Digital Behavior Response in Augmented Reality Versus Non-Augmented Reality Contexts: A Randomized Controlled Trial

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The Diet UX Research Study

Abstract

The use of Augmented Reality (AR) technology constitutes an innovative solution to social and behavior change. This randomized controlled trial aims to understand how millennial and Generation Z mobile users change their digital behavior response over time upon exposure to neutral, correct, and corrected digital information in AR when compared to Non-AR contexts. One hundred and forty-two participants were recruited via snowball sampling using social networking sites and randomly assigned to either the Non-AR or AR groups. Findings indicate that digital information relayed in AR contexts was more influential in stimulating desirable digital behavior response towards correct messages over time when compared to non-AR contexts. Age, gender, education, geographic location, wellbeing status and technology adoption propensity may influence the variability of digital behavior response dependent on the type of message and exposure regimens.

Objectives

The use of AR technology constitutes an innovative solution to health behavior change. This randomized controlled trial aims to understand how millennial and Generation Z mobile users change their digital behavior response over time upon exposure to neutral, correct, and corrected digital information in AR when compared to non-AR contexts while determining factors that influence their digital behavior changes over time.

Methods

Participants must have met the inclusion criteria for being an adult born between 1981 and 2002, speaking good English, having daily access to a Smartphone, and using it for at least two hours a day. One hundred and forty-two participants were recruited via snowball sampling using nine social networking sites and randomly assigned to either the Non-AR or AR groups. They were directed to answer a 23-item mobile-based online survey at baseline (T1) including 4-items of demographic data, 5-item validated World Health Organization-Five Well-being index (WHO-5), and 14-item validated technology adoption propensity (TAP) index), and to answer up to 25-item survey at T2 (T1 + 28 days) using Qualtrics. At T2, the 4-items of demographics were replaced with 6-items to examine any research activity on topics of relevance to the study material at T1, and to determine if any behavior change action was undertaken because of that research during the 28-day period. Only those who indicate using any social media platform were further prompted to specify the top three social media platforms used. Otherwise, the rest of the survey and experimental design remained the same to allow comparability and study of trends at T1 and T2. Following surveys at each time interval, participants in each group were automatically enrolled in three experiments and were prompted to choose one action based on the transtheoretical model of behavior change and complete a 9-item validated scale of perceived persuasiveness after each experiment at T1 and T2. Digital behavior response was measured as the average score of behavior change and perceived persuasiveness scales, with and without AR.

Results

Participants were mostly millennials (87.3%), females (67.6%), educated (42.3% university graduates, 31.0% master's degree), and geographically spread (28.2% Jordan, 26.8% Syria, and 21.1% United States). See *Table 1*. The mean WHO-5 scores were 54.56 ± 17.59 at T1 and 54.54 ± 18.90 at T2, a moderate mental wellbeing status. See *Figures 1 and 2*.

The mean TAP scores were 3.5958 ± 0.52 at T1 and 3.6693 ± 0.45 at T2, a moderate to high adoption, increasing with time. *See Figures 3 and 4*. Majority of participants (85.72% in Non-AR and 78.48% in AR) did not research any information related to the study content during the last 28 days.

Table 1: Demographic characteristics of the research subjects (n=142)

Demographic Characteristics	Percent AR (n=79)	Percent Non-AR (n=63)	Percent Total (n=142)
Gender	**55.6**	**44.4**	**100.0**
Male	35.4	27.0	31.7
Female	63.3	73.0	67.6
Prefer not to say	1.7	0.0	0.7
Age	**55.6**	**44.4**	**100.0**
Millennials	87.3	87.3	87.3
Gen-Z	12.7	12.7	12.7
Highest Education Levels	**55.6**	**44.4**	**100.0**
University Graduates	39.2	46.0	42.3
Master's degree	30.4	31.7	31.0
Most Popular Countries	**55.6**	**44.4**	**100.0**
Jordan	27.8	28.6	28.2
Syria	29.1	23.8	26.8
United States	17.7	25.4	21.1
Others*	25.4	22.2	23.9

**Others include Canada, China, Egypt, France, Georgia, Germany, India, Lebanon, Morocco, Palestine, United Kingdom, and Venezuela*

Figure 1: Mean WHO-5 scores at T1

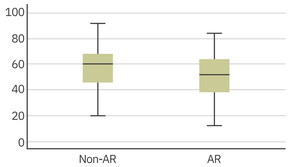


Figure 2: Mean WHO-5 scores at T2

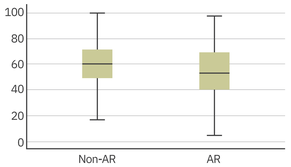


Figure 3: Mean TAPI scores at T1

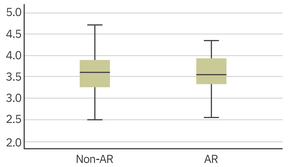
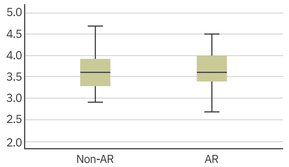


Figure 4: Mean TAPI scores at T2



An independent-samples t-test was run to determine if there were differences in digital behavior response in Non-AR and AR groups at T1 and T2. Upon exposure to correct message, participants reported higher digital behavior response to AR (M = 2.7965, SD = 0.92) than Non-AR (M = 2.2157, SD = 0.78) at T1, a statistically significant difference, M = -0.58074, 95% CI [-0.87 to -0.29], t (140)= -4.011, p = 0.000, d = 0.68. Participants also reported higher digital behavior response to AR (M = 3.080, SD = 0.10) than Non-AR (M = 2.581, SD = 0.94) at T2, a statistically significant difference, M= -0.4988, 95% CI [-0.81 to -0.19], t (140)= -3.215, p = 0.002, d = 0.75. See *Table 2*.

Table 2: Independent Sample T-Tests analysis results of digital behavior response to a correct digital nutrition message titled Heartbeat Mix at T1 and T2 where n=142.

	Levene's Test for Equality of Variances		t-test for Equality of Means						
	F	Sig	T	Df	Sig (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
								Lower	Upper
At T1	1.058	0.305	-4.011	140	0.000	-0.58074	0.14479	-0.86701	-0.29448
At T2	0.167	0.684	-3.215	140	0.002	-0.4988	0.1551	0.1551	-0.1921

Upon exposure to corrected message, participants reported higher digital behavior response to AR (M = 2.6728, SD = 0.84) than Non-AR (M = 2.5787, SD = 0.99) at T1 a non-statistically significant difference, M = -0.09405, 95% CI [-0.39 to 0.21], t (140) = -0.609, p =0.543. Participants also reported higher digital behavior response to AR (M = 3.108, SD = 0.88) than Non-AR (M = 2.938, SD = 0.99) at T2, a non-statistically significant difference, M = -0.1695, 95% CI [-0.48 to 0.14], t (140) = -1.074, p =0.285. See *Table 3*.

Table 3: Independent Sample T-Tests analysis results of digital behavior response to corrected digital nutrition message titled Detox Mix at T1 and T2 where n=142.

	Levene's Test for Equality of Variances		t-test for Equality of Means						
	F	Sig	T	Df	Sig (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
								Lower	Upper
At T1	3.597	0.060	-0.609	140	0.543	-0.09405	0.15436	-0.39924	0.21113
At T2	1.939	0.166	-1.074	140	0.285	-0.1695	0.1579	-0.4816	0.1426

Upon exposure to neutral message, participants reported higher digital behavior response to Non-AR (M = 2.4948, SD = 0.85) than AR (M = 2.4648, SD = 0.74) at T1, a non-statistically significant difference, M = 0.02995, 95% CI [-0.23 to 0.28], t (140) = 0.224, p = 0.823. Participants also reported higher digital behavior response to Non-AR (M = 2.857, SD = 0.83) than AR (M = 2.837, SD = 0.93) at T2, a non-statistically significant difference, M = 0.0204, 95% CI [-0.27 to 0.32], t (140) = 0.137, p =0.892. See *Table 4*.

Table 4: Independent Sample T-Tests analysis results of digital behavior response to a neutral digital nutrition message titled Energy Mix at T1 and T2 where n=142.

	Levene's Test for Equality of Variances		t-test for Equality of Means						
	F	Sig	T	Df	Sig (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
								Lower	Upper
At T1	0.310	0.579	0.224	140	0.823	0.02995	0.13350	-0.23399	0.29389
At T2	2.331	0.129	0.137	140	0.892	0.0204	0.1495	-0.2752	0.3161

Conclusion

Digital information relayed in AR contexts was more influential in stimulating desirable digital behavior response towards correct messages over time when compared to non-AR contexts. Age, gender, education, geographic location, wellbeing status and technology adoption propensity may influence the variability of digital behavior response dependent on message content and exposure regimens. Further research is needed to inspire message design for health behavior change in AR contexts.

Implications for Practice

With AR ready smartphones becoming more accessible, AR is likely to support social and behavior change. Media psychologists are needed to better inform design of health and nutrition messages in AR contexts based on media psychology theory while addressing the influence of demographic factors, current wellbeing status, and propensity to technology adoption on digital behavior response in the context of social influence, diverse communication modes, cultural diversity, and within one's personal, social, and cultural constructs around food, nutrition, and health.

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Keywords

Augmented reality, digital behavior response, digital information, technology adoption propensity, and mental wellbeing.