

Incorporating Pharmacogenetic Testing into Graduate Pharmacy Curriculum Significantly Enhances Students' Knowledge and Attitude towards Personalized and Precision Medicine

Dalga Surofchy, PharmD (c); Sam Oh, PhD, MPH; Joshua Galanter, MD, MAS; Pin Xiang, PharmD; Megan Li, PhD (c); Su Guo, PhD; Tejal Desai, PhD; Bernard Joseph Guglielmo, PharmD; Kathy Giacomini, PhD; Janel Long-Boyle, PharmD, PhD; Alan HB Wu, PhD; and Esteban Burchard, MD, MPH
University of California, School of Pharmacy, UCSF, 505 Parnassus Ave, San Francisco, CA 94143. dalga.surofchy@ucsf.edu
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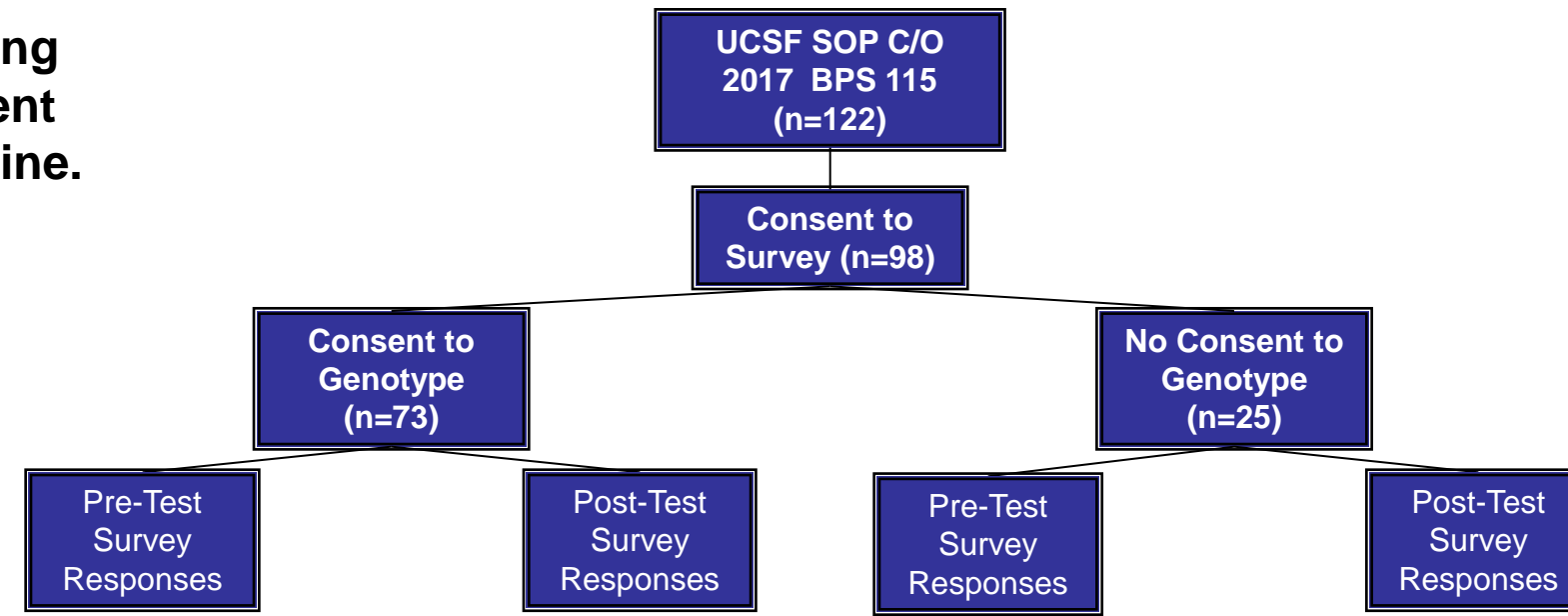
INTRODUCTION

- Knowledge and attitude towards of pharmacogenomics (Pgx) is fundamental for pharmacists in our health system in order to:
 - appropriately develop personalized drug therapy regimens
 - make formulary decisions
 - work collaboratively to manage limited healthcare dollars
- This study assesses the ability of personal Pgx testing in the classroom setting to enhance pharmacy student knowledge and attitude towards personalized medicine.

OBJECTIVES

To evaluate and determine if pharmacy student's participation in personal Pgx testing:

- ENHANCES UNDERSTANDING of Pgx concepts and clinical applications
- CHANGES ATTITUDE toward personalized medicine and clinical integration of Pgx
- ENHANCES CLASSROOM LEARNING



METHODS

- An online Likert-based survey was distributed to 122 first-year University of California, San Francisco (UCSF) pharmacy students 2 weeks prior to and 1-week after a curricular based Pgx course.
- Students choose one of the following drug metabolizing enzymes (CYP2C19, CYP2D6, UGT1A1) and pharmacodynamics-relevant proteins (interleukin (IL)-28B & human lymphocyte antigen HLAB*5701) to have genotyped.
- Using R and a linear mixed effects model, we analyzed and compared the pre-course and post-course Likert (1-5) survey data to determine if there was an impact of personal Pgx testing on knowledge and attitude.
- For clinical meaningfulness, we limited our analysis to results with a minimum effect size of +0.25 Likert points.
- Study approved by UCSF Committee on Human Research. Study blinded to course directors and had no impact on students' performance in the course.

BACKGROUND AND DEMOGRAPHICS

Table 1: Gender and Race/Ethnicity by Genotyping Status

CHARACTERISTIC	Genotyped Group N = 73	Non-Genotyped Group N = 25
Percent female	71.2	60.0
RACE/ETHNICITY	N (%)	N (%)
Hispanic	0 (0.00%)	1 (4.00%)
Black	1 (1.40%)	1 (4.00%)
White	15 (20.5%)	4 (16.0%)
Asian	41 (56.2%)	17 (68.0%)
Other*	14 (19.2%)	2 (8.00%)
Pacific Islander	2 (2.70%)	0 (0.00%)

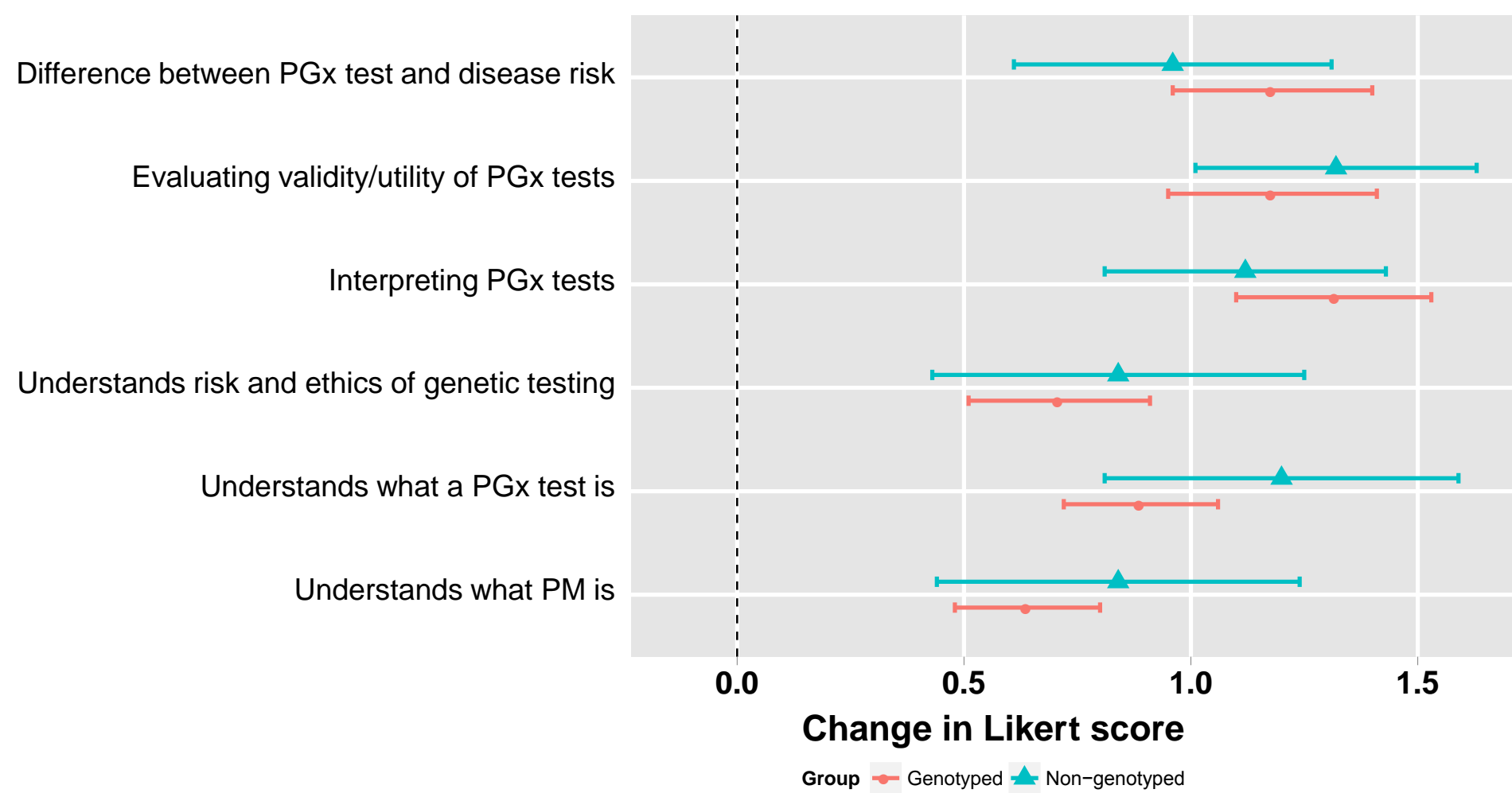
Table 2: Drug Metabolizing Enzymes, Function, and Mutation Frequencies by Race

Enzyme (reference)	Function	Mutation Frequency
CYP2D6 ¹⁻³	Affects large numbers of drugs, notably analgesics, tamoxifen, and antidepressants and medications for attention deficit disorder.	Black: 0-5% Caucasian: 5-14% Asian: 0-1%
CYP2C19 ²⁻⁴	Affects cardiovascular drugs including clopidogrel and proton pump inhibitors and some antidepressant medications.	Black: 5% Caucasian: 2-5% Asian: 19%
UGT1A1 ⁵	Affects some anticancer drugs and is responsible for hyperbilirubinemia induced by Gilbert's syndrome.	Black: 19% Caucasian: 8% Asian: 2%
HLAB*5701 ⁶	When present can cause Stevens Johnson Syndrome and delayed hypersensitivity mostly among Asians.	Black: 1% Caucasian: 6-7% Asian: up to 20%
IL28b ⁷	Predicts drug (PEG-Interferon & ribavirin) efficacy and natural ability to clear hepatitis C infections.	Black: 24-50% Caucasian: 8-13% Asian: 0-1%

RESULTS

Figure 1: Knowledge and Attitude Assessment in Participants by Genotyping Status

Knowledge Assessment



Attitude Assessment

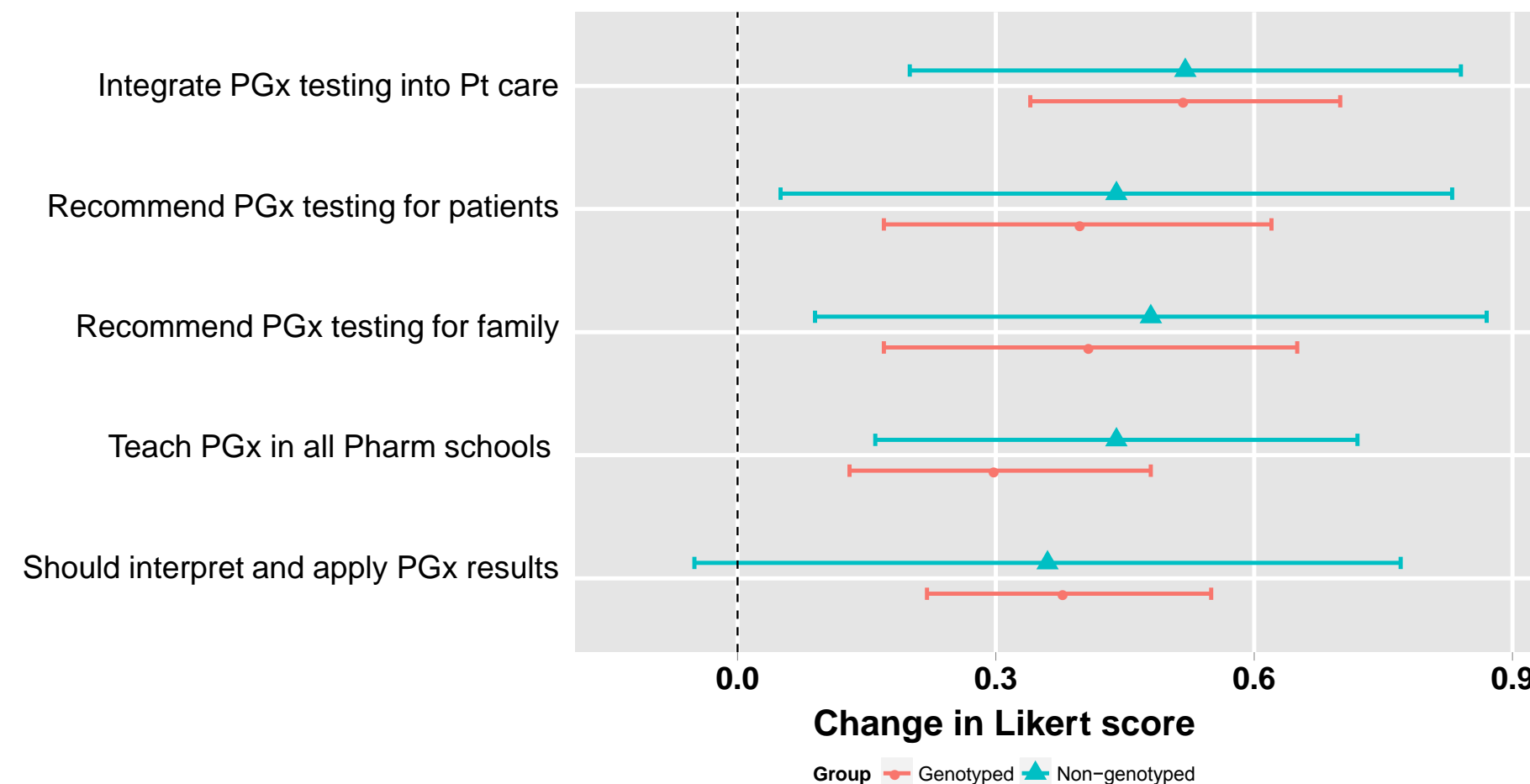
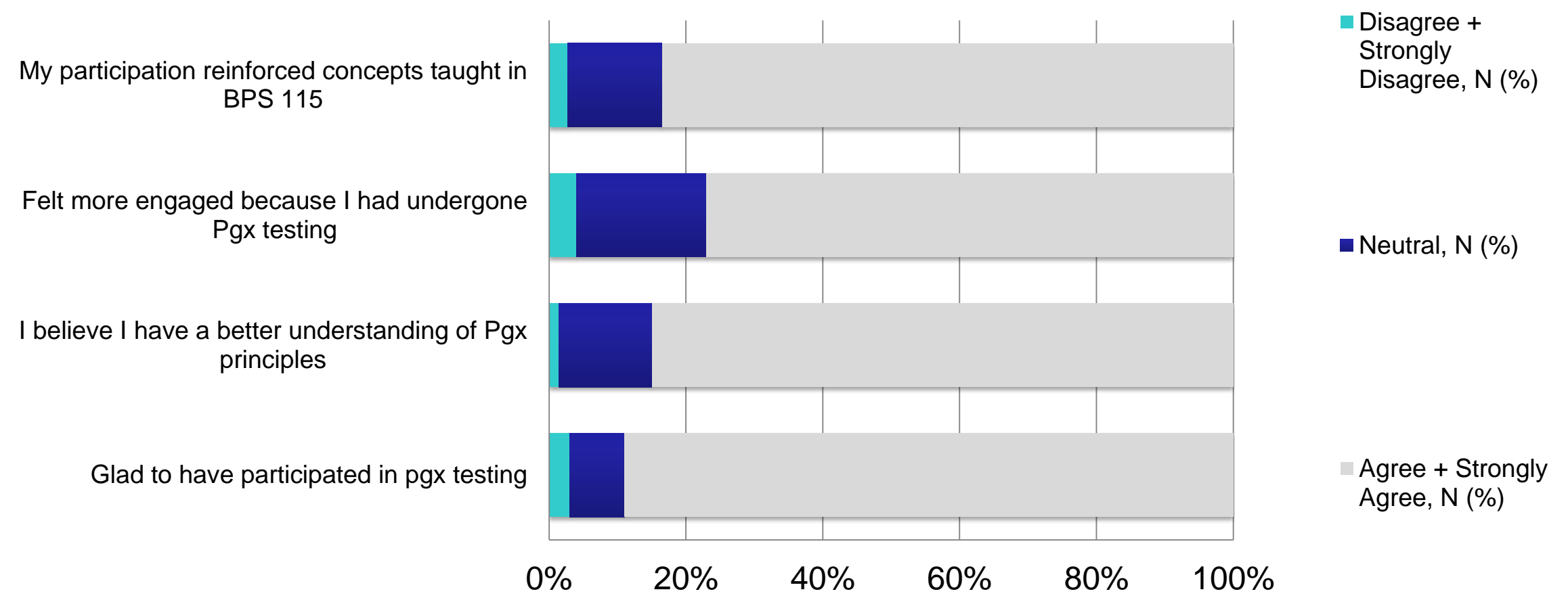
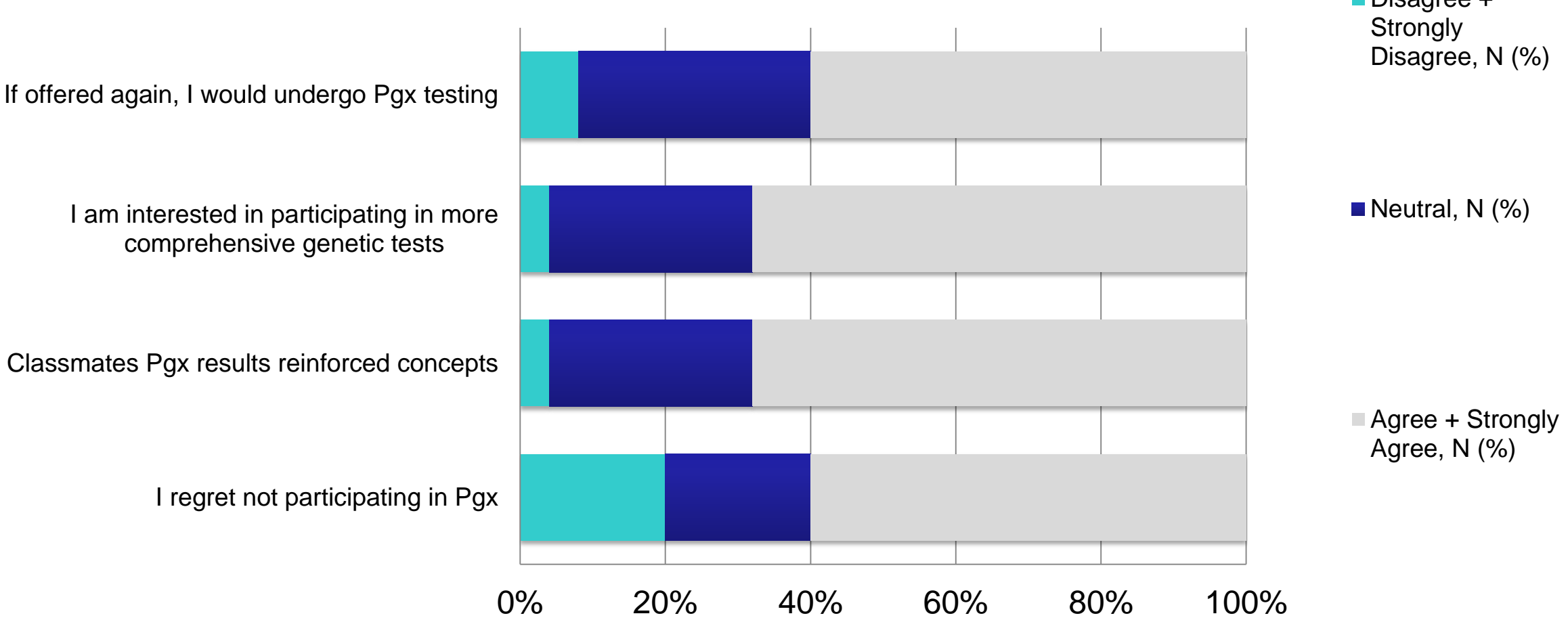


Figure 2: Reflections of Participants by Genotyping Status

Genotyped Group, N = 73



Non-Genotyped Group, N=25



CONCLUSIONS

- Personalized Pgx testing → significant enhancements in knowledge and attitudes towards precision medicine.
- Even non-genotyped had an enhancement in knowledge and attitude → likely as a result of engagement with their classmates and faculty.
- The significance of this finding is extraordinary as it demonstrates that an interactive hands-on approach to educating future pharmacists about pharmacogenetics is a fundamental curricular change that should become commonplace across all professional doctorate programs in the country.
- Pharmacists must be the healthcare professional who pioneer the transition of Pgx into our health care system to make the safest, most efficacious and cost effective clinical decisions for patients.
- Pharmacists in Managed Care Organizations must understand Pgx to make evidence based formulary decisions and transition into this era of precision medicine.

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FUTURE DIRECTION

- Incorporate personal Pgx testing into curricula of pharmacy and medical schools at UCSF and across the country.
- Follow up on genotyped students in 5-10 years to assess impact of personal Pgx testing on careers.
- Continue educating future health care professionals on the importance of precision medicine.
- Have pharmacy students provide actionable interventions / counseling at UCSF for patients with Pgx data.

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