Integration of user behavior into cookstove design through utility functions and the Theory of Planned Behavior

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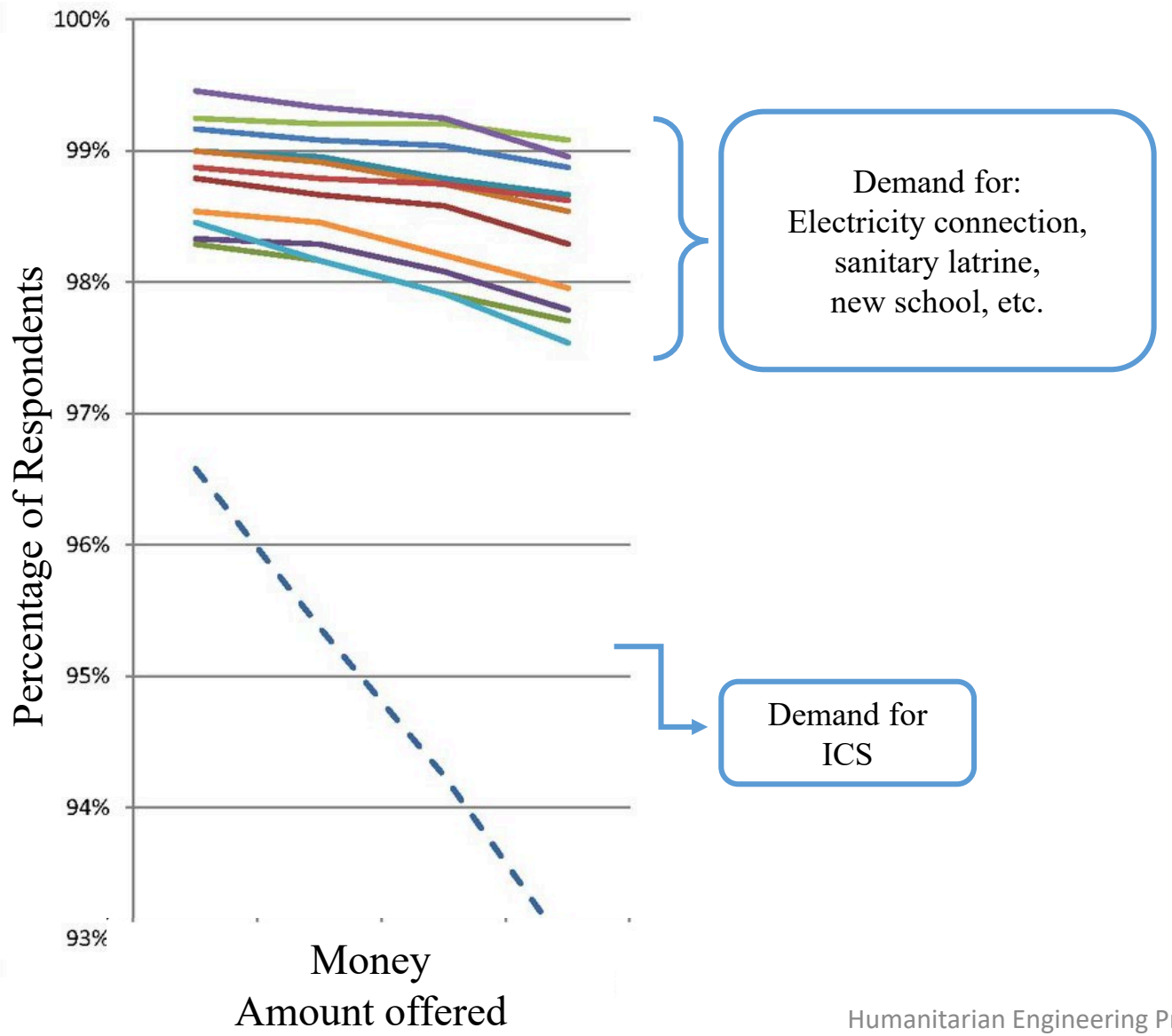
The Challenge of Adoption



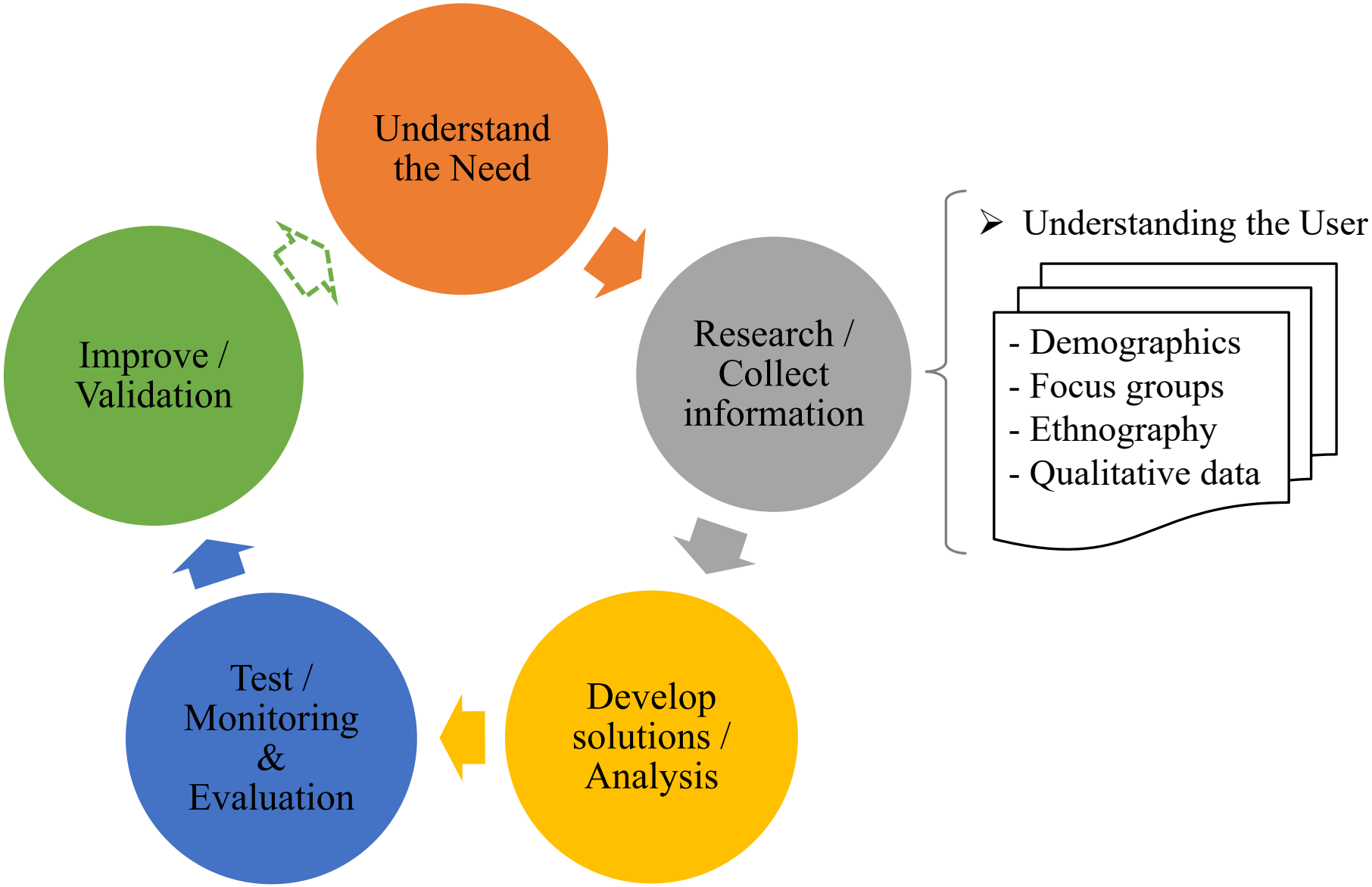
Design with features that users value could help to alleviate low adoption rates (Mobarak et al., 2012).

Both the technology and promotion messages must improve so users perceive benefits of ICS to improve adoption in north India (Jeuland et al., 2015).

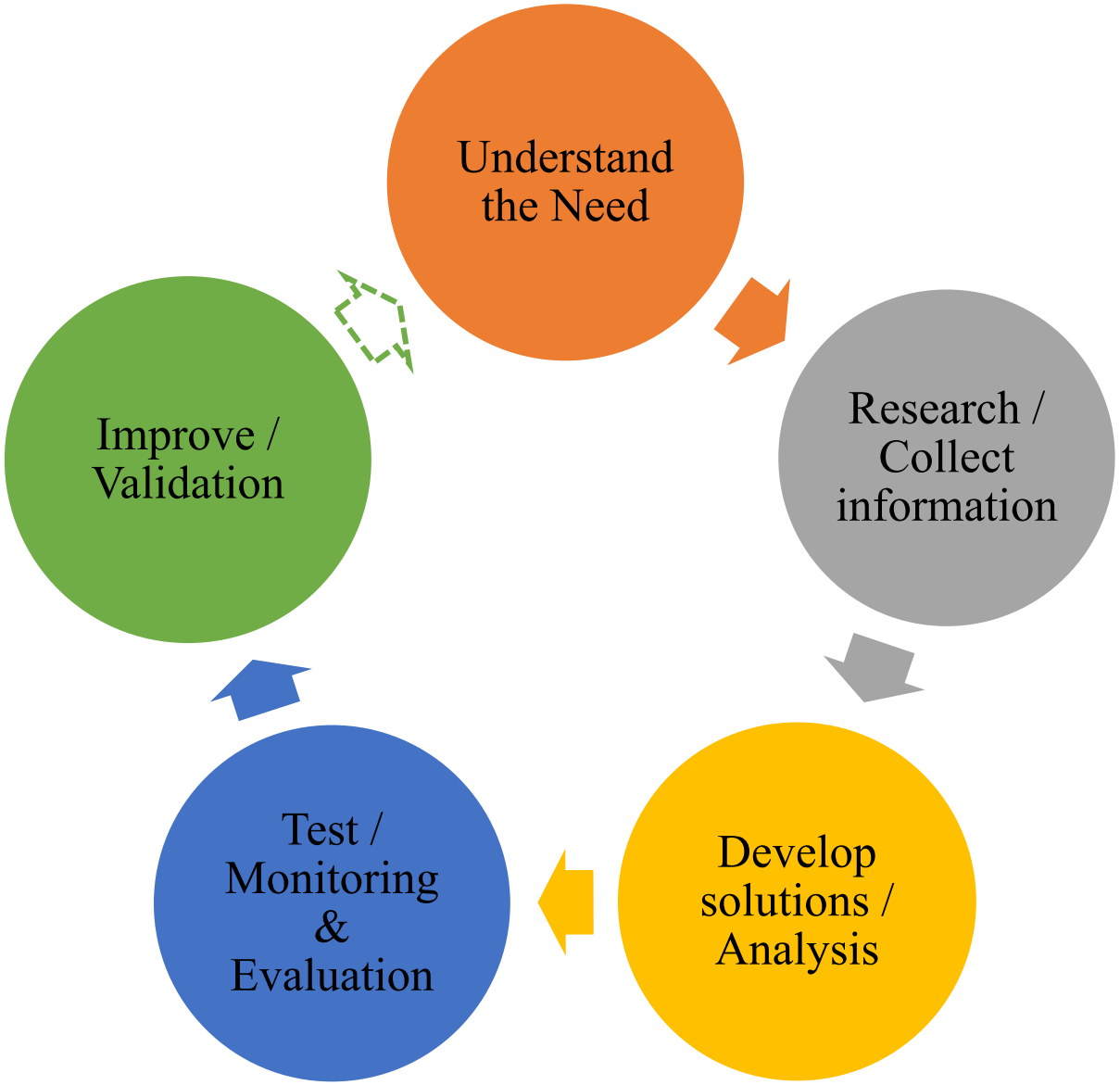
Low stove valuation by users prevented adoption and improvements in health or firewood consumption (Hanna, Duflo, and Greenstone, 2016).

Ahmed Mushfiq Mobarak et al. PNAS 2012;109:10815-10820

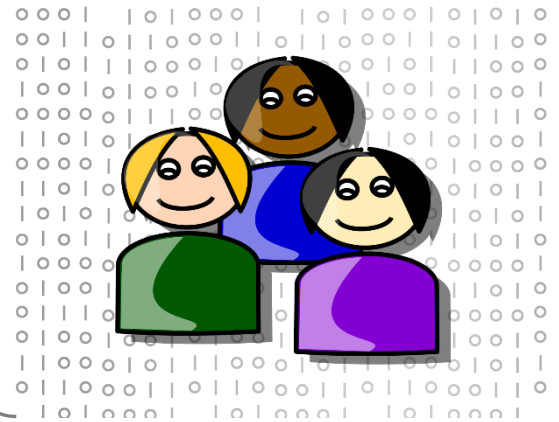
Technology Design Process



What Is Not Addressed?

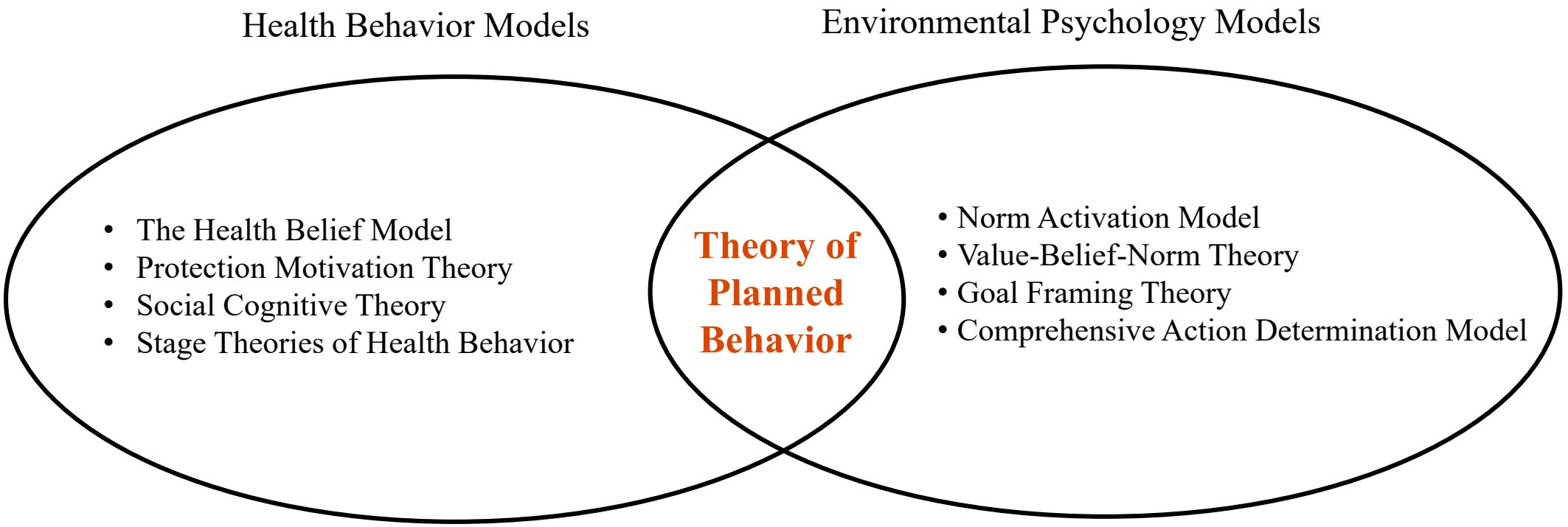


- Understanding the User



Quantitative Data Based on Beliefs and Personal Evaluations

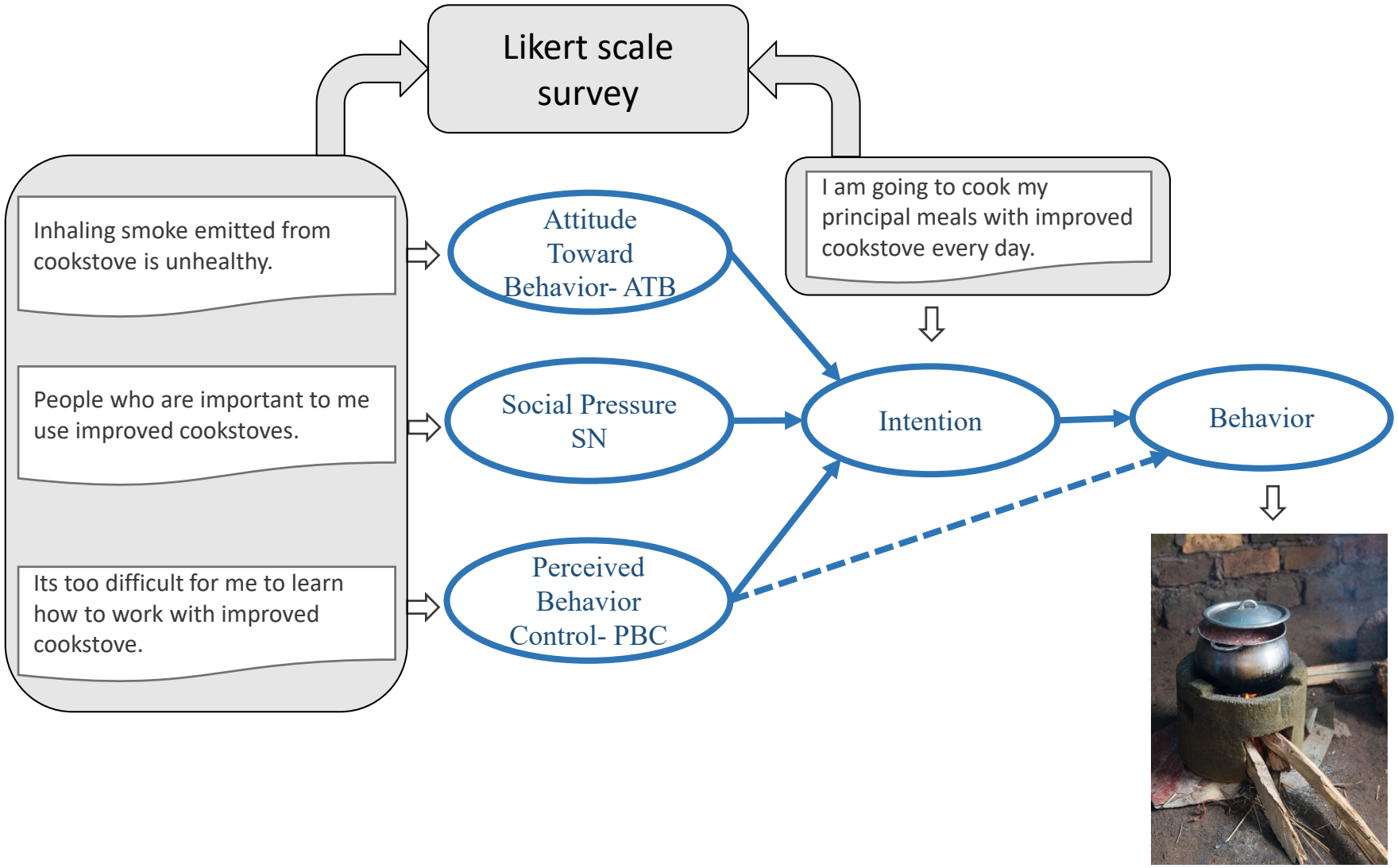
Practices in User Behavior Integration



Mark Conner and Paul Norman, *Predicting health behaviour : research and practice with social cognition models*. Open University Press, 2005.

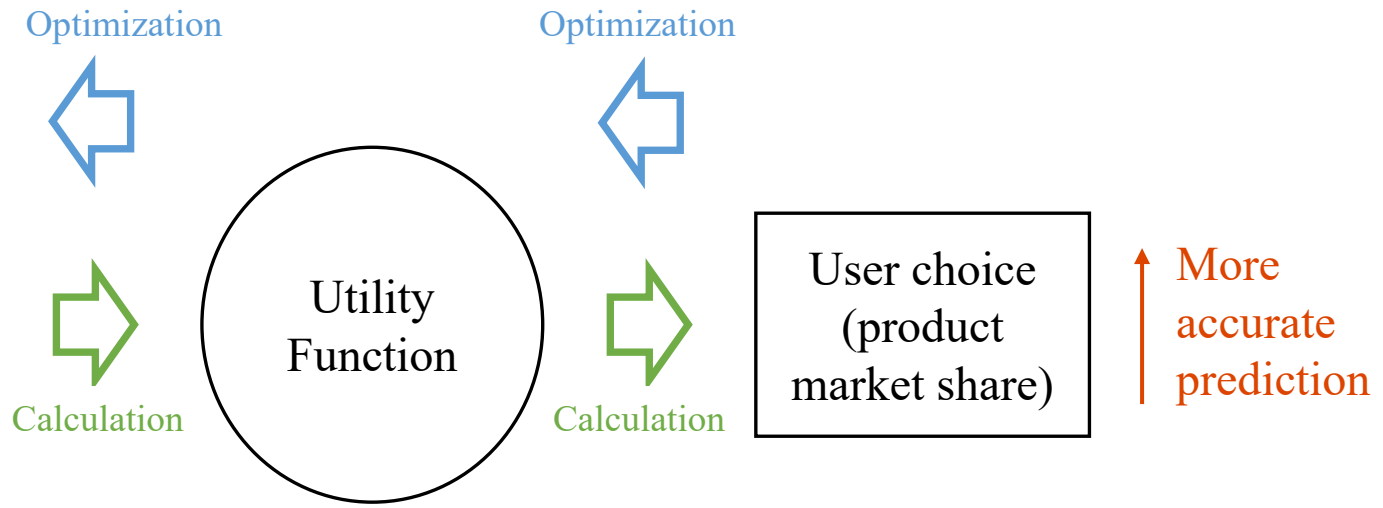
Robert Gifford, Linda Steg, and Joseph P. Reser, "Environmental Psychology," in *The IAAP Handbook of Applied Psychology*, Blackwell Publishing Ltd., 2011, pp. 440–470.

Theory of Planned Behavior



Decision-Based Design with TPB

- Technology design attributes (size, dimensions, weight, etc.)
- User Attributes (age, income, purchase history, etc.)
- Usage Context Attributes
- TPB attributes



$$W_{in} = W(\beta : T_i, U_n, C_{i,n})$$

Case study: ICS Design Analysis in Uganda

- Uganda
  - 175 households
  - Pilot, baseline, follow-up
  - ICS: ILF rural woodstove
  - Mobile surveying using Magpi®

International Lifeline Fund

Results

Utility estimation without TPB

Independent Variables		No TPB attribute	
Price		0.019***	(0.003)
Fuel type		-1.054***	(0.229)
Income	1	0.254	(0.403)
	2	-0.243	(0.649)
	3	0.102	(0.536)

ρ^2(%)	21.55
Hit rate (%)	61.8
Log-Likelihood	-187.81

Adding one TPB construct

Independent Variables		One TPB construct	
Price		0.020***	(0.003)
Fuel type		-1.033***	(0.230)
Income	1		
	2	-0.241	(0.230)
	3		
PBC – Independence in decision making	1	-13.170***	(0.513)
	2	-0.075	(1.077)
	3	1.836*	(1.054)
	4	0.780*	(0.443)

ρ^2(%)	22.66
Hit rate (%)	52.47
Log-Likelihood	-185.15

Adding a TPB interaction term

Independent Variables		Interaction with TPB	
Price		0.019***	(0.003)
Fuel type		-1.053***	(0.230)
Income	1		
	2	1.106	(0.716)
	3		
ATB – importance of less fuelwood consumption	1		
	2		
	3	-1.238	(2.661)
	4		
Income * ATB	1	1.954	(4.861)
	2	1.487	(8.260)
	3	4.363	(10.856)
	4	0.653	(8.373)
	5	2.754	(11.131)
	6	0.815	(8.831)

ρ^2(%)	23.42
Hit rate (%)	61.8
Log-Likelihood	-183.11

Utility estimation with TPB

Independent Variables		All TPB attributes	
Price		0.019***	(0.003)
Fuel type		-1.049***	(0.230)
Income	1		
	2	0.071	(0.362)
	3		
ATB – importance of less fuelwood consumption	1	-16.686***	(1.680)
	2	31.523***	(1.803)
	3	-2.834**	(1.339)
	4	-1.783	(1.262)
PBC – Independence in decision making	1	-45.382***	(2.003)
	2	-11.706***	(1.356)
	3	4.105***	(1.440)
	4	2.730***	(0.976)
SN – Social network's influence	1	1.204	(1.710)
	2	-0.556	(1.074)
	3	-0.551	(0.954)

ρ^2(%)	27.02
Hit rate (%)	47.23
Log-Likelihood	-174.31

Robust standard errors in parenthesis. * p-value <0.1 , ** p-value < 0.05 , *** p-value < 0.01

Conclusions

- ✓ TPB attributes improve the prediction power of utility functions
- ✓ Designers could estimate market share of technologies based on users' beliefs and behavioral characteristics
- ✓ Model works with relatively large sample sizes (rule of thumb more than 200 observations)
- ✓ Technology design and implementation strategies could be optimized for higher compatibility with users' behaviors → Improves adoption rate

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Thank you for your time.

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