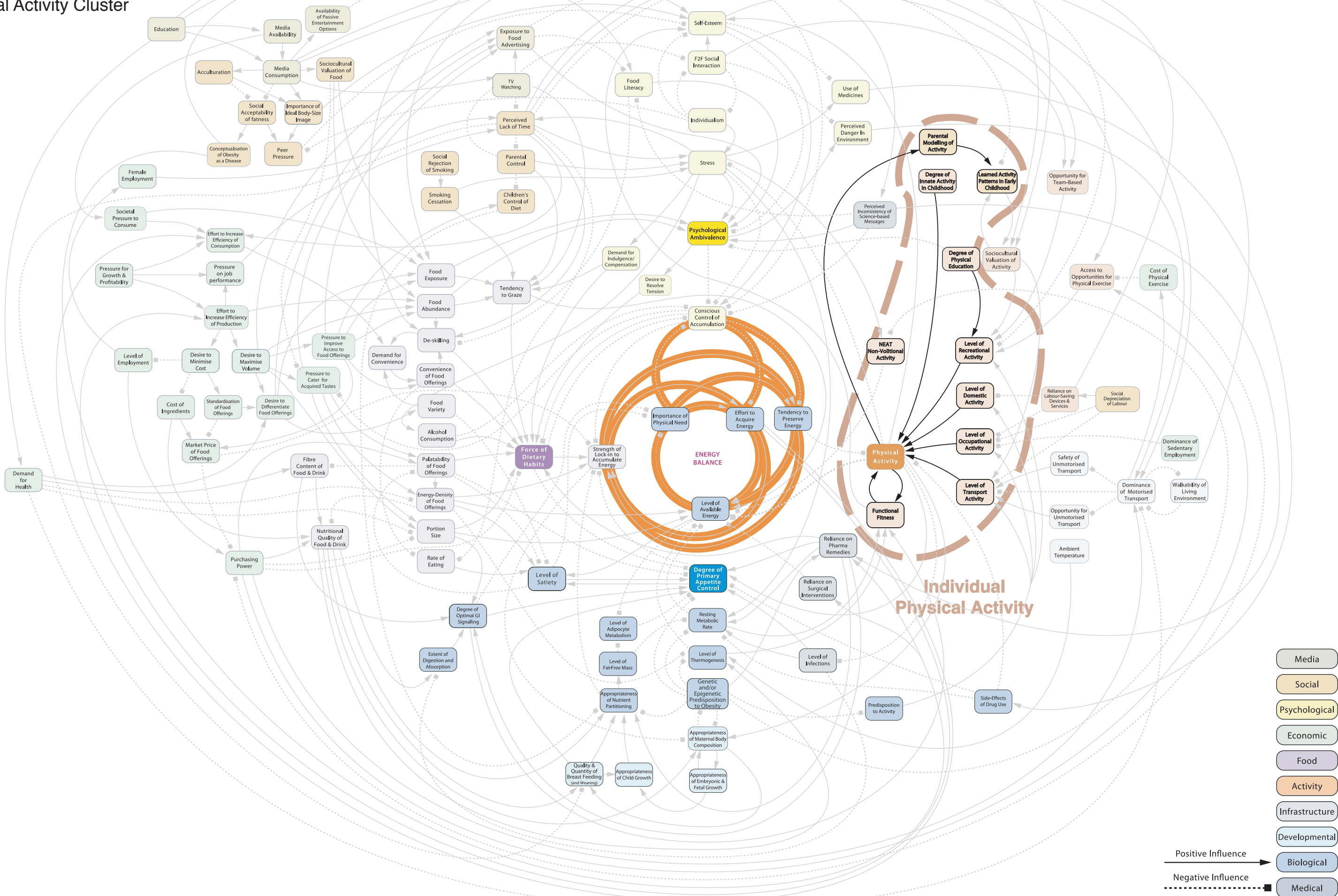
Full Generic Map Physiology Cluster



Map 7

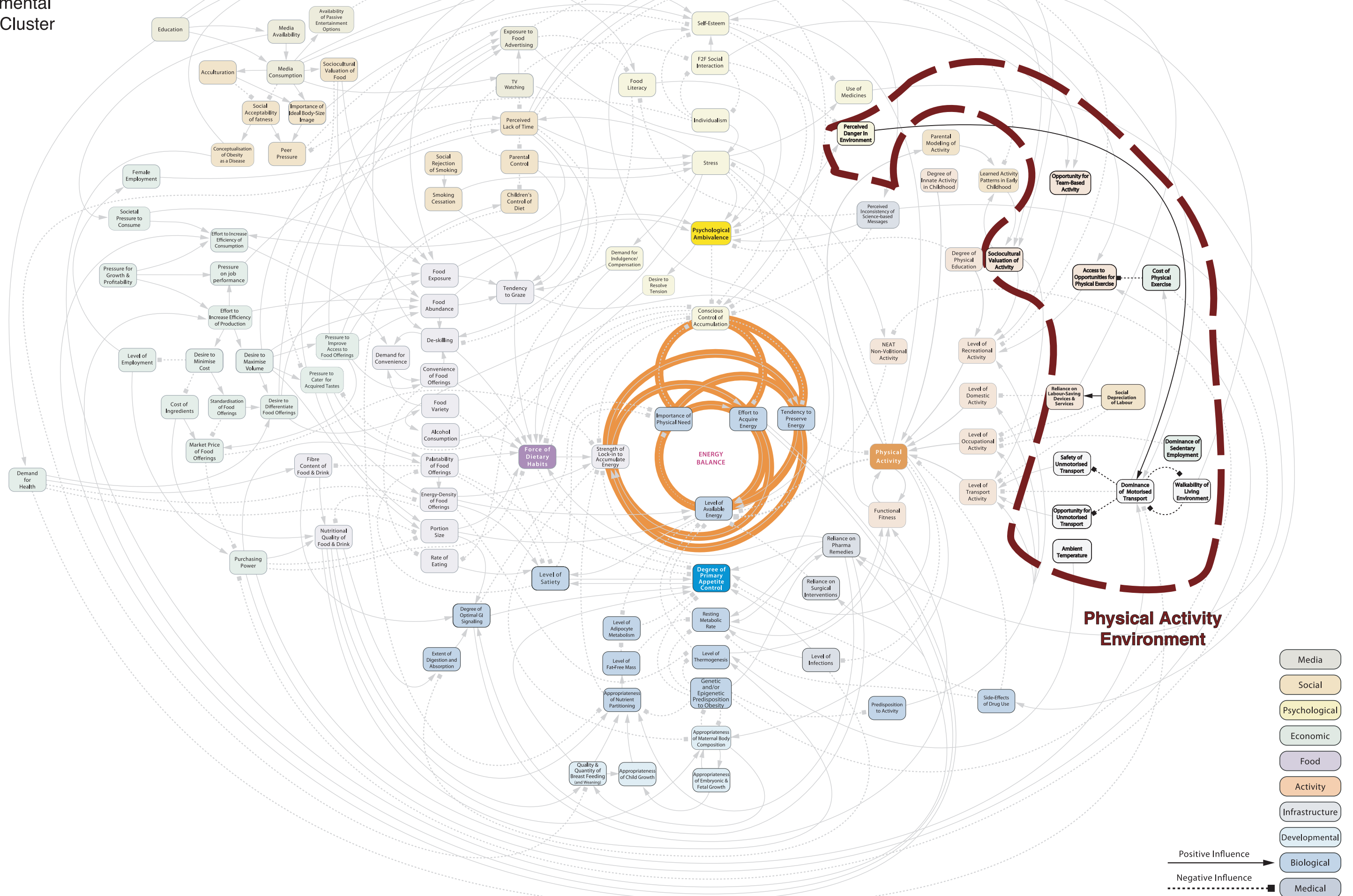
Full Generic Map

Individual Activity Cluster



Map 8

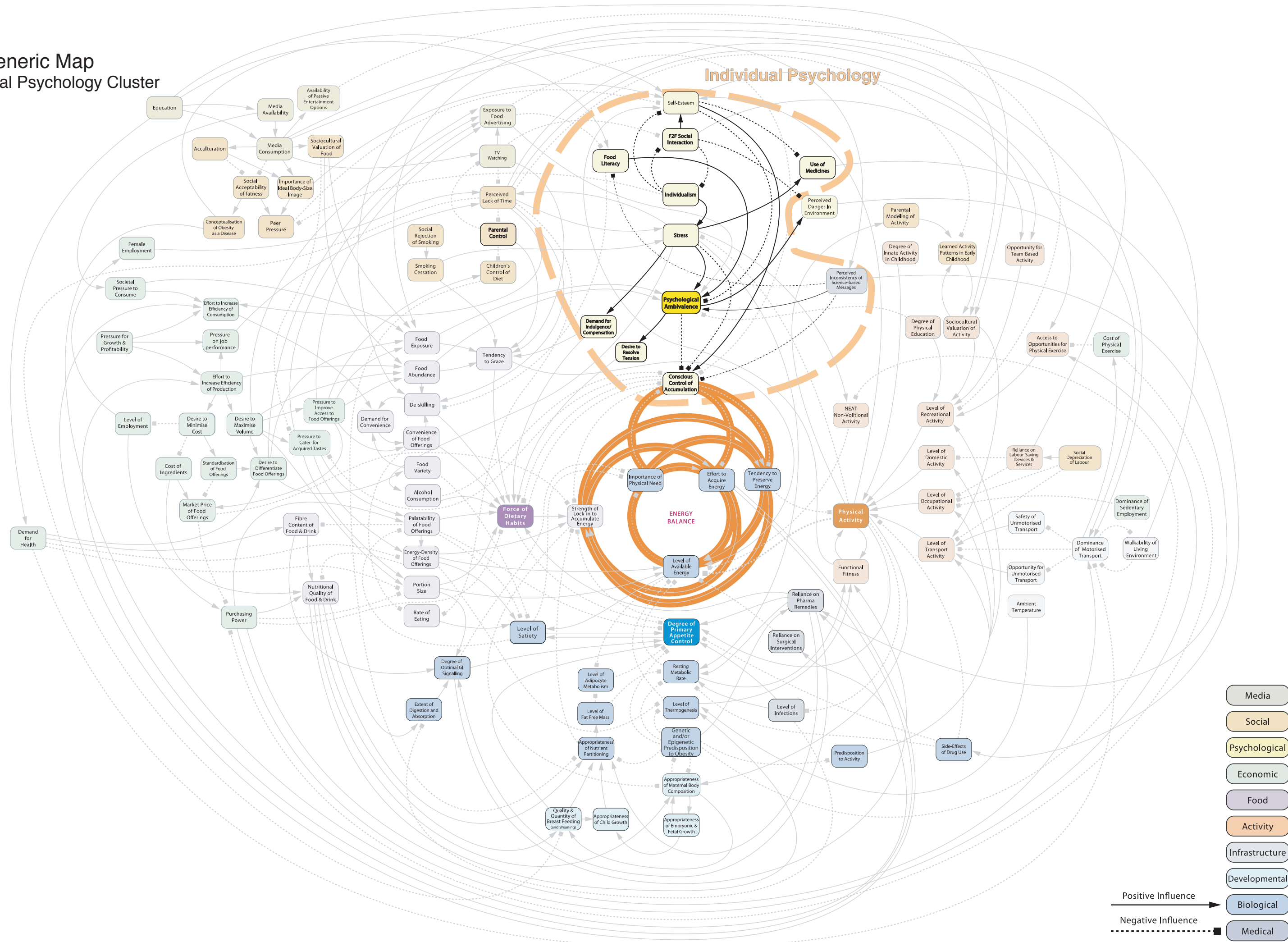
Full Generic Map Environmental Activity Cluster



Map 9

Full Generic Map

Individual Psychology Cluster

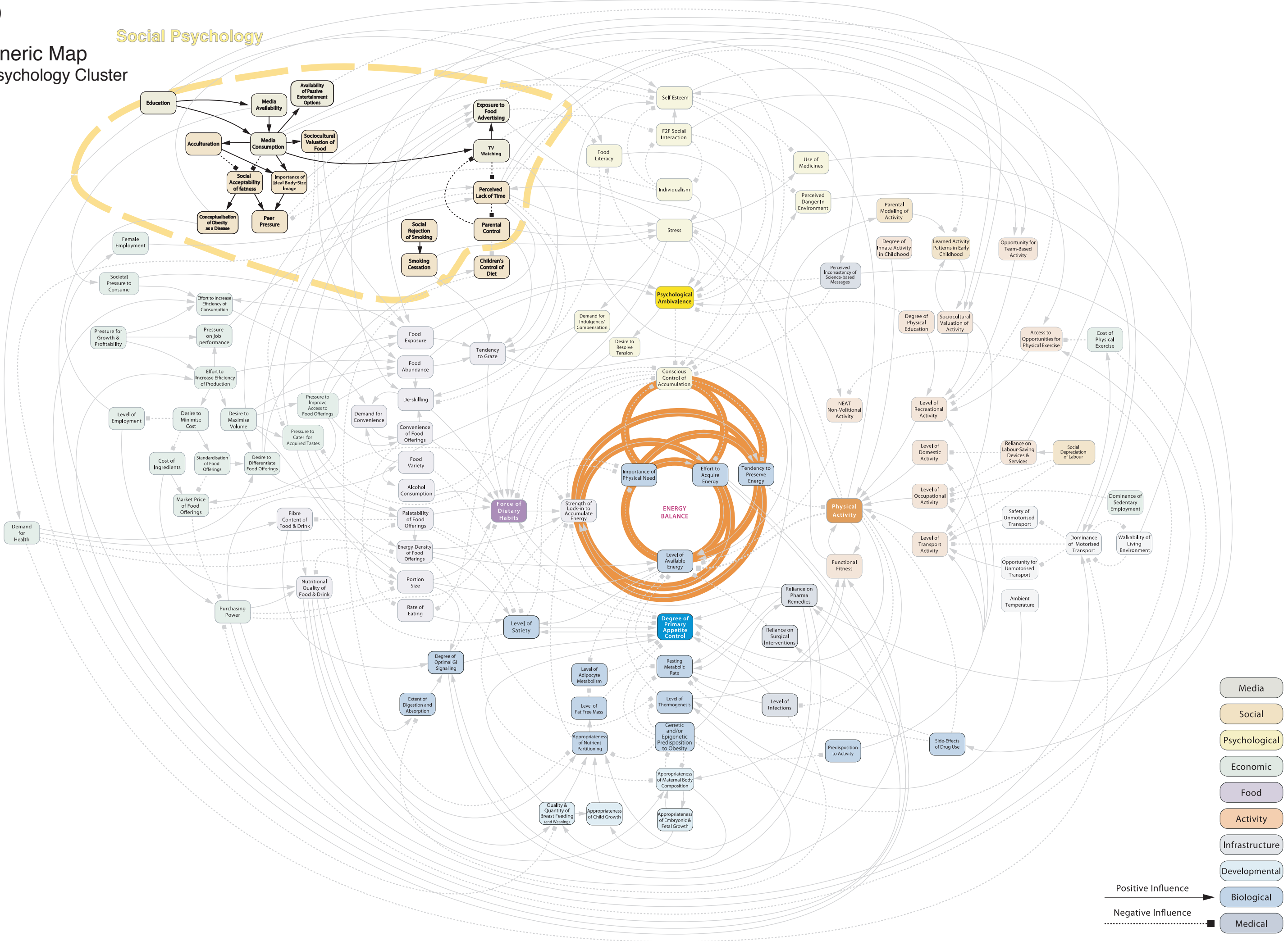


Map 10

Full Generic Map

Social Psychology Cluster

Social Psychology

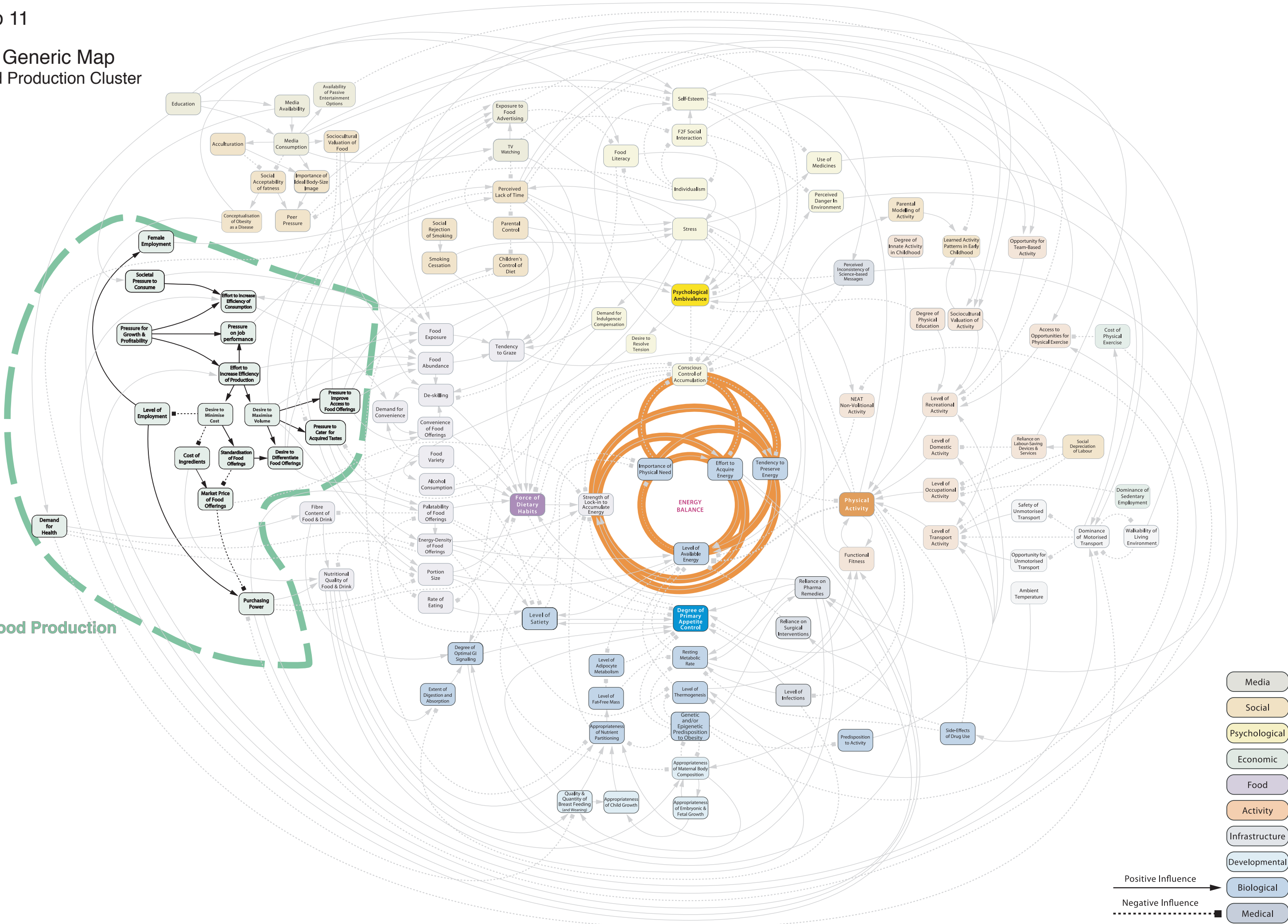


Map 11

Full Generic Map

Food Production Cluster

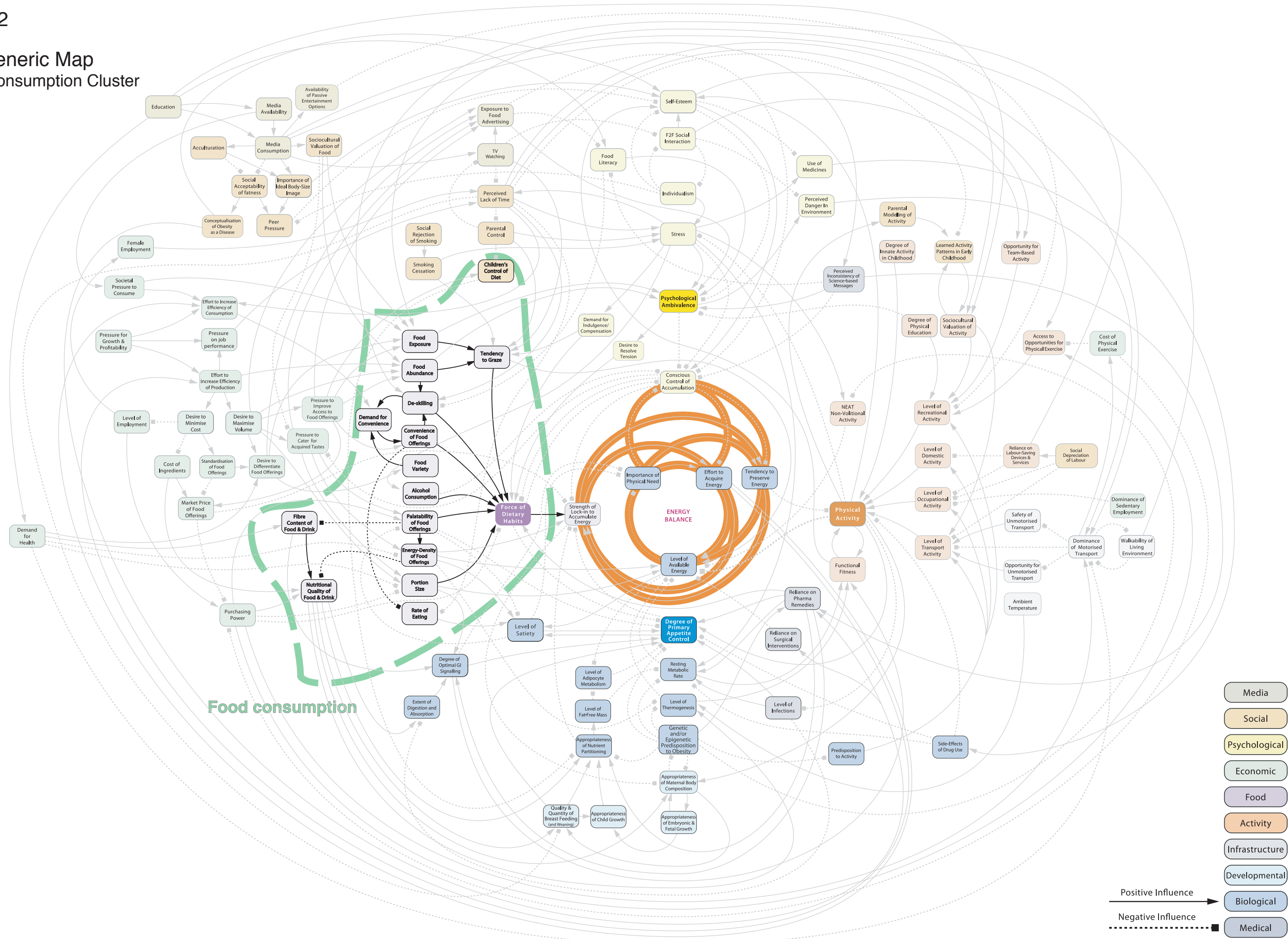
Food Production



Map 12

Full Generic Map

Food Consumption Cluster



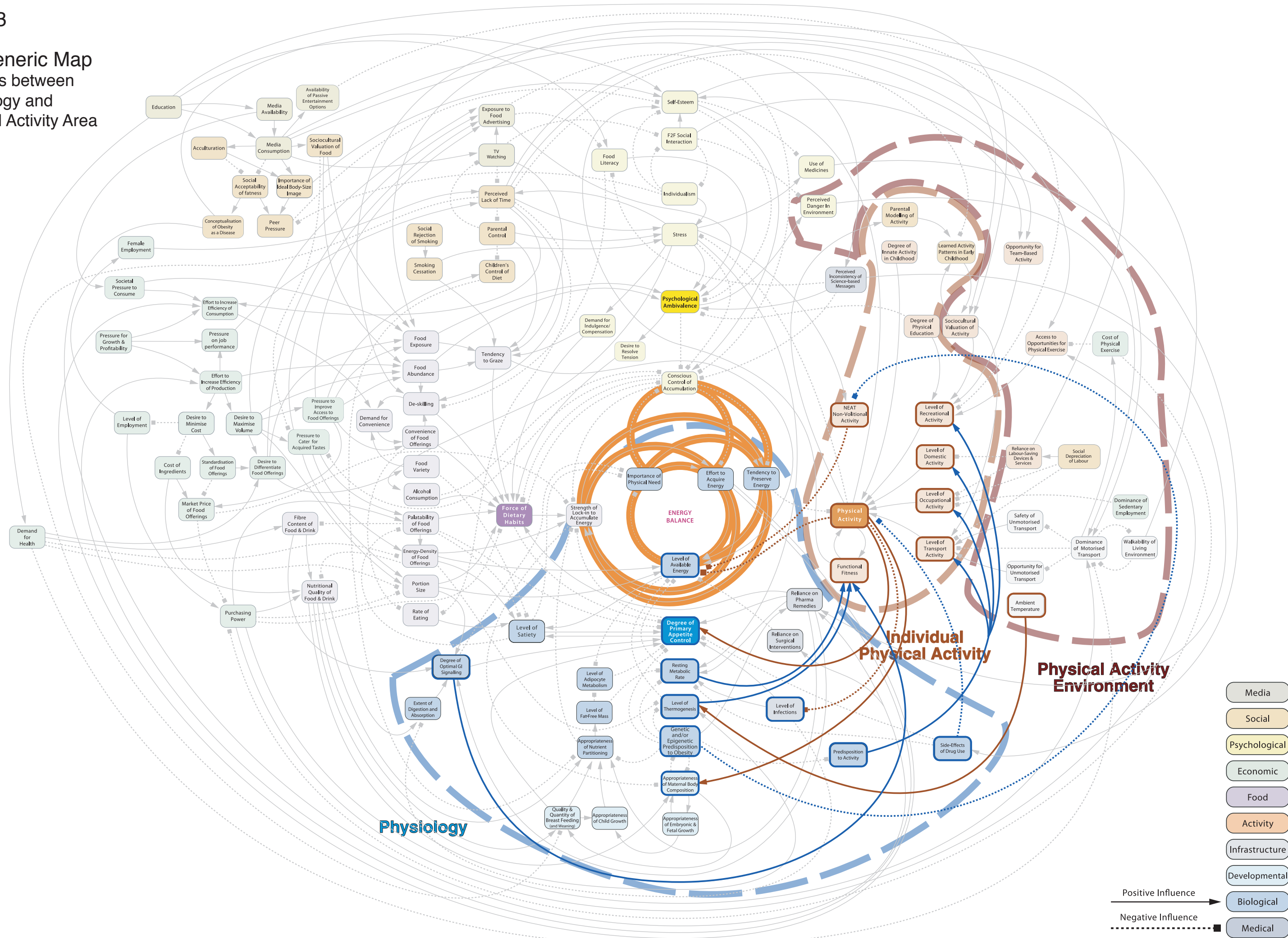
Map 13

Full Generic Map

Linkages between

Physiology and

Physical Activity Area



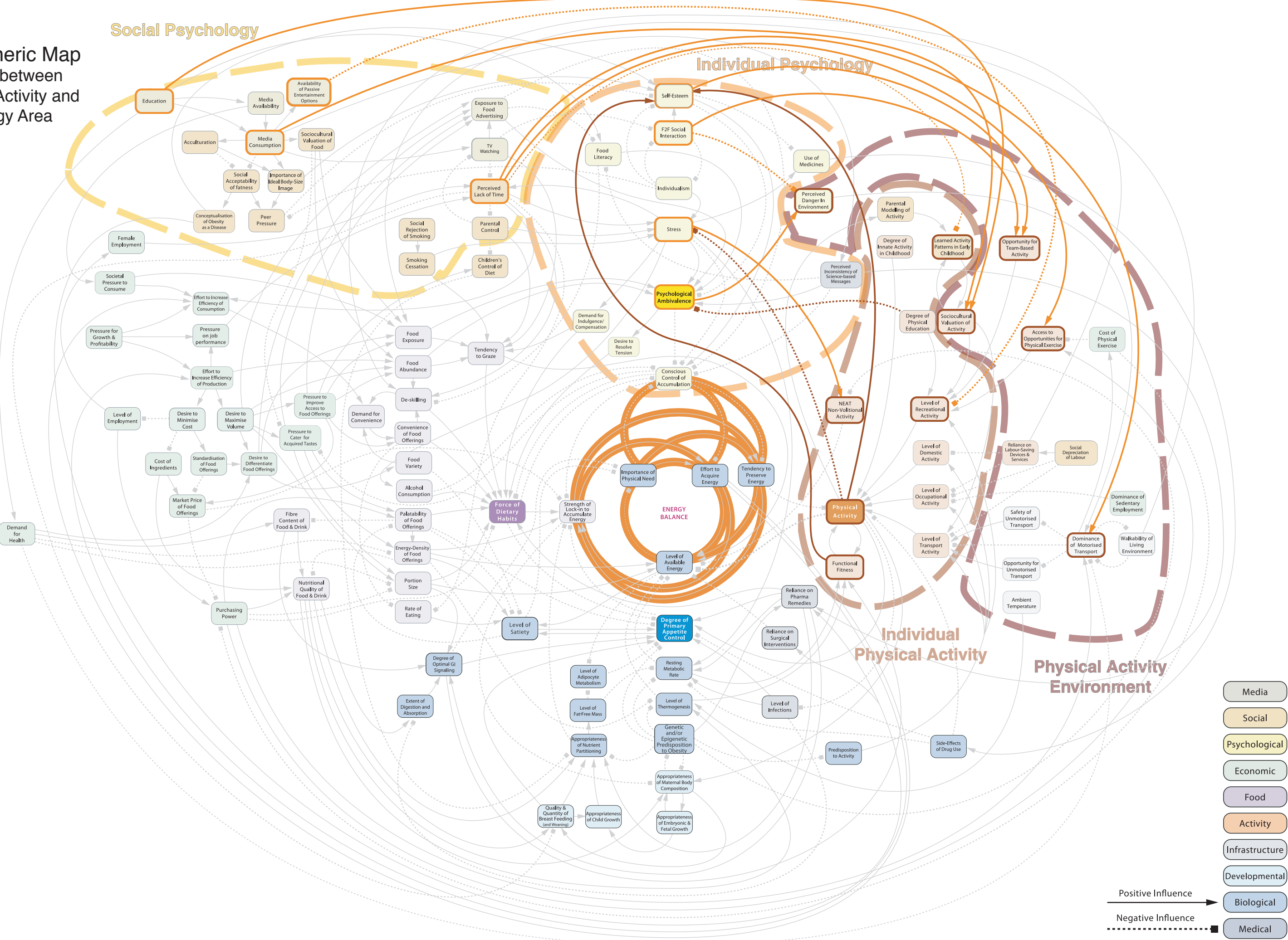
Map 14

Full Generic Map

Linkages between

Physical Activity and

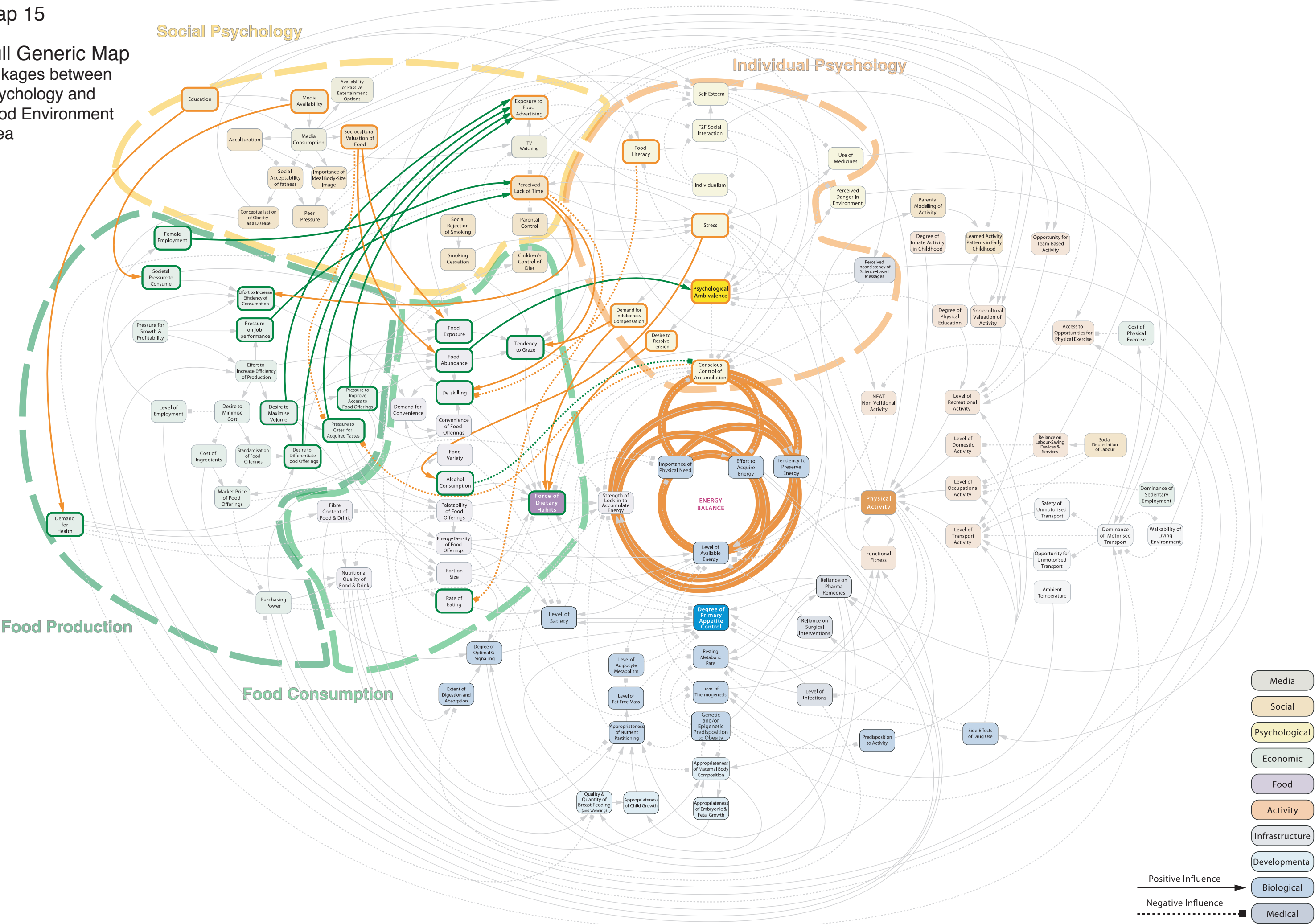
Psychology Area



Map 15

Full Generic Map

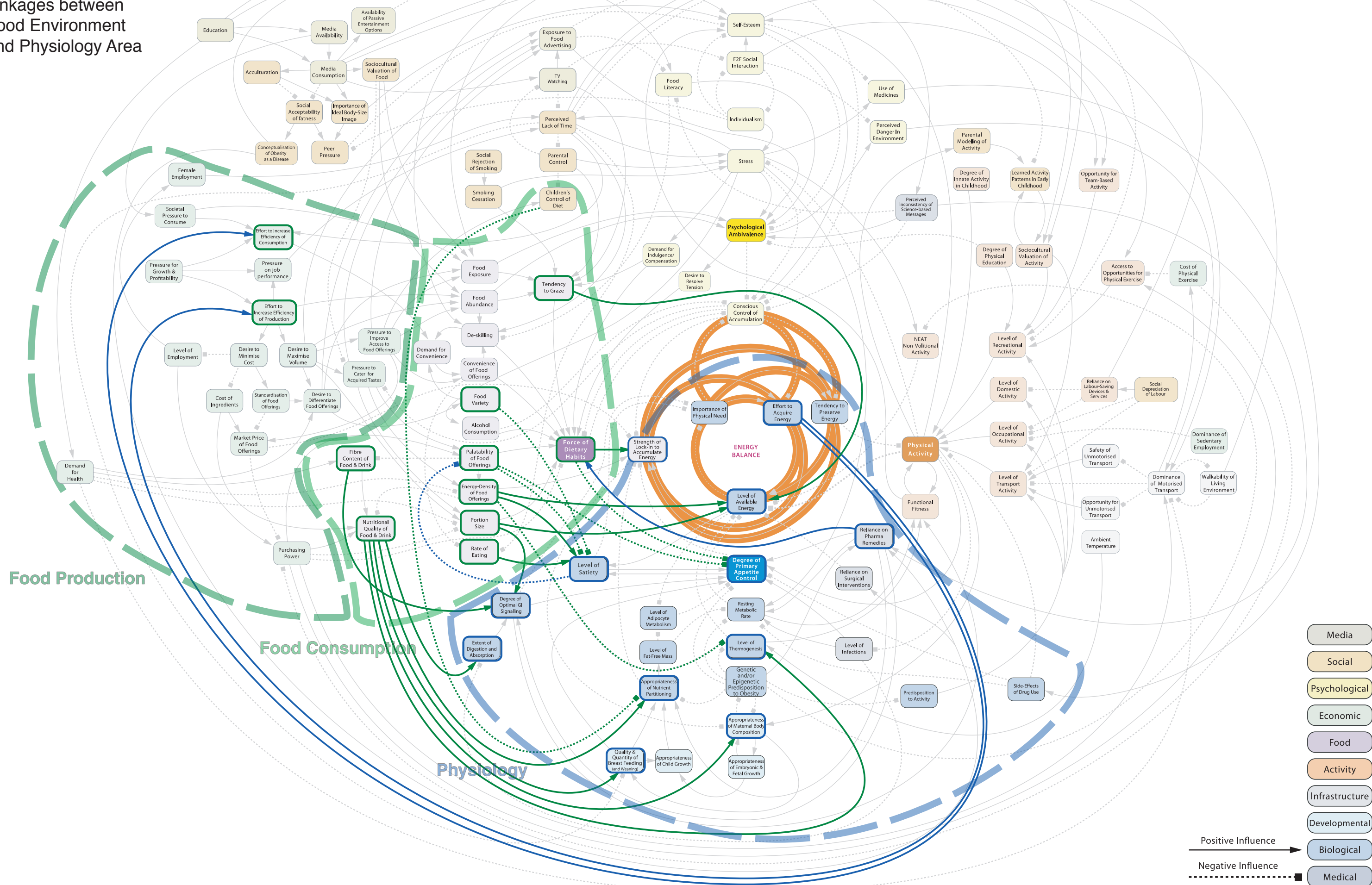
Linkages between Psychology and Food Environment Area



Map 16

Full Generic Map

Linkages between Food Environment and Physiology Area



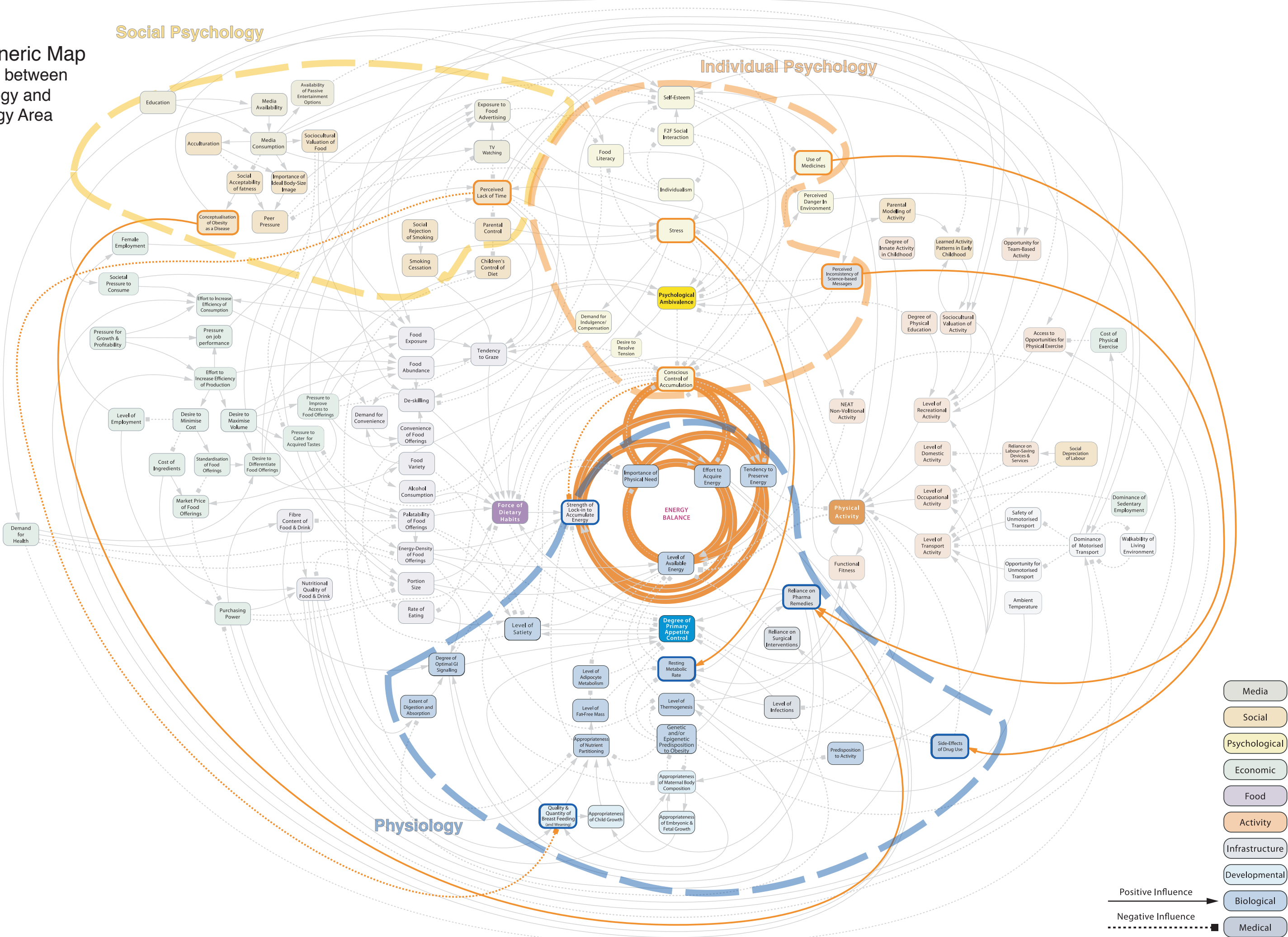
Map 17

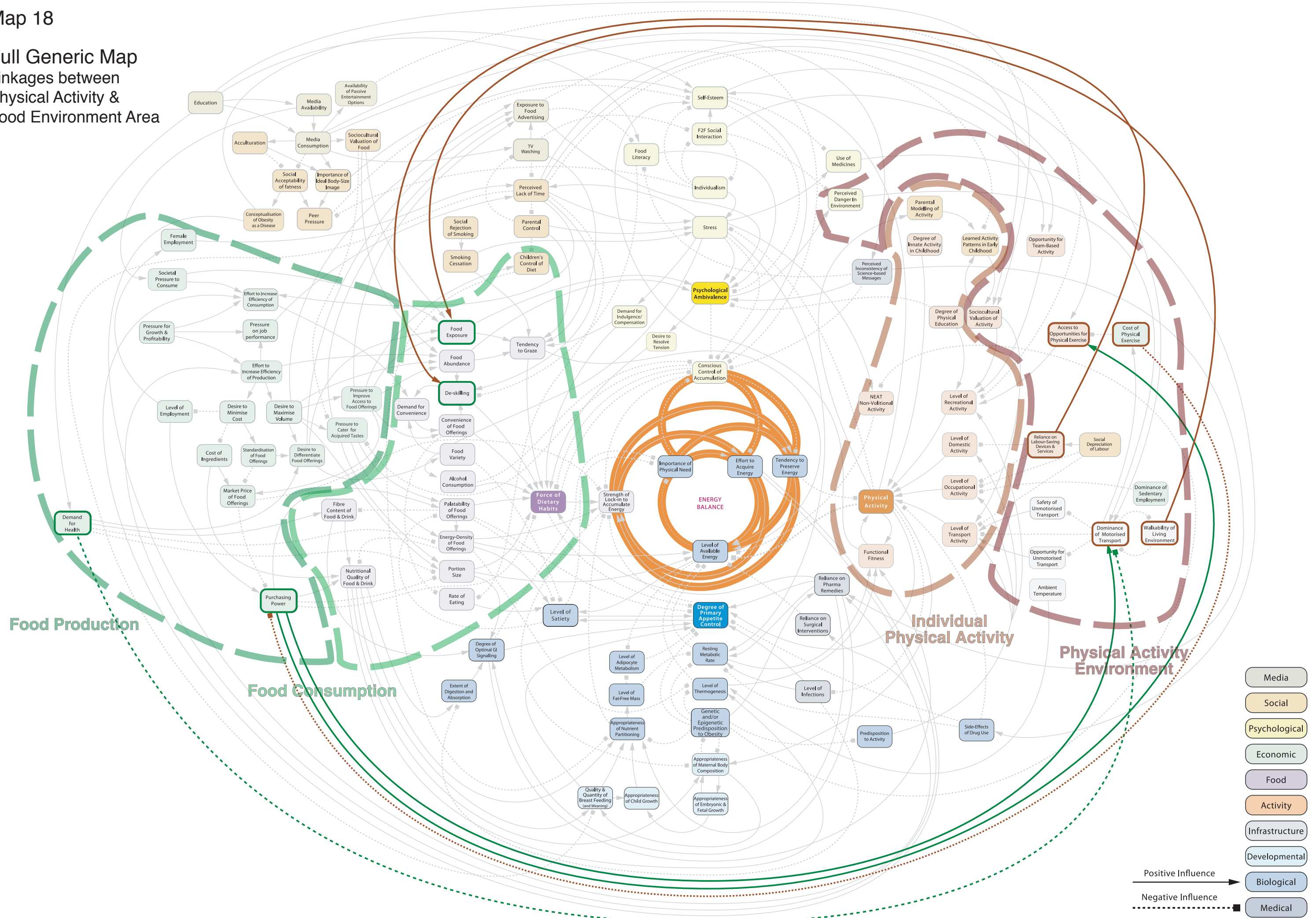
Full Generic Map

Linkages between

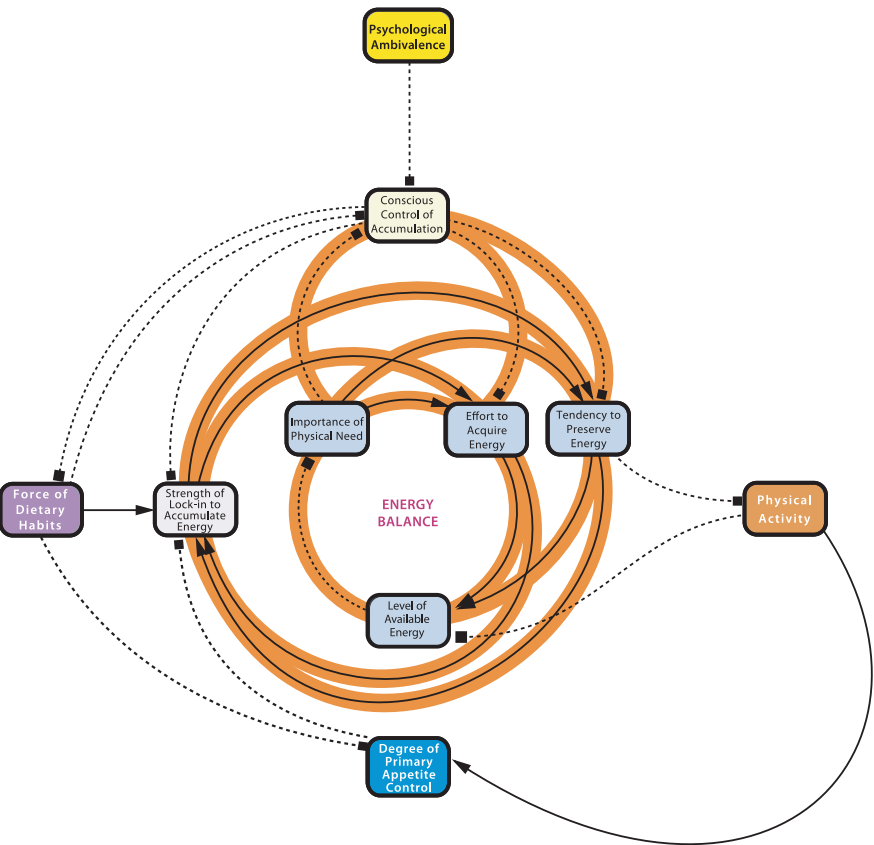
Psychology and

Physiology Area

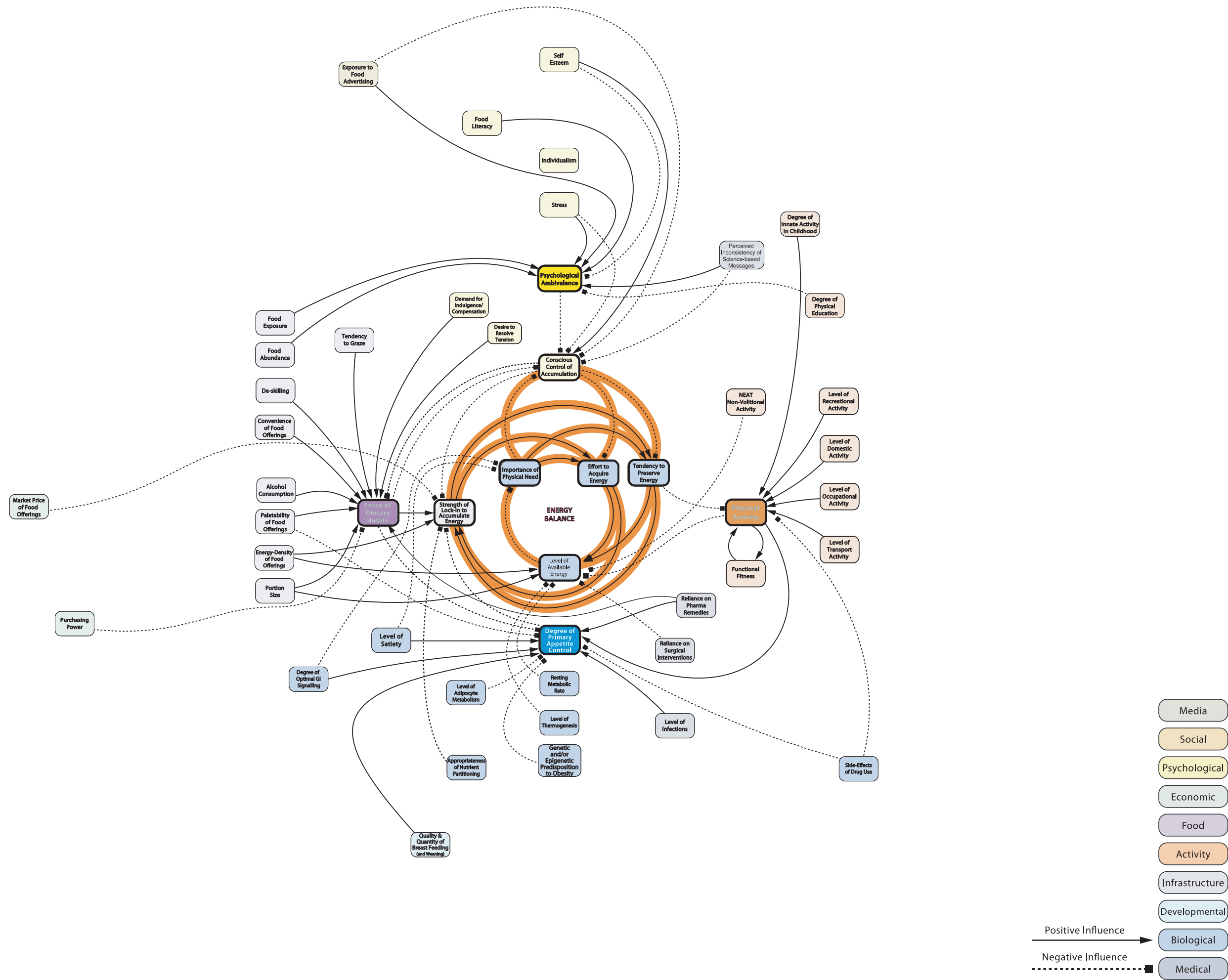




Key Variables:
System Engine
+ 4 Key Variables



Key Variables
System Engine
+ 4 key Variables
+1st Tier Variables



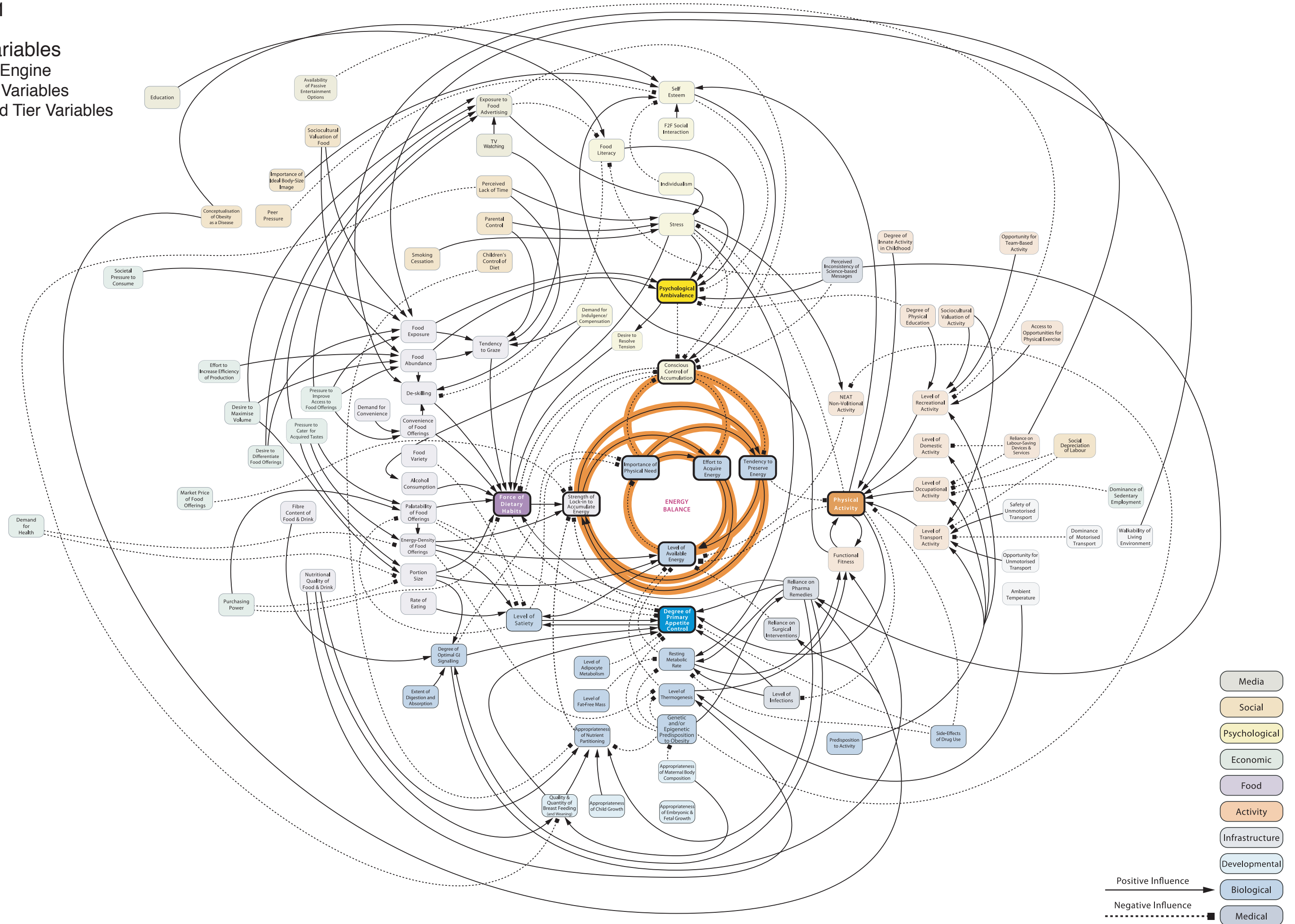
Map 21

Key Variables

System Engine

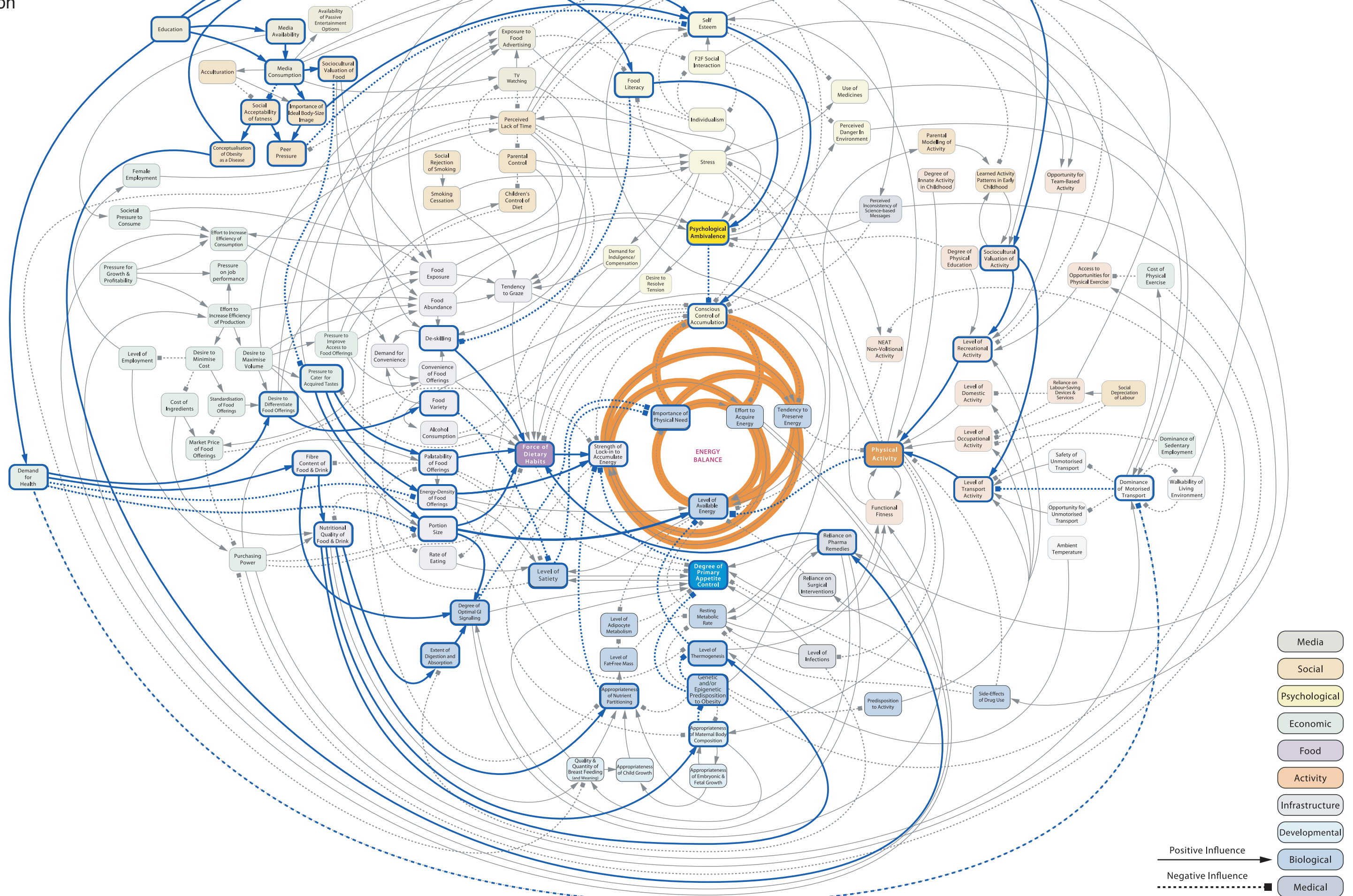
+ 4 Key Variables

+ 1st/2nd Tier Variables



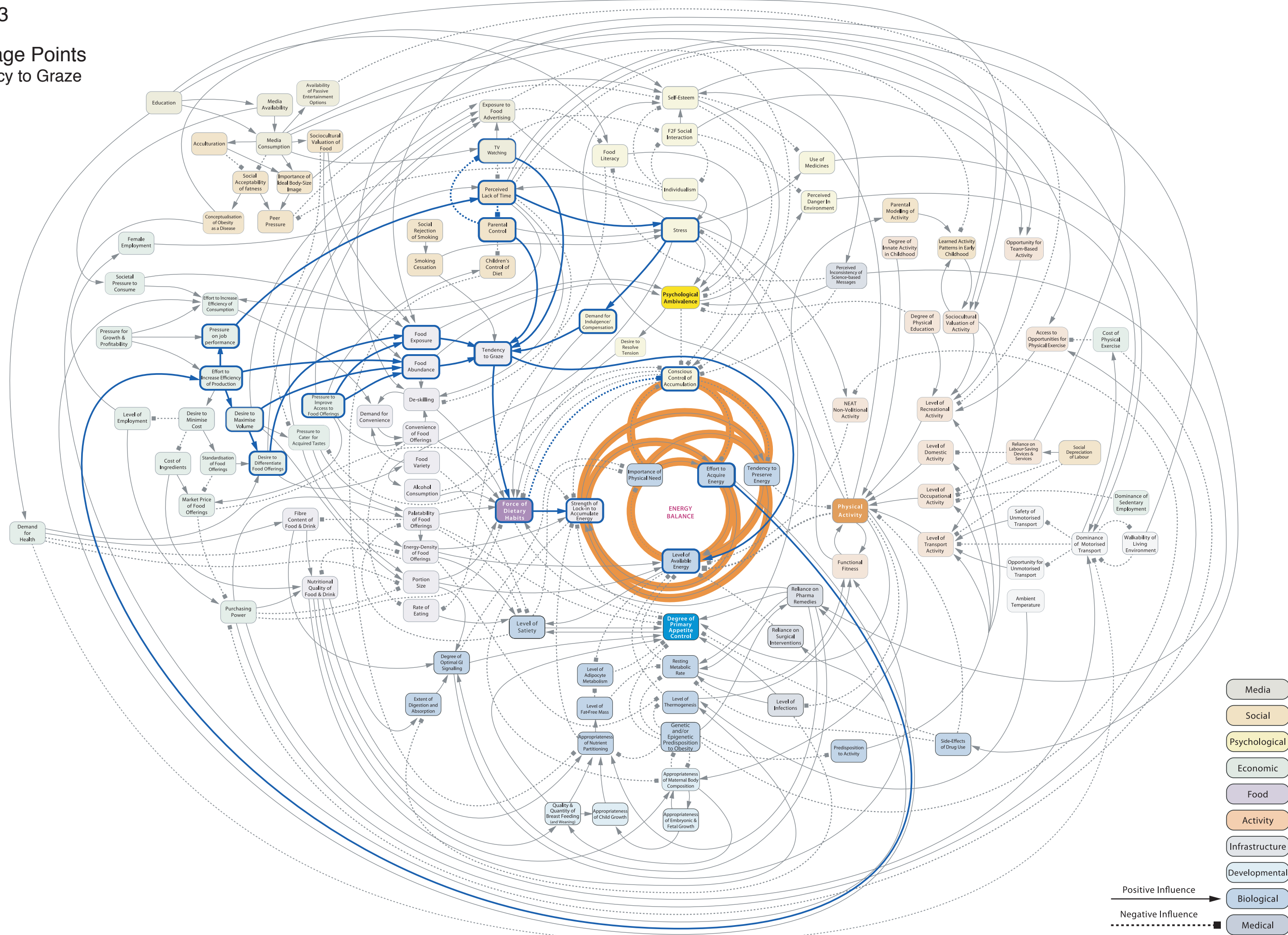
Map 22

Leverage Points Education

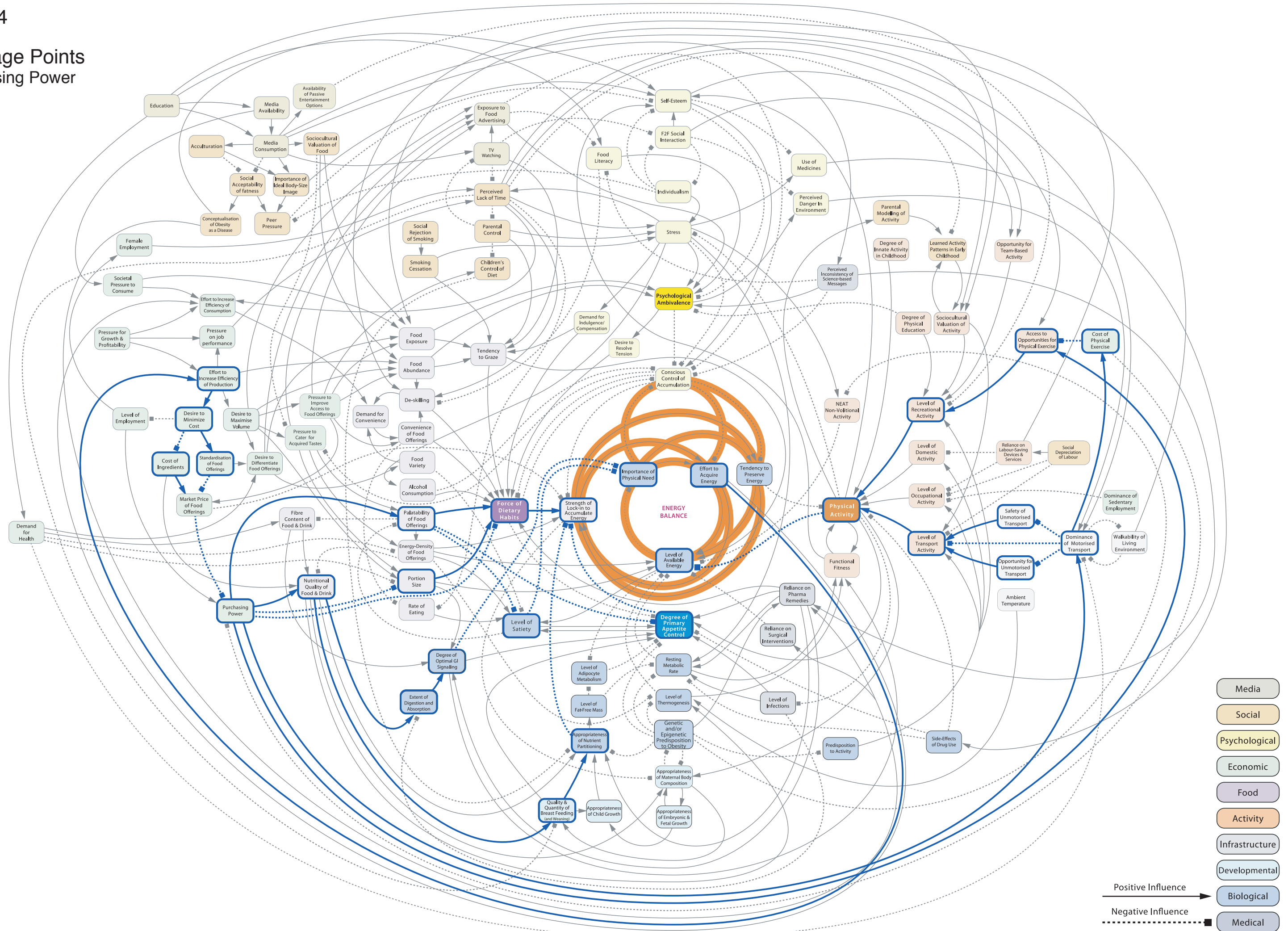


Map 23

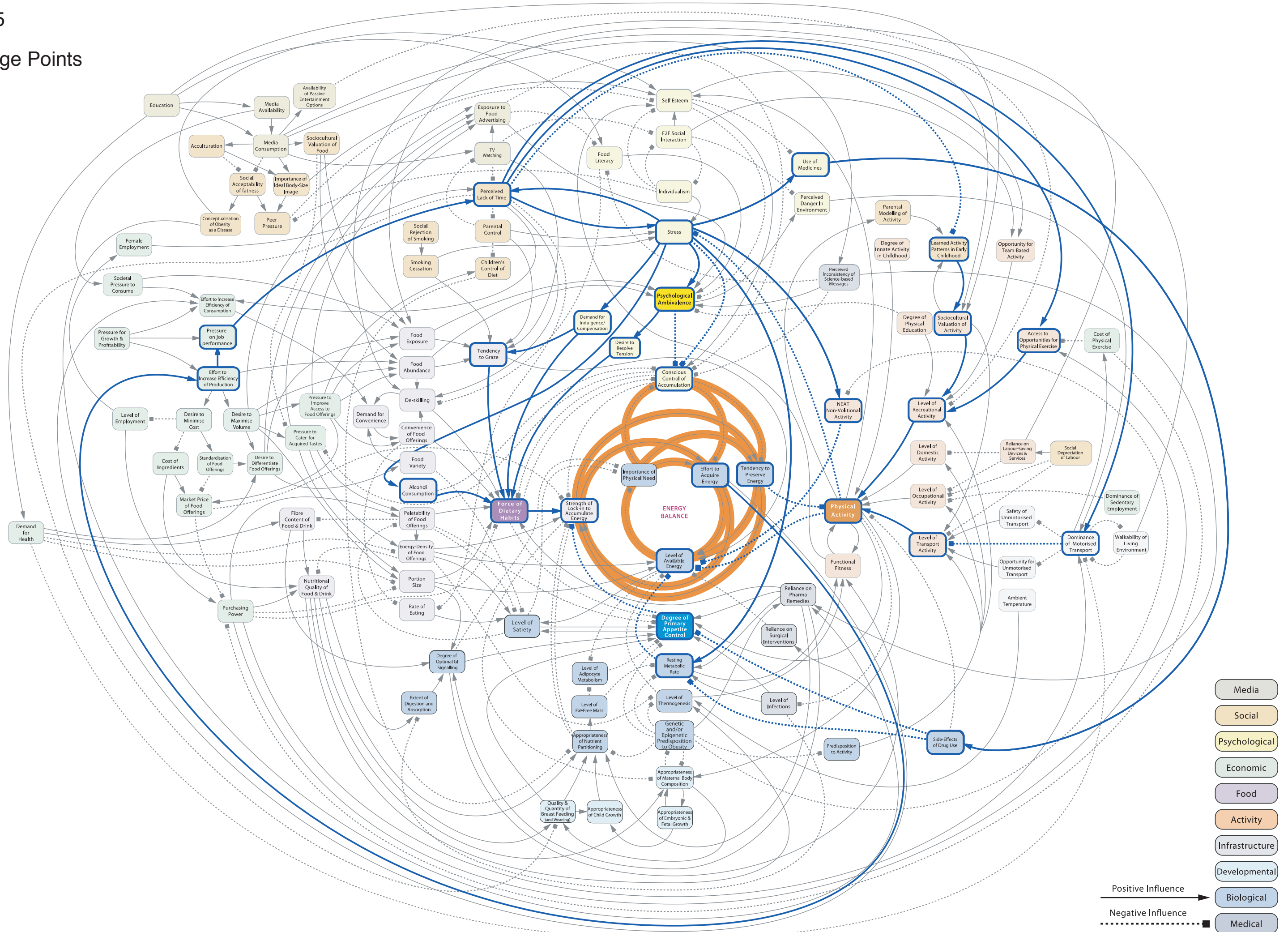
Leverage Points
Tendency to Graze



Leverage Points Purchasing Power

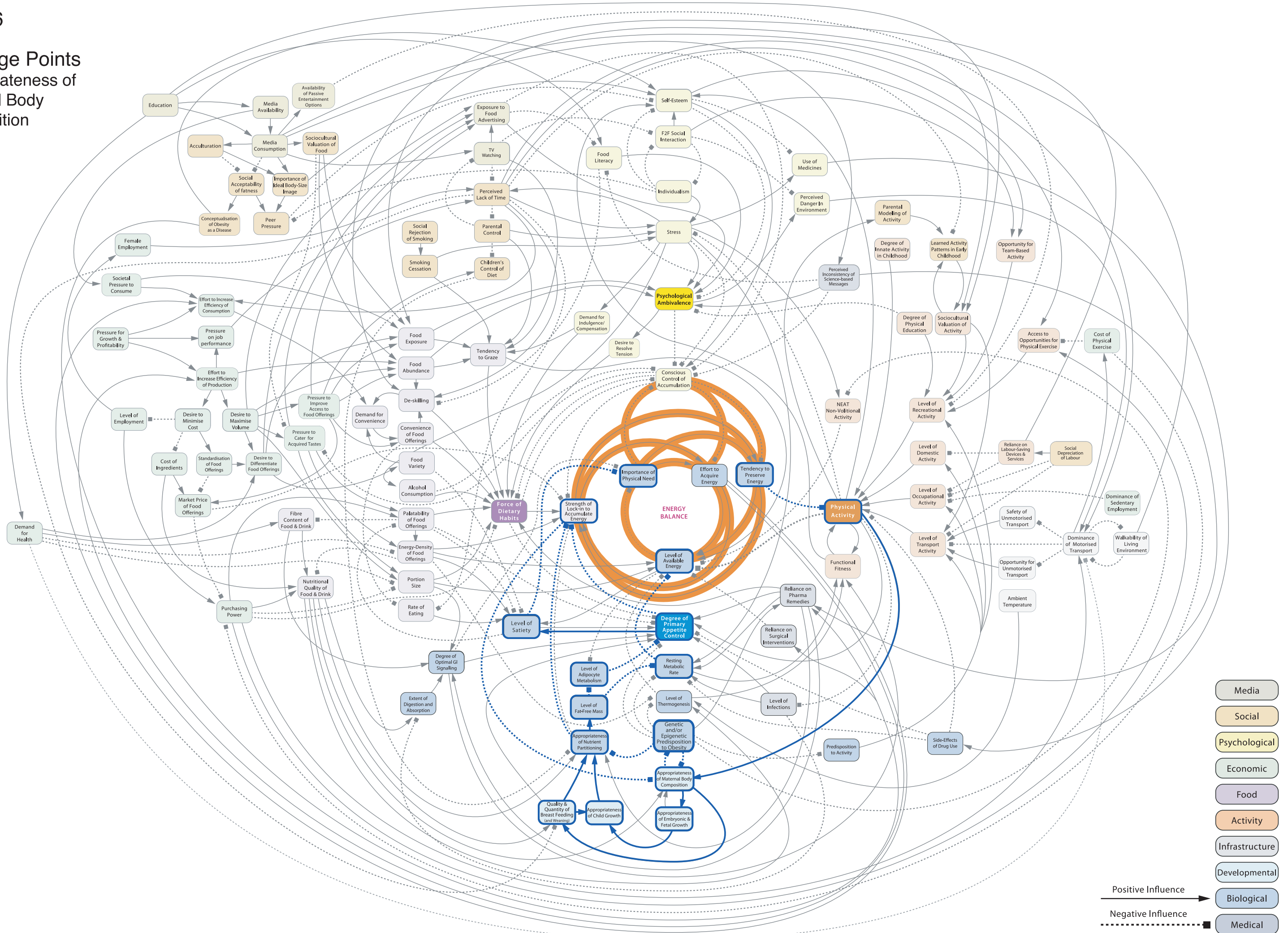


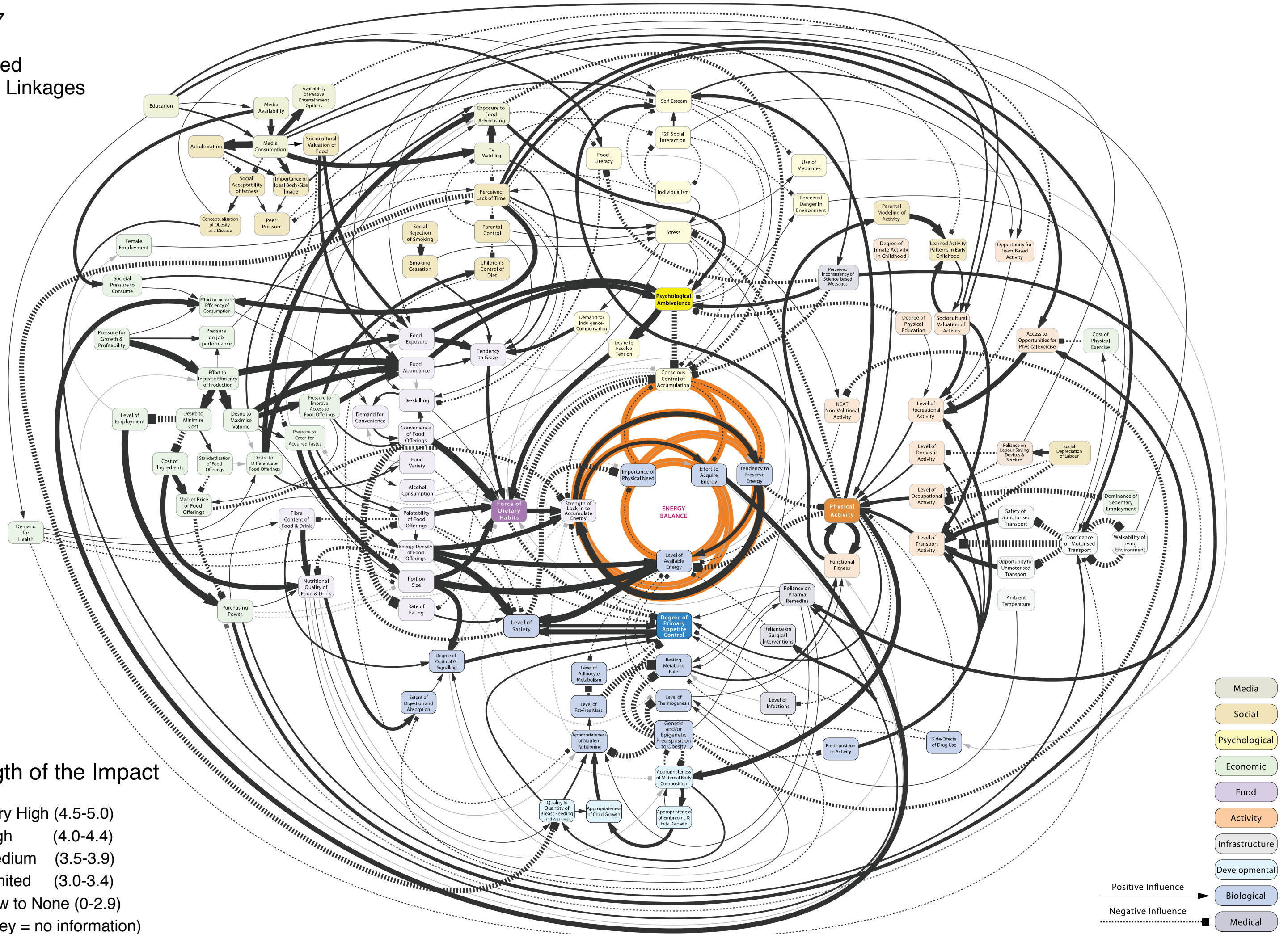
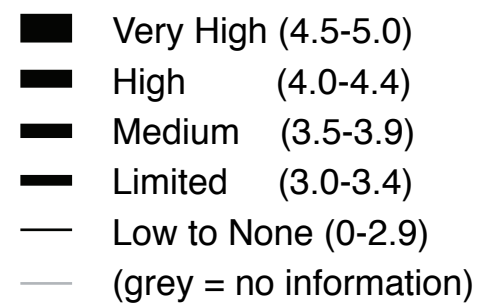
Leverage Points Stress

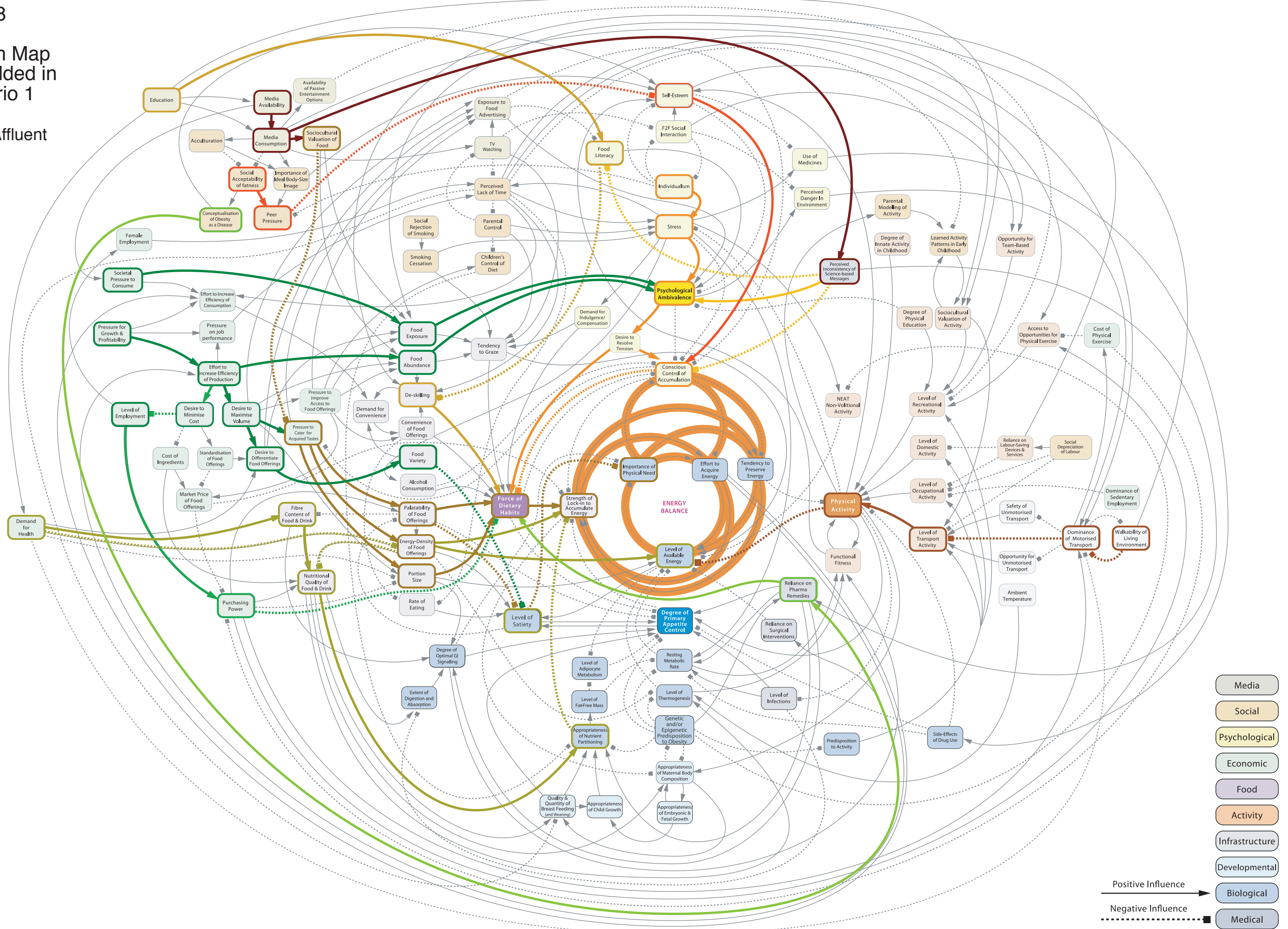


Leverage Points

Appropriateness of Maternal Body Composition



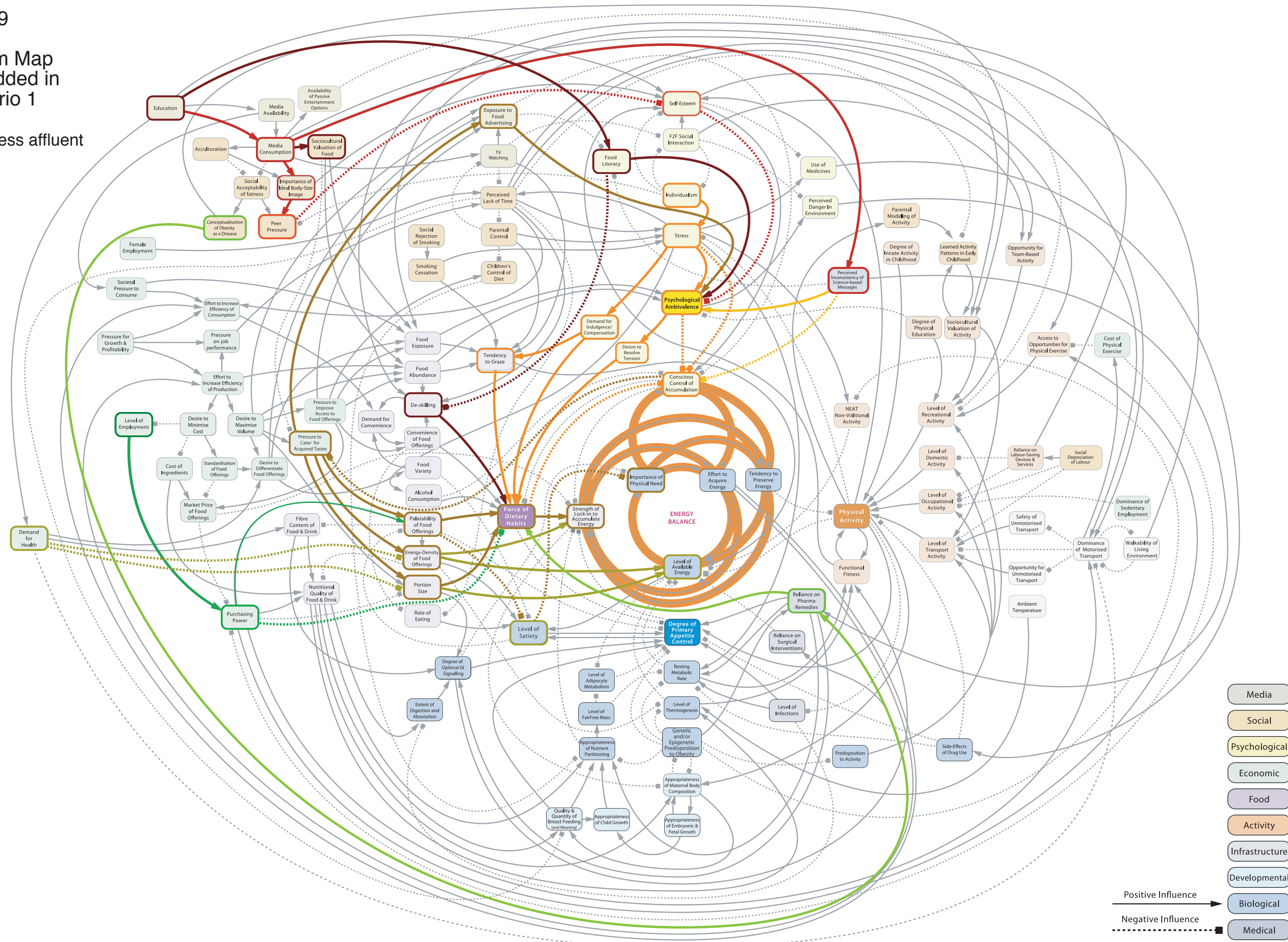




Map 29

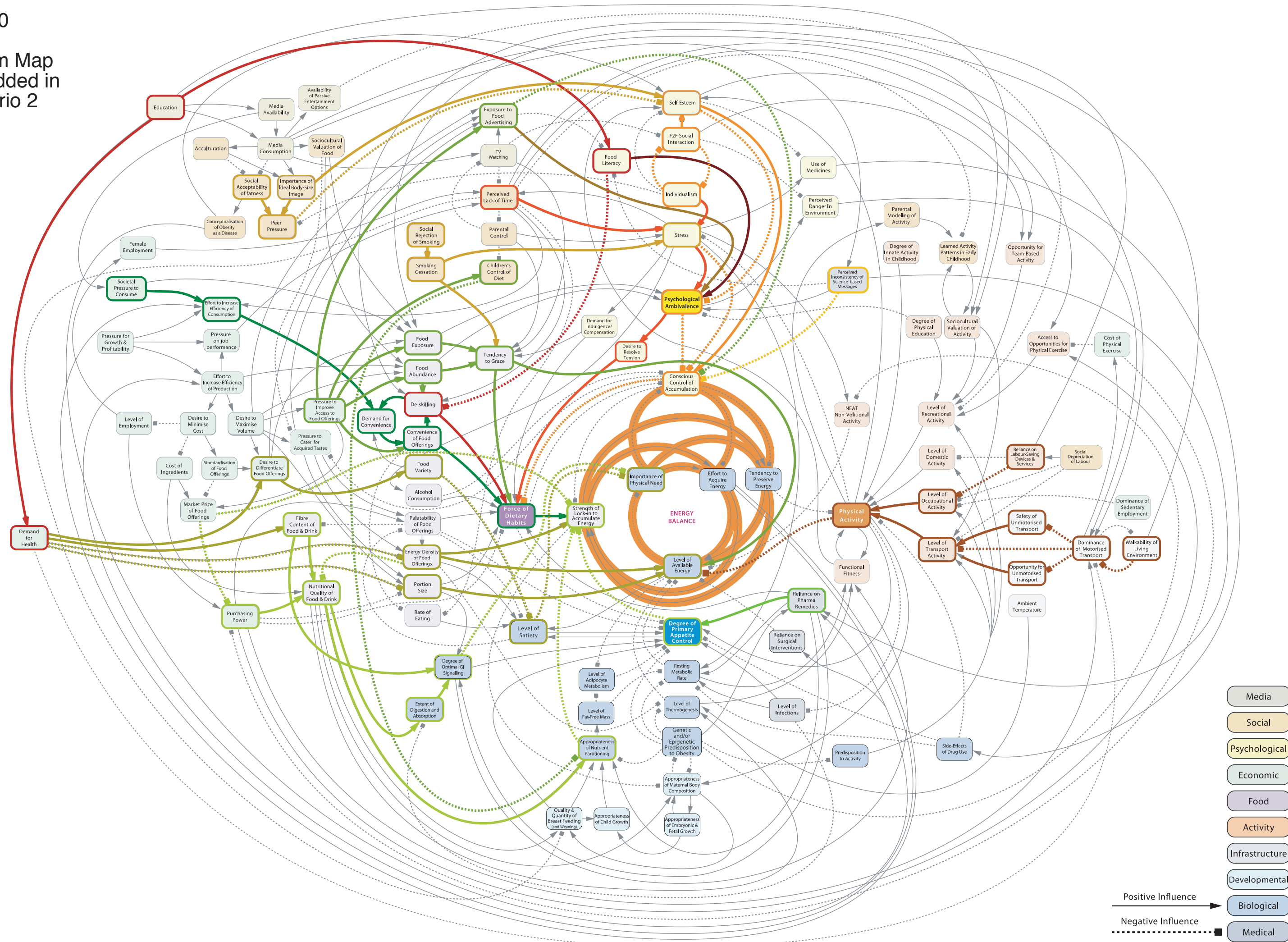
System Map
Embedded in
Scenario 1

b. The less affluent



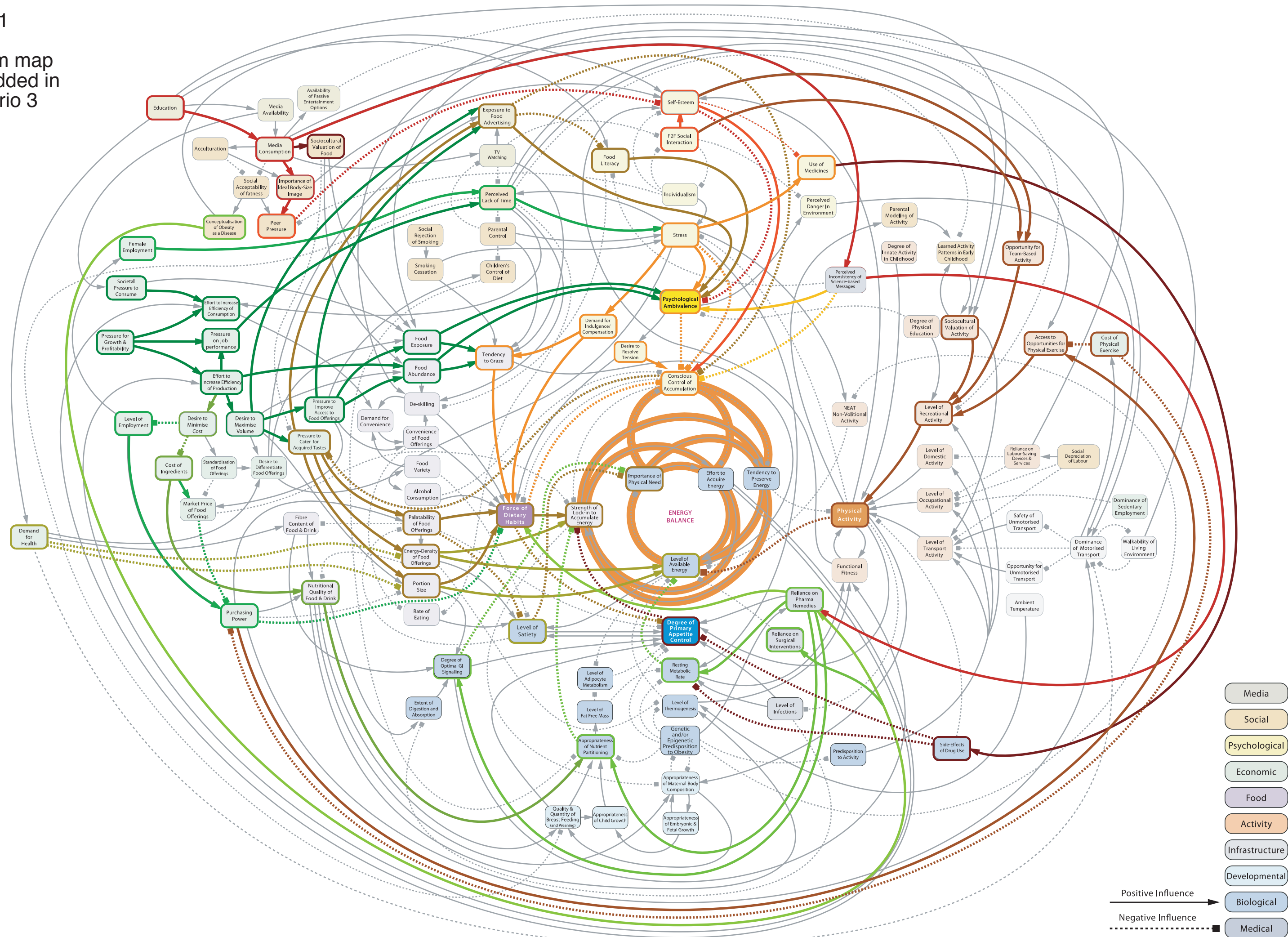
Map 30

System Map
Embedded in
Scenario 2



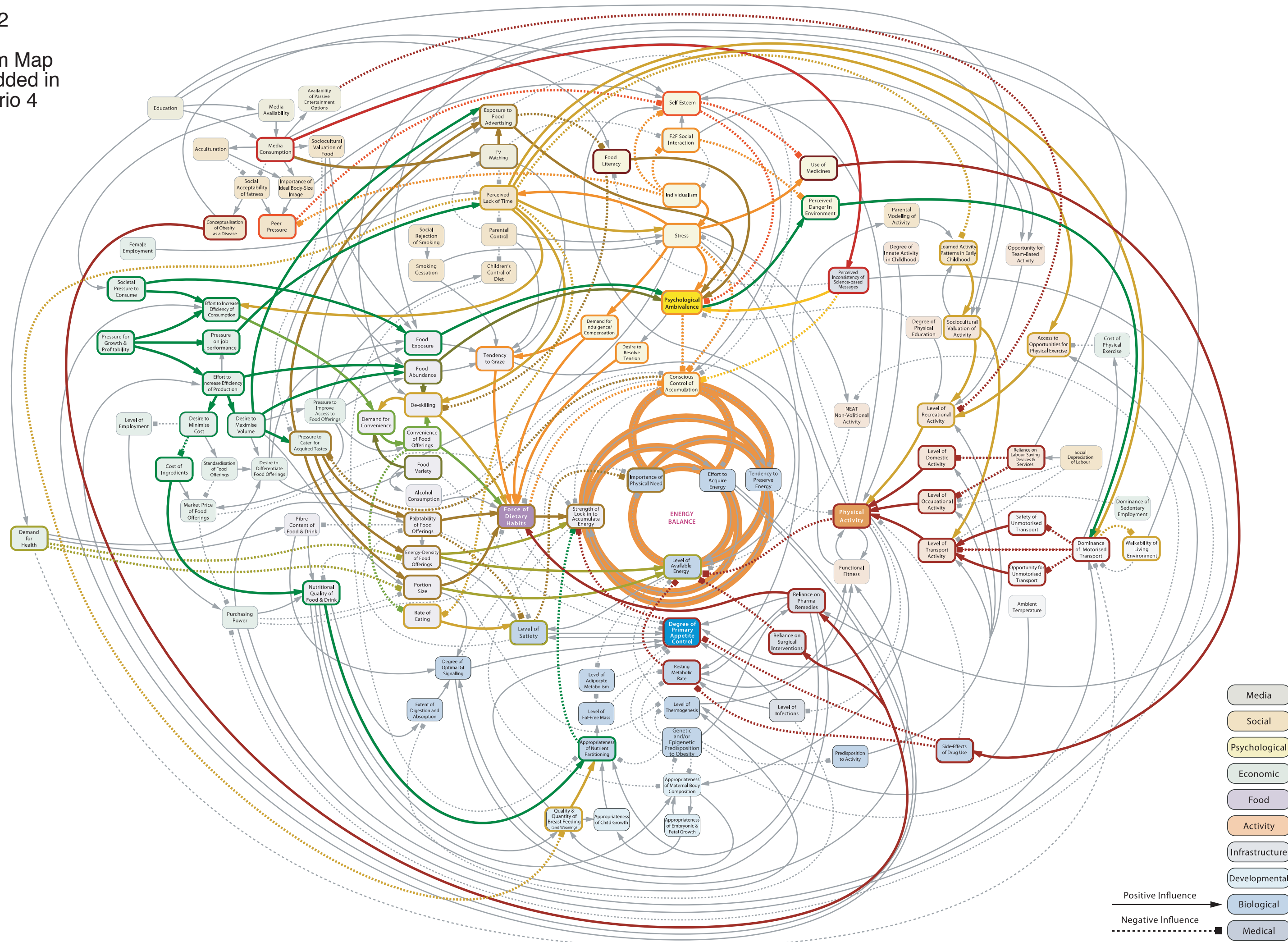
Map 31

System map
Embedded in
Scenario 3

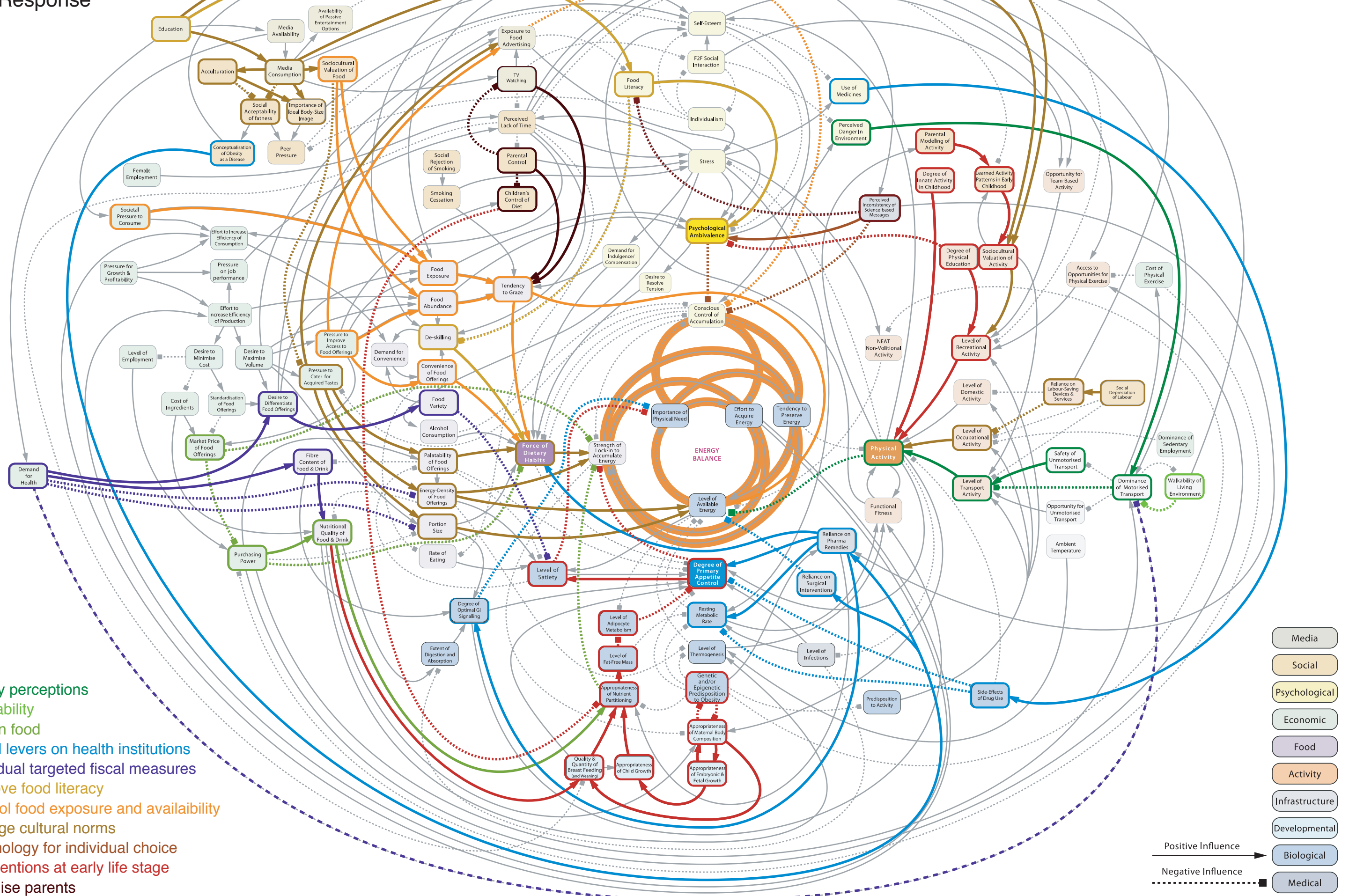


Map 32

System Map
Embedded in
Scenario 4

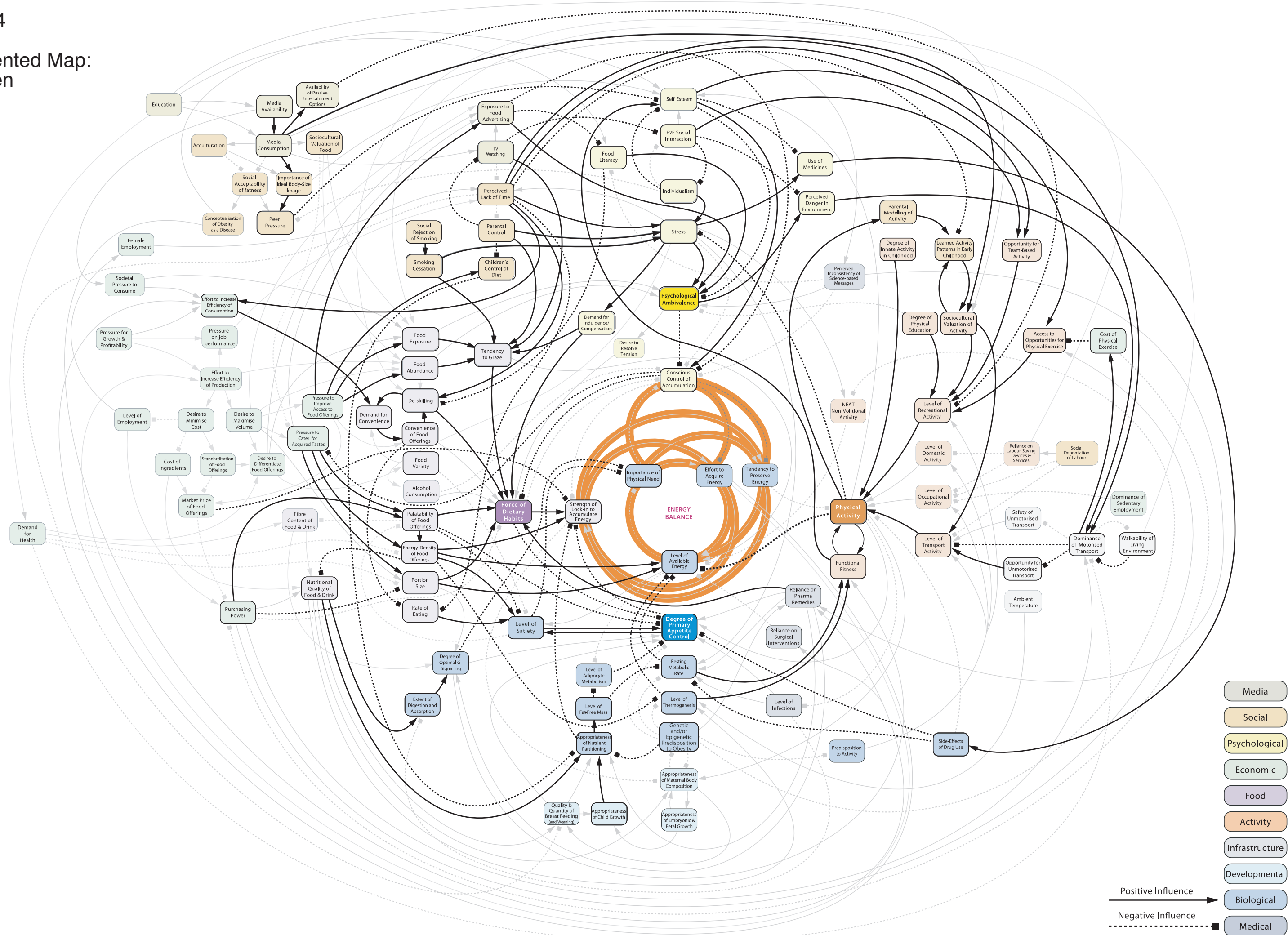


Mapping of Policy Response Ideas



Map 34

Segmented Map:
Children



3 Variable Definitions

Variable	Cluster	Description
<i>Please note: these descriptions are for clarification only. They do not have the status of a generally shared, scientifically based definition; variables marked with (—) are considered to be self-explanatory</i>		
Accessibility to opportunities for physical exercise	Physical activity environment	Physical accessibility (distance, safety) of opportunities for physical exercise
Acculturation	Social psychology	Degree to which a (dominant) culture is assimilated
Alcohol consumption	Food consumption	—
Ambient temperature	Physical activity environment	Average environmental temperature indoors
Appropriateness of embryonic & fetal growth	Physiology	Degree to which the physiological environment for the embryo provides optimal nutrient and physical environment for growth
Appropriateness of child growth	Physiology	Degree to which speed of growth and physiological status of the child are in balance with each other and thus to prevent early onset of adipose tissue formation
Appropriateness of maternal body composition	Physiology	Degree to which the maternal body has the optimal physiological condition at conception, pregnancy and birth
Appropriateness of nutrient partitioning	Physiology	Degree to which the body is able to maintain the appropriate balance between fat, protein and carbohydrate metabolism and storage
Availability of passive entertainment options	Social psychology	Availability of recreational options that involve only limited physical exercise (tv, computer games)
Children’s control of diet	Social psychology	Degree to which children exert influence on dietary choices in a family
Conceptualisation of obesity as a disease	Social psychology	Degree to which people consider obesity to be a abnormal deviation from the healthy norm
Conscious control of accumulation	Engine	Level at which cognitive/reflexive processes exert influence on energy intake and expenditure
Convenience of food offerings	Food consumption	The degree to which food offerings cater to the desire for convenience
Cost of ingredients	Food production	Cost of ingredients used in processed foodstuffs
Cost of physical exercise	Physical activity environment	Financial cost of physical recreation
Degree of innate activity in childhood	Individual physical activity	Degree to which physical activity is part of typical childhood behaviour
Degree of optimal GI signalling	Physiology	Degree of intestinal signals resulting from digestion and absorption of food that help to control the intake of type and amount of foods.
Degree of physical education	Individual physical activity	Degree to which people have learned to use their body (for labour, leisure and transport)
Degree of primary appetite control by brain	Physiology	Degree to which the brain automatically (non-consciously) responds to signals of the digestive system to control type and amount of food intake
Demand for convenience	Food consumption	Consumer demand for convenient (time/effort saving) food offerings
Demand for health	Food production	—
Demand for indulgence/compensation	Individual psychology	Strenght of demand for psychological release after stress or effort
Desire to differentiate food offerings	Food production	Industry-internal drive to distinguish themselves from competition
Desire to maximise volume	Food production	Industry-internal drive to maximise volumes sold on the market
Desire to minimise cost	Food production	Industry-internal drive to minimise the cost of production

Variable	Cluster	Description
Desire to resolve tension	Individual psychology	Desire to resolve psychological conflict between what people desire and what they need to stay healthy
De-skilling	Food consumption	The degree to which individuals are not able anymore to engage independently in routine tasks for daily living (such as cooking)
Dominance of motorised transport	Physical activity environment	Degree to which motorised transport dominates other ways of transport
Dominance of sedentary employment	Physical activity environment	Degree to which average citizens influence one another's choices
Education	Social psychology	—
Effort to acquire energy	Engine	Effort people spend to acquire bodily energy via food intake
Effort to increase efficiency of consumption	Food production	By consumers
Effort to increase efficiency of production	Food production	Effort by economic actors (industry)
Energy-density of food offerings	Food consumption	Number of calories per unit food weight
Exposure to food advertising	Social psychology	—
Extent of digestion and absorption	Physiology	Degree of optimal energy and nutrient absorption by the human body
Female employment	Food production	—
F2F social interaction	Individual psychology	Intensity of face-to-face interaction between individuals
Fibre content of Food & Drink	Food consumption	—
Food abundance	Food consumption	The aggregate amount of food (volume) that is at any moment in time available in UK society
Food exposure	Food consumption	The number of food cues individuals are confronted with on a daily basis
Food literacy	Individual psychology	Degree to which people are able to assess nutritional quality and provenance
Food variety	Food consumption	The number of different food products (natural and processed) available at any moment in time
Force of dietary habits	Food consumption	The degree to which behavioural patterns related to food intake are dictated by routine and habit
Functional fitness	Individual physical activity	Level of physical fitness to perform daily tasks
Genetic and/or epigenetic predisposition to obesity	Physiology	Degree to which a person is predisposed by his genetic make-up to develop obesity; degree of indirect inheritance that contributes to obesity susceptibility
Importance of ideal body-size image	Social psychology	Degree to which there is a dominant image of an ideal body size in a society
Importance of physical need	Engine	Degree to which physical need for energy triggers energy spending and acquiring behaviour
Individualism	Individual psychology	Weakness of social fabric
Learned activity patterns in early childhood	Individual physical activity	Degree of activity experienced by the foetus, newborn and child in early life through parental physical activity
Level of adipocyte metabolism	Physiology	Degree to which fat is rapidly absorbed and stored in adipose tissue (fat storage cells)
Level of available energy	Engine	Level of energy available to an individual
Level of domestic activity	Individual physical activity	Level of physical activity exhibited in the domestic arena

Variable	Cluster	Description
Level of employment	Food production	—
Level of fat-free mass	Physiology	Relative level of fat-free tissue (muscle) in comparison to fat tissue (adipose tissue)
Level of female employment	Food production	—
Level of infections	Physiology	Degree of general occurrence of all type of diseases in society
Level of occupational activity	Individual physical activity	Level of physical activity associated to professional duties
Level of recreational activity	Individual physical activity	Degree to which people engage in physical activity for recreation
Level of satiety	Physiology	Degree to which food digestion and absorption in the gut reduces the need for food intake
Level of thermogenesis	Physiology	Degree of energy needed to maintain body temperature
Level of transport activity	Individual physical activity	Level of physical activity associated to transport
Market price of food offerings	Food production	—
Media availability	Social psychology	Availability of media across formats
Media consumption	Social psychology	Degree to which people make use of the media offerings
Non-volitional activity (NEAT)	Individual physical activity	Extent to which people engage in non-volitional activity (twitching etc)
Nutritional quality of Food & Drink	Food consumption	—
Opportunity for team-based activity	Physical activity environment	—
Opportunity for unmotorised transport	Physical activity environment	Availability of facilities/infrastructure for unmotorised transport
Palatability of food offerings	Food consumption	—
Parental control	Social psychology	Level of control exerted by parents on children's choices
Parental modelling of activity	Individual physical activity	Degree to which parents act as a role model in physical activity related behavioural patterns
Peer pressure	Social psychology	Degree to which average citizens influence one another's choices
Perceived danger in environment	Physical activity environment	—
Perceived inconsistency of science-based messages	Individual psychology	Degree to which there is incompatibility between scientific assessments on food related issues which (are perceived) to be similar
Perceived lack of time	Social psychology	By all citizens, particularly those engaged in economic activity
Physical activity	Individual physical activity	Level of physical activity people engage in
Portion size	Food consumption	—
Predisposition to activity	Physiology	—
Pressure for growth and profitability	Food production	Degree to which economic actors are led in their decisions by financial measures of performance
Pressure on job performance	Food production	Pressure on employees, as generic production factors in an industrial economy

Variable	Cluster	Description
Pressure to cater for acquired taste	Food production	Industry-internal pressure to calibrate food offerings to what consumers are used to/like
Pressure to improve access to food offerings	Food production	Industry-internal drive to bring food offerings as closely as possible to consumers
Psychological ambivalence	Individual psychology	Degree to which people experience a psychological conflict between what people desire (e.g. fatty, sweet foods) and the need to stay healthy
Purchasing power	Food production	—
Quality & Quantity of breast feeding	Physiology	—
Rate of eating	Food consumption	Time-span devoted to consuming a meal
Reliance of labour-saving devices	Physical activity environment	Reliance on labour-saving devices for daily chores
Reliance on pharma remedies	Physiology	—
Reliance on surgical interventions	Physiology	Reliance on pharma & surgical remedies to deal with effects of obesity
Resting metabolic rate	Physiology	Degree of energy utilised by the metabolism in a resting state (no physical nor intestinal activity)
Safety of unmotorised transport	Physical activity environment	Level of risk for harm by engaging in non-motorised transport
Self esteem	Individual psychology	Sense of purpose and self-confidence of individuals
Side-effects of drug use	Physiology	—
Smoking cessation	Social psychology	Number of people quitting smoking
Social acceptability of fatness	Social psychology	—
Social depreciation of labour	Physical activity environment	Degree to which manual labour is negatively valued in a given socio-cultural group
Social rejection of smoking	Social psychology	—
Societal pressure to consume	Food production	Endemic pressure (via a variety of channels and actors) to consume
Sociocultural valuation of food	Social psychology	Degree to which food is positively valued within a given socio-cultural group
Sociocultural valuation of physical activity	Physical activity environment	Degree to which physical activity is positively valued in a given socio-cultural group
Standardisation of food offerings	Food production	Degree to which processed foodstuffs are based on similar production processes, ingredients and market positioning
Strength of lock-in to accumulate energy	Engine	Degree to which behavioural patterns to spend and acquire energy are psychologically, biologically, institutionally locked in
Stress	Individual psychology	Perceived level of stress by individuals
Tendency to graze	Food consumption	Tendency to eat outside fixed meal times
Tendency to preserve energy	Engine	Tendency of people to reduce expenditure of bodily energy
TV watching	Social psychology	Time spent watching TV
Use of medicines	Individual psychology	—
Walkability of living environment	Physical activity environment	—

