TECHNICAL BRIEF

Exploring Age Differences on the Hogan 360

Authored by:
Dr Xander van Lill, Organisational Psychologist, PBC
Dr Lynne Cruickshank, Head of Research, PBC

Introduction

When applied within an appropriate context, 360-degree feedback can enhance leadership effectiveness by helping leaders align their behaviours with organisational goals (Smither et al., 2005). However, the impact of such feedback depends on several factors: the psychometric quality of the instrument, the user's understanding of evidence-based strategies for behavioural change, and the ability to engage leaders in sustained developmental efforts. Poorly constructed or biased measures can have the opposite effect, potentially undermining motivation and engagement (Nowack & Mashihi, 2012).

The Hogan 360 Technical Manual (Peter Berry Consultancy, 2022) provides evidence supporting the reliability and validity of the Hogan 360 as a leadership assessment tool. This technical brief expands on that foundation by examining measurement equivalence and mean group differences related to age. Specifically, we assess whether rater bias may influence how individuals from different age groups are evaluated and whether there are meaningful differences in average Hogan 360 ratings between younger and older participants.

Meta-analytic research by Ng and Feldman (2008) suggests that age is generally unrelated to core task performance, creativity, and training effectiveness. However, older employees are more likely to engage in organisational citizenship behaviours and safety-related actions, and they exhibit fewer counterproductive behaviours such as aggression, substance misuse, tardiness, and voluntary absence. Taken together, these findings indicate that older workers demonstrate comparable core performance, alongside higher levels of behaviours that support colleagues and the organisation.

In line with this evidence, we did not anticipate substantial age-related differences in Hogan 360 performance outcomes in general. Nonetheless, this study explores whether age influences ratings to ensure the tool's continued fairness and interpretive accuracy.

Method

Sample

Data were analysed from 22,198 subjects who completed the Hogan 360 between January 1, 2013, and December 31, 2023. Of these, 7,448 participants (34%) were under 40, while 14,750 participants (66%) were 40 or older.

Instrument

The Hogan 360 (Peter Berry Consultancy, 2022), is a comprehensive multi-rater survey designed to gather leadership feedback from key stakeholder groups, including managers, peers, and direct reports. This tool assesses four main domains and 14 underlying competency subthemes, providing a holistic view of leadership effectiveness.

In its current format, the Hogan 360 features:

- 50 scaled items rated on a 7-point scale, with 1 meaning 'Does not describe this person at all' and 7 meaning 'Describes this person exactly'. These items are aligned with the four domains of the Hogan 360 Leadership Model and their respective sub-themes.
- Ranked items that highlight the subject's top strengths and areas for improvement. Raters choose the subject's top four strengths and opportunities from 30 items, with the top selection given the highest weight of 4, followed by weights of 3, 2, and 1.
- Three open-ended questions focused on identifying strengths, opportunities, and overused strengths.

This research focuses on data from the scaled items.

Figure 1

The Hogan 360 Leadership Model



Analysis

Measurement invariance refers to the statistical property that ensures a measurement tool, such as a survey, test, or assessment, functions equivalently across different groups or contexts. This means the instrument measures the same underlying construct in the same way regardless of cultural background, gender, language, or age. Establishing measurement invariance is critical for making valid comparisons between groups, as it confirms that observed differences are attributable to the measured construct rather than bias in the measurement tool (Brown, 2015).

In this technical brief, we followed the sequence Vandenberg and Lance (2000) recommended to test measurement invariance across multiple groups. We evaluated the equivalence of an oblique lower-order model for the Hogan 360 domains. Invariance was assessed by comparing model fit statistics from a series of multigroup confirmatory factor analyses representing increasing levels of constraint: configural invariance (equality of factor structure), metric invariance (equality of factor loadings), scalar invariance (equality of intercepts), and strict invariance (equality of residual variances). Analyses were conducted using version 0.6-19 of the lavaan package (Rosseel, 2012) in R (R Core Team, 2024). This version includes updates as described by Rosseel et al. (2024).

Mardia's multivariate skewness (93,785.57; $p < .01$) and kurtosis (487.01; $p < .01$) coefficients indicated a non-normal multivariate distribution. Given the use of rating scales with seven response categories (Rhemtulla et al., 2012) and the violation of multivariate normality (Satorra & Bentler, 1994; Yuan & Bentler, 1998), we used robust maximum likelihood (MLM) estimation, as recommended by Bandalos (2014). Model fit was evaluated using the comparative fit index (CFI), Tucker–Lewis Index (TLI), standardised root mean square residual (SRMR), and root mean square error of approximation (RMSEA) (Brown, 2015; Hu & Bentler, 1999). Fit was considered acceptable if RMSEA and SRMR were less than or equal to .08, and CFI and TLI were greater than or equal to .90 (Brown, 2006; Browne & Cudeck, 1992). Brown (2015) argues that models with CFI and TLI values between .90 and .95 may still be considered acceptable if other indices, such as RMSEA and SRMR, fall within recommended thresholds.

After evaluating measurement invariance, we investigated the relationship between age and leadership ratings across the 14 Hogan 360 subthemes. Robust independent samples t-tests were conducted using version 1.1-6 of the WRS2 package in R (Mair & Wilcox, 2020; R Core Team, 2024) to compare mean differences between individuals under 40 and above. These tests incorporated modern robust statistical procedures, as Wilcox (2024) outlined, helping to account for potential violations of normality and heteroscedasticity.

In addition to group comparisons, we treated age as an ordinal variable to explore potential developmental trends in leadership effectiveness. Guided by established methodological frameworks (Cohen et al., 2003; Aiken & West, 1991), we conducted multiple regression analyses to test linear and curvilinear associations between age and leadership subthemes. Age was operationalised as an ordinal variable reflecting six decades (<20, 20–29, 30–39, 40–49, 50–59, and 60+), which was then converted into a numeric form to represent increasing age. A squared term was included to capture curvilinear patterns. Each subtheme was regressed on both the linear and quadratic terms, and model comparisons were evaluated using changes in explained variance (ΔR^2) and ANOVA tests to assess the added value of the curvilinear component.

Results

Table 1 presents the inter-factor correlations separately for employees aged 40 and over and those under 40. The oblique lower-order confirmatory factor models demonstrated satisfactory fit in both groups. For employees aged 40+, the model yielded fit indices of $\chi^2(1084) = 9916.29$, CFI = .91, TLI = .90, SRMR = .06, and RMSEA = .06 [.06, .07]. For employees under 40, the fit statistics were $\chi^2(1084) = 4090.40$, CFI = .92, TLI = .91, SRMR = .05, and RMSEA = .06 [.06, .07]. These results support adequate model fit across age groups (Brown, 2015; Hu & Bentler, 1999).

Table 1

Latent Factor Correlations From the 14-factor Confirmatory Factor Analysis for Employees 40+ (Under the Diagonal) and Employees Under 40 (Above the Diagonal)

Sub-Theme	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1. Integrity	-	.94	.80	.92	.89	.78	.75	.74	.78	.70	.64	.81	.65	.69
2. Resilience	.92	-	.87	.95	.92	.83	.75	.79	.80	.74	.66	.87	.72	.75
3. Communication	.75	.81	-	.90	.99	1.00	.88	.96	.91	.85	.88	.95	.94	.92
4. People Skills	.92	.94	.87	-	.98	.85	.76	.79	.79	.74	.67	.92	.73	.74
5. Team Player	.87	.88	.97	.97	-	.95	.83	.89	.86	.82	.78	.98	.86	.86
6. Engaging	.69	.74	.96	.78	.89	-	.89	.92	.91	.85	.87	.92	.93	.94
7. Capability	.69	.69	.85	.72	.81	.87	-	.87	.94	.77	.76	.78	.78	.81
8. Efficiency	.66	.71	.93	.73	.84	.89	.83	-	.92	.80	.87	.85	.90	.88
9. Results	.73	.74	.89	.76	.84	.88	.91	.90	-	.80	.81	.80	.82	.86
10. Customer	.61	.63	.80	.69	.78	.83	.73	.78	.75	-	.76	.77	.79	.80
11. Accountability	.55	.55	.85	.59	.73	.82	.71	.84	.76	.70	-	.78	.88	.82
12. Motivation	.83	.86	.92	.93	.97	.86	.74	.81	.80	.74	.70	-	.86	.85
13. Strategy	.59	.64	.90	.67	.80	.90	.77	.89	.81	.76	.84	.79	-	.95
14. Innovation	.60	.64	.88	.66	.79	.91	.80	.83	.82	.79	.77	.77	.93	-

Note. All the correlations were significant at the .05 level. The results are based on 2,912 raters for employees 40+ and 996 for under 40. A smaller subset of data was analysed due to the need for complete item responses from raters. Rater categories for employees of both age categories included direct reports, peers, managers, and other stakeholders.

The pattern of inter-factor correlations observed among employees aged 40 and above, compared to those under 40, fell within a comparable range, indicating a consistent underlying factor structure across age groups. Internal consistency estimates for both groups were also strong, with coefficient alpha and omega values exceeding .80. Following this, we tested for model invariance across raters evaluating employees in the two age groups. The results of this invariance analysis are presented in Table 2.

Table 2

Measurement Invariance Test Across Age Groups on the Hogan 360 Lower-Order Model

Model	$\chi 2$	*df*	CFI	RMSEA	*Δ df*	*Δ* CFI	Δ RMSEA
Config	*14120.67*	*2168*	*0.91*	*0.06*	-	-	-
Metric	*14203.92*	*2204*	*0.91*	*0.06*	*36*	*<0.01*	*<0.01*
Scalar	*14415.50*	*2240*	*0.91*	*0.06*	*36*	*<0.01*	*<0.01*
Strict	*14766.46*	*2290*	*0.91*	*0.06*	*50*	*<0.01*	*<0.01*

Note. The results are based on 2,912 raters for employees 40+ and 996 for under 40. Rater categories for both age groups included direct reports, peers, managers, and other stakeholders. The following is a brief explanation of the key terms used above.

- CFI: Compares how well your model fits the data against a baseline model where variables are uncorrelated. It ranges from 0 to 1, with higher values showing a better fit. A CFI of 0.90 or higher suggests the model demonstrates satisfactory fit.
- Δ CFI: When testing measurement invariance, we investigate changes in CFI between models with and without constraints. Constraints are conditions applied to ensure specific parts of the model, such as factor loadings (metric invariance), intercepts (scalar invariance), or error variances (strict invariance), are equal across groups. These constraints test whether the model behaves similarly across groups. If the change in CFI (ΔCFI) is less than 0.01 when constraints are added, it suggests the constraints do not significantly harm the model fit, supporting the equivalence of the measure across groups.
- RMSEA: Shows how well the model fits the data by measuring the difference between the model's predictions and the actual data, adjusted for its complexity (i.e., number of mathematical elements specified). Values at or below 0.08 suggest satisfactory fit.
- ΔRMSEA: When testing measurement invariance, we check changes in RMSEA between models with and without constraints. Like the CFI difference, these constraints test whether the model behaves similarly across groups. If the change in RMSEA (ΔRMSEA) is less than 0.015 when added, it suggests the constraints do not significantly harm the model fit, supporting measurement invariance.

The ΔCFI (< .01) and ΔRMSEA (< .015) provided sufficient evidence for measurement invariance across factor loadings, intercepts, and residuals when comparing raters evaluating employees aged 40 and over with those evaluating employees under 40 (Chen, 2007; Cheung & Rensvold, 2002). This suggests that raters held consistent underlying assumptions about the subthemes in the Hogan 360 domains, irrespective of the employee's age group. With preliminary evidence supporting the invariance of the factor structure across groups, we proceeded to examine mean group differences in Hogan 360 ratings, as presented in Table 3.

Table 3

T-test Results, Sub-Theme Means, Standard Deviations, and Reliability Coefficients Across Age Groups

Model	Group	Mean	*SD*	Alpha	Omega	*t*	*df*	*d*
Integrity	Above40	5.83	.55	.88	.88	6.99	9664.95	.08 (.06, .09)
	Under40	5.89	.53	.86	.87			
Resilience	Above40	5.65	.60	.89	.89	10.03	9131.35	.11 (.09, .12)
	Under40	5.73	.57	.89	.89			
Communication	Above40	5.51	.58	.80	.80	3.57	9131.10	.04 (.02, .05)
	Under40	5.55	.55	.82	.82			
People Skills	Above40	5.51	.67	.92	.92	8.45	9681.59	.09 (.08, .11)
	Under40	5.59	.63	.92	.92			
Team Player	Above40	5.41	.63	.90	.90	8.29	9859.79	.09 (.07, .11)
	Under40	5.49	.59	.90	.90			
Engaging	Above40	5.68	.58	.88	.87	6.28	9706.43	.07 (.05, .09)
	Under40	5.74	.55	.90	.89			
Capability	Above40	6.03	.49	.84	.84	5.14	9046.77	.05 (.04, .07)
	Under40	6.00	.48	.85	.85			
Efficiency	Above40	5.53	.60	.88	.87	10.03	9105.48	.10 (.09, .12)
	Under40	5.62	.57	.90	.90			
Results	Above40	5.79	.52	.92	.92	10.67	9110.77	.13 (.11, .14)
	Under40	5.87	.49	.93	.93			
Customer	Above40	5.63	.55	.91	.91	3.85	9654.81	.04 (.02, .06)
	Under40	5.67	.53	.90	.90			
Accountability	Above40	5.45	.53	.85	.85	2.43	8963.74	.03 (.01, .04)
	Under40	5.44	.52	.87	.87			
Motivation	Above40	5.36	.67	.91	.91	3.75	9065.76	.04 (.02, .06)
	Under40	5.41	.63	.91	.91			
Strategy	Above40	5.37	.57	.88	.88	3.49	9754.99	.04 (.02, .05)
	Under40	5.40	.54	.90	.90			
Innovation	Above40	5.50	.56	.89	.89	7.74	9106.28	.08 (.06, .09)
	Under40	5.56	.52	.90	.90			

Note. All the effects reported were significant at the .05 level. The results are based on 14,750 raters for employees 40+ and 7448 for employees under 40 who obtained scores on the Hogan 360. The following is a brief explanation of key terms reported above.

- Alpha: Evaluates whether multiple items that measure the same concept produce consistent results. Coefficients of 0.7 or higher are satisfactory.
- Omega: Is another measure of scale reliability that is often considered more robust than Alpha. It indicates how well a set of items measures a single underlying concept, and it is beneficial when items have varying levels of strength in measuring the concept. Coefficients of 0.7 or higher are satisfactory.
- Yuen's d: Measures the size of the difference between two groups, but it ignores extreme values that might impact the results. It provides a more accurate picture of the differences between the groups being compared, even when the data does not meet standard statistical assumptions. Values of 0.10, 0.30, and 0.50 correspond to small, medium, and large effect sizes.

Employees under 40 scored statistically significantly higher on most subthemes, except Capability and Accountability, where employees aged 40 and above received higher ratings. However, none of these group differences reached a magnitude large enough (d > .30) to be considered practically meaningful. Accordingly, the findings suggest that neither age group, under 40 nor 40 and above, is likely to be disadvantaged by applying a standard benchmark in evaluating leadership effectiveness.

While initial findings indicate that dividing age groups at 40 yields minimal differences in leadership ratings, we also explored age as an ordinal variable to examine more nuanced relationships with the Hogan 360 subthemes. Following a similar approach to Ng and Feldman (2008), we assessed linear and curvilinear associations between age cohorts and performance to investigate whether lifespan development influences leadership effectiveness. The results of these regression analyses are presented in Table 4.

Table 4

Standardised Regression Coefficients and Model Fit Indices Predicting Hogan 360 Subthemes from Age

Subtheme	β	*p*(β)	β^2	*p*(β^2)	*Panv*	Shape
Integrity	-.10	<.001	.05	.47	.47	None
Resilience	-.09	<.001	.02	.10	.10	None
Communication	.11	<.001	-.15	<.001	<.001	Inverted-U
People Skills	-.16	<.001	.09	.84	.83	None
Team Player	-.10	<.001	.03	.12	.12	None
Engaging	.23	<.001	-.30	<.001	<.001	Inverted-U
Capability	.21	<.001	-.17	<.001	<.001	Inverted-U
Efficiency	-.05	<.001	-.02	<.001	<.001	Inverted-U
Results	-.04	<.001	-.04	<.001	<.001	Inverted-U
Customer	.09	<.001	-.13	.03	.03	Inverted-U
Accountability	.41	<.001	-.41	<.001	<.001	Inverted-U
Motivation	.04	<.001	-.09	.05	.05	None
Strategy	.17	<.001	-.20	<.001	<.001	Inverted-U
Innovation	.16	.01	-.23	<.001	<.001	Inverted-U

Note. β= standardized linear coefficient; β^2 = standardized quadratic coefficient; p_{anv} = model comparison p-value; Shape = pattern of curvilinear association. The following is a brief explanation of key terms reported above.

- Positive β: A positive beta means that as age increases, the Hogan 360 score tends to increase. The overall direction of the relationship is upward.
- Negative β: A negative beta means that as age increases, the Hogan 360 score tends to decrease. The overall direction of the relationship is downward.
- Positive β^2: A positive beta squared indicates a U-shaped pattern. Scores tend to be lower in the middle of the age range and higher at both younger and older ages.
- Negative β^2: A negative beta squared indicates an inverted U-shaped pattern. Scores tend to be highest in the middle of the age range and lower at both younger and older ages.
- *Panv*: A smaller *Panv* means the curved model fits significantly better (the improvement is unlikely to be due to chance).

Nine subthemes demonstrated statistically significant quadratic trends, characterised by inverted-U-shaped relationships: Communication, Engaging, Capability, Efficiency, Results, Customer, Accountability, Strategy, and Innovation. In each case, the negative and significant quadratic term ($\beta^2 < 0$, $p < .05$), along with model comparison tests ($p_{anv} < .05$), indicated improved fit over the linear model. These trends suggest that ratings on these subthemes generally rise with age, peak in midlife, and decline slightly thereafter. The strongest effects were observed for Engaging ($\beta^2 = -.30$) and Accountability ($\beta^2 = -.41$), reflecting elevated midlife ratings.

These curvilinear patterns align with lifespan development theory and prior research. According to Super's life-span, life-space theory (1957, 1990), midlife represents a maintenance phase marked by deeper role investment and consolidation of career accomplishments, conducive to accountability and confidence in roles. Similarly, Erikson's psychosocial theory (1950, 1982) posits that the midlife stage centres on resolving the conflict between generativity and stagnation, often motivating individuals to lead and contribute meaningfully. Consistent with these views, Ng and Feldman's (2008) meta-analysis found that age positively relates to organisational citizenship behaviours and core task performance, particularly in middle adulthood. These findings suggest that motivational and developmental peaks in midlife may translate to elevated leadership ratings on dimensions such as Engaging and Accountability, followed by modest declines, potentially tied to shifting values or work centrality.

Conclusion

Measurement invariance analyses confirmed that the factor structure of the Hogan 360 remains consistent across age groups, with comparable latent factor correlations and satisfactory model fit for employees under and over 40. The findings provide no substantive evidence of age-related bias in Hogan 360 ratings. While employees under 40 received slightly higher scores on most subthemes, these statistically significant differences were consistently small in magnitude (all $d < .30$), indicating limited practical meaningfulness. A further, more nuanced investigation using curvilinear regression analyses, identified statistically significant quadratic trends for some subthemes (e.g., Engaging, Accountability). These likely reflect interesting lifespan development trends observed in the Hogan 360 and could be meaningfully leveraged during conversation, if they are relevant to the individual. However, across the subthemes, the size of these relationships are modest ($\beta^2 = .02$ to .41; $M = .14$) and the results support using the Hogan 360 across age groups without requiring age-based adjustments.

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Author Note:

Correspondence regarding this document should be addressed to Peter Berry Consultancy at research@peterberry.com.au.

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Sydney
T: +61 2 8918 0888
Level 8, 201 Miller Street
North Sydney, NSW 2060

Melbourne
T: +61 3 8629 5100
Suite 303, 430 Little Collins
Street, Melbourne, VIC 3000

Auckland
T: +64 9 941 9790
11 Britomart Place, Auckland
CBD, Auckland 1010

Dublin
T: +353 1 578 3607
Suite 301, 53 Merrion Square
South Dublin 2, D02 PR63

www.peterberryconsultancy.com

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